

" Ethnobotany and Mineral Contents of Indigenous Vegetables of Kisumu District in Kenya "

BY:

RUSULA ACHIENGLOWINO
B.ED. SECOND CLASS HONOURS, UPPER DIVISION
(KENYATTA UNIVERSITY)

THIS THESIS HAS BEEN ACCEPTED FOR
THE DEGREE OF *M.Sc 1998*
AND A COPY MAY BE PLACED IN THE
UNIVERSITY LIBRARY.

A thesis submitted in partial fulfilment for the
degree of Master of Science in Botany
of the University of Nairobi

UNIVERSITY OF NAIROBI LIBRARY



0132917 6

UNIVERSITY OF NAIROBI
LIBRARY
P. O. Box 30197
NAIROBI

Department of Botany
[University of Nairobi]

September, 1998

DECLARATION

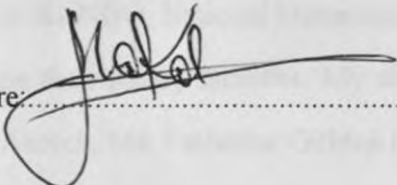
This thesis is my original work and has not been presented for a degree in any other University.

RUSULA A. OWINO

Signature:  Date: 22/9/98.

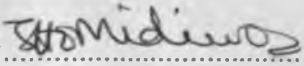
This thesis has been submitted for examination with our approval as the University Supervisors.

PROF. J.O. KOKWARO

Signature:  Date: 28 Sept. 1998

UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

PROF. J.O. MIDIWO

Signature:  Date: September 22, 1998

ACKNOWLEDGEMENTS

I am grateful to the University of Nairobi, and the National Council of Science and Technology, for providing the funds which enabled me complete this work. My sincere thanks and deep appreciation goes to my Supervisors, Prof. J.O. Kokwaro of Botany and Prof. J.O. Midiwo of Chemistry departments for their continuous supervision and encouragement.

I am grateful to Prof. S.K. Imbamba (ECA), Prof. J.K Imungi of Food and Nutrition (Kabete Campus) and Dr. A.K Misra (UON) for encouraging me to work on the wild vegetables of Kenya. I cannot forget Mr. Patrick Maundu of National Museums (Nairobi) for allowing me to compare notes with him and Dolline Busolo of KENGO for her assistance during the early stages of this work.

Thanks to KENGO, National Museums of Kenya (NBI) and ICRAF Directors for allowing me to use their library facilities. My sincere thanks to Mr. Simon Mathenge, the late Mr. Charles Aketch, Ms. Catherine Githinji (All of Botany Department) and Mr. Shivachi of Animal Production Department (Kabete Campus) for their tireless assistance when and where it was required. I am also grateful to Ms. Lucy Ougo of the African Academy of Sciences for typing this work, and to Mr. Robert Oswaggo of Zoology Department (UON) for editing it.

Finally, I wish to thank all the people interviewed in Kisumu District, for it is through their knowledge that I have been able to accomplish the goals of this project.

Last but not least, my special gratitude to my family for being patient throughout the period of my research which required a lot of travelling and being away from home. Special thanks to my brother-in-law, Mr. John R.O. Okello of CMC for assisting me by providing transport to and from Kisumu District severally.

TABLE OF CONTENTS

	Page
Declaration	ii
Acknowledgements	iii
List of figures	vii
List of plates	viii
List of tables	ix
Abstract	x

CHAPTER 1

1.0	INTRODUCTION	1
1.1	Wild plants used as vegetables	1
1.2	Gathering of wild plants	6
1.3	Development of Agriculture from wild plants.....	7
1.3.1	Origin of Agriculture	7
1.3.2	Importance of the wild plants	8
1.4	Position of green leaves in the diet of Kenyans	9
1.5	Use and methods of preparation	10
1.6	General classification	11
1.7	Effect of human population on wild plants including vegetables	12
1.8	Objectives of the project	13

CHAPTER 2

2.0	LITERATURE REVIEW	14
-----	-------------------------	----

2.1	Utilization and promotion of indigenous vegetables in Kenya	15
2.2	Agronomic potential of the leafy vegetables	16
2.3	Conservation status	17

CHAPTER 3

UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

3.0	AREA OF STUDY	18
3.1	Location	18
3.2	Climate	18
3.2.1	Rainfall	18
3.2.2	Temperatures	19
3.3	Soils	19
3.4	Physiography and Geology	21
3.4.1	Rock types	21
3.5	Vegetation	21
3.6	Agro-climatic zones	22
3.7	Human population	22
3.8	Agricultural activities	24
3.8.1	Cash crops	24
3.8.2	Subsistence farming	24

CHAPTER 4

4.0	ETHNOBOTANY AND TAXONOMIC DESCRIPTIONS	27
4.1	Methods of study	27
4.1.1	Field survey	27
4.1.2	Herbarium work	31
4.1.3	Field trials	31

4.2	Taxonomic descriptions of the vegetables	31
4.3	Some common plants that also bear leafy vegetables	84
4.4	Results and discussion	86
4.5	Conclusion	89

CHAPTER 5

5.0	NUTRITIONAL VALUES	91
5.1	Methods	91
5.1.1	Wet digestion	92
5.1.2	Typical analytical procedure	92
5.1.3	Analysis	92
5.2	Results.....	93
5.3	Discussion	97
5.4	Conclusion	99

CHAPTER 6

6.0	CAUTION ON EXPERIMENTATION WITH WILD VEGETABLES ...	101
6.1	Some precautions to be taken when experimenting on leaves for their edibility	102

CHAPTER 7

7.0	GENERAL COMMENTS AND RECOMMENDATIONS ...	105
	APPENDIX 1: ETHNOBOTANICAL SURVEY FORM	107
	APPENDIX 2: SOME RESPONSES TO QUESTIONNAIRE	109
	BIBLIOGRAPHY	114

LIST OF FIGURES

1.	Administrative boundaries of Kisumu District	20
2.	Average annual rainfall (mm) for Kisumu District	23
3.	Altitude (metres) of Kisumu District	23
4.	Soil map of Kisumu District	25
5.	Agro-Climatic zone map of Kisumu District	25
6.	Population density of Kisumu District (1989 census)	26
7.	Population distribution of Kisumu District (1989 census)	26
8.	Geographical divisions of Kenya as used in Flora of Tropical East Africa ...	33
9.	Mineral percentage of Sample plants (Bar graph)	94

LIST OF PLATES

	Pg
1a. <i>Amaranthus hybridus</i> - intercropped with <i>Brassica oleracea</i> var. <i>acephala</i>	43
1b. <i>Amaranthus hybridus</i> - growing at Nairobi International Show Ground (1996)	43
2. <i>Basella alba</i> growing at Nairobi International Show Ground (1996)	46
3a. <i>Gynandropsis gynandra</i> growing at Nairobi International Show Ground (1996)	49
3b. <i>Gynandropsis gynandra</i> growing wild at an open field in Kisumu District	49
4. <i>Commelina benghalensis</i> growing at a field in Kisumu District	52
5. <i>Bidens pilosa</i> - vegetable picking stage	54
6. <i>Ipomoea eriocarpa</i>	60
7. <i>Cucurbita maxima</i> planted at a homestead farm in Kisumu District	62
8. <i>Erythrococca bongensis</i> hanging on a wall of a hut in Kisumu District ...	64
9. <i>Manihot esculenta</i> in cultivation at a farm in Kisumu District	65
10a. <i>Crotalaria brevidens</i> var. <i>intermedia</i> growing at Nairobi International Show Ground (1996)	70
10b. <i>Crotalaria brevidens</i> var. <i>intermedia</i> (fruiting stage) planted at a homestead farm in Kisumu District.....	70
11. <i>Vigna unguiculata</i>	72
12. <i>Sesamum angustifolium</i> (flowering stage)	77
13. <i>Solanum nigrum</i> growing at Nairobi International Show Ground (1996)	81
14a. <i>Corchorus olitorius</i> (red stem) growing wild at an open field in Kisumu District	83
14b. <i>Corchorus olitorius</i> growing at Nairobi International Show Ground (1996)	83

LIST OF TABLES

1	Indigenous vegetables of Kenya	3
2	Indigenous vegetables of Kisumu District	29
3	Mineral content (Ca, P, Fe, and Mg) of some vegetables of Kisumu District (percentage is per 2.5 g dry matter)	93
4	Nutrient contents of some Kenyan vegetables compared with exotics	95
5	Nutrient content of some leafy vegetables	96
6	Some plants with poisonous leaves used as vegetables	104

ABSTRACT

Ethnobotanical study of herbage or leafy vegetables of Kisumu District in Nyanza Province of Western Kenya has been carried out to establish whether the indigenous species are still utilized. About 60 species have been identified and found to be commonly utilized, most of which are gathered from the wild. A few e.g *Gynandropsis gynandra*, *Solanum nigrum*, *Amaranthus* spp., *Corchorus* spp. and *Crotalaria brevidens* var. *intermedia* are cultivated in some places.

These plants span across nineteen dicotyledonous and one monocotyledonous families. The family Leguminosae leads in the number of species utilized as vegetables, followed by Amaranthaceae, Acanthaceae, Compositae, Convolvulaceae, and Solanaceae (each provide four vegetable species, the ones mentioned during the survey) and Capparidaceae, Cucurbitaceae, Euphorbiaceae, Malvaceae, Pedaliaceae and Tiliaceae have each provided three species. Chenopodiaceae and Commelinaceae have two species each and Basellaceae, Onagraceae, Oxalidaceae, Polygonaceae, Portulacaceae and Zygophyllaceae have each provided one vegetable species.

Out of these, ten commonly used species were analyzed for calcium, iron, phosphorus and magnesium contents. The survey has shown most rural folks to be dependent on these indigenous vegetables for most part of the year especially when conditions are dry and pests rampant. The plants are well adapted to the harsh environmental conditions (e.g poor soils, dry seasons) prevalent in many parts of Nyanza and are also resistant to pests and diseases which most exotics easily succumb to.

During rainy seasons, these vegetables grow naturally and abundantly in farmlands, homesteads, along river banks, etc. At such times, they are cooked mixed with exotics like kale and spinach which are then available. Though some of them may not possess the qualities found in the regularly cultivated varieties, they are quite nutritious and when well prepared offer a very

agreeable flavour. With a bit of breeding, they can therefore form an important readily available source of food for all and especially to many rural peoples (Kokwaro, 1990). There is a cultural acceptance of some, but a lot needs to be done to help in popularising them so as to curb ignorance and prejudice which leads to underutilization and their depreciation.

Most of these vegetables have also been found to have medicinal values, especially in the treatment of gastro-intestinal problems. The popular cultivated species mentioned above are well utilised for this purpose but majority of the little known species are underutilized.

Despite all these benefits some near relatives of the vegetables have been found to be poisonous therefore caution should be taken when collecting them from the wild by utilising only properly identified species for various purposes.

UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

CHAPTER 1

1.0 INTRODUCTION

The current unpredictable weather leading to long spells of dry seasons together with the high trend in population growth in most African countries have caused panic as far as food availability is concerned. There is now a need to re-introduce the indigenous food plants which are less sensitive to such drastic conditions compared to the exotics.

The green plants are the beginning of the food chain and on them depends the life of other terrestrial organisms. The leaves can be considered as highly organized factories that convert local crude materials, carbon-dioxide, water and minerals to food. In the tropics, they serve as direct food sources to man under the most civilized circumstances; the popular species are grown and preserved on both home and commercial scales (Martin and Ruberte, 1979).

Apart from food, plants supply us with a cornucopia of useful and vital products to cover virtually every need: medicines, spices, firewood, contraceptives and therefore forms the central feature of our environment.

1.1 WILD PLANTS USED AS VEGETABLES

In a technical sense, all plants are vegetables. The term however, is usually applied to edible plants which store up reserve food in roots, stems, leaves and fruits and which are eaten cooked or raw as salad plants (Kokwaro, 1979).

In this case, the term refers to the leafy or herbage vegetables. These include the plants in which the above ground portions are consumed as vegetables, i.e, whole shoot or leaves only (Table 1).

Many diets of the tropics are based on starchy staples, supplemented, when possible, by foods high in protein (fish, beans, groundnuts, beef, white ants etc). The wild plants used as vegetables enrich such diets and are physiologically useful regulators of the digestive tract. They also add vitamins and minerals quite out of proportion to their weight (King, 1971).

In Kisumu District, as in most rural areas of Kenya, green leaves from wild plants are used as regular and important items of the diet. In times of stress, they provide nutritious and readily available sources of food (Martin and Ruberte, 1979; Kokwaro, 1990; Johns *et al.*, 1991). Analysis by FAO (1968 and 1988), Imungi & Potter (1983), and Chweya (1985) show many indigenous vegetables like *Gynandropsis gynandra* (Capparidaceae), *Solanum nigrum* (Solanaceae), *Sesamum* spp. and others to be nutritious.

They rank high in protein, fat and mineral contents yet most indigenous greens are underutilized and neglected, or depreciated and destroyed. Among reasons for such neglect are ignorance and prejudice. The term "Indigenous" here refers to "native" (original) species and the introduced ones which have now become naturalized such that they appear local.

Table 1: Indigenous vegetables of Kenya.

FAMILY	SCIENTIFIC NAME	COMMON NAME	LUO NAME(S)	A,P
Acanthaceae	<i>Asystasia gangetica</i>	Asystasia	Atipa	A
	<i>A. mysorensis</i>	"		"
	<i>Justicia flava</i>	Justicia	Nyar ner atipa	"
	<i>J. metammensis</i>		Piu Piu	"
	<i>Thunbergia alata</i>	Black-eyed susan	Nyawend agwata	P
Amaranthaceae	<i>Achyranthes aspera</i>	Devil's horsewhip	Ayucha	A
	<i>Amaranthus graecizans</i>	Amaranth	Ododo	"
	<i>A. hybridus</i>	Chinese spinach/ pigweed	Omboga	"
	<i>A. spinosus</i>	Spiny pigweed	Akuthe	"
	<i>Celosia schweinfurthiana</i>		Tungu	"
Basellaceae	<i>Basella alba</i>	India/Ceylon spinach	Nderma/Ndemra	P
Capparidaceae	<i>Cleome hirta</i>		Nyar ner Dek	A
	<i>C. monophylla</i>		Deg dani	"
	<i>Gynandropsis gynandra</i>	Spider weed	Akeyo/Dek	"
Chenopodiaceae	<i>Chenopodium album</i>	Goosefoot/ fat hen		A
	<i>C. opulifolium</i>	Round-leaved goosefoot/ lambquarters	Tinga/Tinga-tinga	"
Commelinaceae	<i>Commelina africana</i>		Angayo/Ngaya- ngaya	A
	<i>C. benghalensis</i>	Wandering jew	Odielo	"
	<i>C. imberbis</i>			
Compositae	<i>Bidens pilosa</i>	Black jack; black fellow/ Spanish needles;	Onyiego/ Nyanyiek mon	P
	<i>Galinsoga parviflora</i>	Gallant soldier	Osieko	A
	<i>Launaea cornuta</i>	Wild lettuce	Achak	"
	<i>Sonchus oleracea</i>	Sow thistle	Achak	"
	<i>Tridax procumbens</i>	Tridax	Ofuch apuoyo	"

Table 1 (cont): Indigenous vegetables of Kenya.

FAMILY	SCIENTIFIC NAME	COMMON NAME	LUO NAME(S)	A,P
Convolvulaceae	<i>Ipomoea aquatica</i>	Swamp cabbage/ water spinach		A
	<i>I. batatas</i>	Sweet potato	Rabuon/Mrawu	A,P
	<i>I. cairica</i>	Railway creeper		P
	<i>I. eriocarpa</i>			"
	<i>I. pes-caprae</i>	Goats foot Convolvulus		"
Cucurbitaceae	<i>Cucumis sativus</i>	Cucumber	Budho/Sewewe/ Susa	P
	<i>Coccinia adoensis</i>		Mutkuru/Mutguru	
	<i>C. trilobata</i>			
	<i>Cucurbita maxima</i>	Pumpkin	Budho/Susa	P
	<i>Luffa cylindrica</i>			
	<i>Momordica charantia</i>	African Cucumber		
	<i>M. rostrata</i>			
Cruciferae	<i>Erucastrum arabicum</i>			A
Euphorbiaceae	<i>Acalypha volkensii</i>	Acalypha	Dindi	P
	<i>Erythrococca bongensis</i>	Erythrococca	Hariadho/Siriadho	"
	<i>Manihot esculenta</i>	Cassava/Manioc	Muogo/Mariwa	"
Labiatae	<i>Hoslundia opposita</i>			A
Leguminosae	<i>Abrus precatorius</i>	Crab's eye/lucky bean climber	Ombulu	P
	<i>Arachis hypogaea</i>	Groundnut/Peanut	Njugu	A
	<i>Cajanus cajan</i>	Pigeon pea	Mbas	P
	<i>Senna bicapsularis</i>		Ang'or	P
	<i>Cassia occidentalis</i>	Coffee senna	Nyayado/Ohingla tiang'	P
	<i>Crotalaria brevidens</i> var. <i>intermedia</i>		Mitoo/Mtoo	A

Table 1 (cont): Indigenous vegetables of Kenya.

FAMILY	SCIENTIFIC NAME	COMMON NAME	LUO NAME(S)	A,P
	<i>Crotalaria ochroleuca</i>			
	<i>Phaseolus coccineus</i>	runner bean	Bo	A
	<i>Tamarindus indica</i>	Tamarind	Chwaa/Ochwaa	P
	<i>Tephrosia pumila</i>		Nyang'or	
	<i>Vigna unguiculata</i>	Cow pea	Bo	A,P
	<i>V. membranacea</i>			A
Liliaceae	<i>Asparagus buchananii</i>			P
	<i>A. racemosus</i>			"
Malvaceae	<i>Hibiscus esculentus</i>	Okra/Lady's finger	Dania madongo	A
	<i>Sida alba</i>		Adongo Nyar yuora	P
	<i>Sida acuta</i>	Prickly sida		P
Moraceae	<i>Ficus ingens</i>			P
Onagraceae	<i>Ludwigia stolonifera</i>		Nyasugumba/ Obera	A
Oxalidaceae	<i>Oxalis corniculata</i>	Yellow sorrel	Awayo	A
Passifloraceae	<i>Adenia venata</i>			P
Pedaliaceae	<i>Sesamum angolense</i>		Onyulo madongo	A,P
	<i>S. angustifolium</i>		Onyulo matindo	A
	<i>S. indicum</i>	Simsim/Sesame	Nyim	"
Polygonaceae	<i>Oxygonum salicifolium</i>			A
	<i>O. sinuatum</i>	Double thorn	Nyatiend gweno/ Okuro	P
	<i>Rumex usambarensis</i>			"
Portulacaceae	<i>Portulaca oleracea</i>			A
	<i>P. quadrifida</i>	Portulaca	Obwanda	"
	<i>Talinum portulacifolium</i>			

Table 1 (cont): Indigenous vegetables of Kenya.

FAMILY	SCIENTIFIC NAME	COMMON NAME	LUO NAME(S)	A,P
Rubiaceae	<i>Pavetta crassipes</i>			
	<i>Pentanisia shweinfurthii</i>			
Solanaceae	<i>Nicandra physaloides</i>	Chinese lantern/ Apple of peru	Osuga	A
	<i>Physalis peruviana</i>	Cape gooseberry	Nyatonglo	P
	<i>Solanum nigrum</i>	Black nightshade/ Wonderberry	Osuga	A
Tiliaceae	<i>Corchorus africana</i>		Apoth	A
	<i>C. olitorius</i>	Jute/Jews mallow		A
	<i>C. trilocularis</i>			A
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrops/Puncture vine/Devil's thorn	Okuro	A

A - Annual

P - Perennial

Source: Imbamba, 1973; Terry and Michieka, 1987; Kokwaro 1990; Chweya, 1990; Opolo *et al.*, 1991; Musale & Irongi, (1993).

1.2 GATHERING OF WILD PLANTS

Early man, following the habits of his ape - like ancestors first made use of food plants by gathering the edible parts of wild plants (fruits mainly). However, gathering of wild plants is still carried on even in the civilized countries of Eastern Europe when people go out to pick wild black berries or mushrooms (Harrison *et al.*, 1969; Juma, 1989).

In times of famine or food scarcity people revert to making more use of wild plants which are not normally eaten (Grivetti, 1978; Martin and Ruberte, 1979; Kokwaro, 1990; Johns and Kokwaro, 1991).

In Kenya, traditional vegetables and fruits are usually collected from the wild in the rural areas, mostly by children and women.

1.3 DEVELOPMENT OF AGRICULTURE FROM WILD PLANTS

1.3.1 Origin of Agriculture

Our existing food plants originated in many different parts of the world. Russian botanist Vavilov, who devoted much research into their origin concluded that there were up to twelve main centres of origin in different regions though there is no doubt that some originated in other scattered places (Harrison *et al.*, 1969). Majority of these centres were in Asia, Africa and the Mediterranean basins and three in America. The food crops then spread to other parts and due to seed selection, by the nineteenth century yields of many crops had been greatly raised due to the development of modern science and genetics. Among the centres of diversity, only Ethiopian centre falls in the sub-Saharan Africa. Northern Kenyan highlands and wetlands are included in the Ethiopian centre in the strict sense of Vavilov's classification. But in a wider sense, much of Kenya and many of her traditional crops could be considered to belong to Vavilov's Ethiopian Centre.

Man went ahead not only to select parent plants but to make hybrids between species and varieties, to search wild world plants with promising characters and even himself to create new genetic variations by treating plants with chemical substances or bombarding them with X-rays (Harrison *et al.*, 1969; Hoyt, 1988). This has resulted in cultivated forms of many crops being more divergent from the wild ancestors from which they had been derived.

1.3.2 IMPORTANCE OF THE WILD PLANTS

The number of species bearing edible green leaves in the tropics and subtropics is very large (Terra, 1966; Martin and Ruberte, 1979; Tindall, 1983). In Kenya, there are over 80 plants used (Table 1); Musale and Irongi (1993) recorded over 200 species.

Green leaves used as vegetables have insignificant carbohydrates content. Though they are often not rich sources of protein, species like *Manihot esculenta* (Euphorbiaceae) contain sufficient amounts to supplement an otherwise inadequate starchy diet. Most of them contain vitamin A,C, riboflavin and thiamine (Abe and Imbamba, 1977; Douglas, 1979). *Asystasia* species are used for treating stomach problems, enlarged spleens in newborns, for swellings and rheumatic pains in East Africa (Kokwaro, 1993). *Sesamum angustifolium* treats eye troubles, infant diarrhoea and is emetic, it may have potential oil in its seeds; apparently, the related species *Sesamum indicum* is the plant from which Sesame or Simsim Oil is obtained.

In general, most of these vegetables are important for treating stomach/gastro-intestinal problems in both adults and children. The genus *Amaranthus* (Amaranthaceae) is well known for its edible seeds in Mexico, Africa and Central America, but most species are equally useful pot-herbs (NAS, 1975). They are herbaceous, short-lived annuals rich in Vitamin A and C, calcium and phosphorus.

Basella alba (Basellaceae) is also widely adapted to a variety of soils and climates of Africa. It is widespread throughout Kenya. In West Africa, the sweet potato, *Ipomoea batatas* is well known for its edible leaves which are rich in protein. In the Euphorbiaceae, *Manihot esculenta* (Cassava) is best known for its edible roots in the tropic and as a source of tapioca, starch and animal feed in the temperate zones. It bears large lobed leaves near the tips of long branches. The young leaves are used as vegetables and provide protein values of 17.8 to 35.5% (dry weight).

Corchorus olitorius (Tiliaceae), also known as jute, jews-mallow, or bush okra is probably the most important source of edible greens in a genus known for such species. It originated from Africa but was introduced at a very early date to India and later to China. The leaves and shoots of all varieties are edible. Other vegetable species include *Vicia faba* (broad bean), *Vigna* species, *Pisum sativum* (garden pea) and *Phaseolus vulgaris*, all of the Leguminosae.

Many other vegetables are used by rural people but are little known by majority, and their chemical components have not been established. This project has tried to accomplish this for some so as to make them popular as a source of greens not only to rural folks but to many.

1.4. POSITION OF GREEN LEAVES IN THE DIET OF KENYANS

The changing land use pattern due to development has tended to encourage cultivation of food crops that are also cash generating at the expense of the common non-cash generating vegetables. More and more families have therefore been forced to plant exotic fast growing vegetables such as cabbage and kale in order to meet their daily food and cash requirements. Unfortunately, this has discouraged the cultivation of many traditional vegetables such that, in the places where they are utilised they are just left to grow naturally.

These indigenous herbage vegetables are not equally appreciated in all parts of Kenya. Education and experience play a major role in determining their acceptability as part of the normal diet. The Maasai and people of similar climatic zones consider them as food for livestock. However, this attitude is slowly changing in most parts as a result of several workshops held by various non-governmental organizations like Kenya Energy and Environment Organization (KENGO), Indigenous Food Plants Programme -

(IFPP), World Neighbours (WN) etc. in collaboration with various government ministries and parastatals.

Both Nyanza and Western Provinces of Kenya lead in the utilization of indigenous varieties, followed by Coast and Eastern Provinces respectively. Thus, the place of green leaves in the diet is largely a matter of culture, training and habit.

1.5 USE AND METHODS OF PREPARATION

The most common use in all parts of Kenya is as a boiled vegetable. Such usage is very sound since potential pathogens are thus eliminated, sometimes poisonous or irritating substances are neutralized and spoilage is brought to a halt (Martin & Ruberte, 1979).

Generally, cooking should be as brief as possible to avoid destruction of nutrients by overheating but there are some vegetables that have bitter principles and are only palatable after boiling for a long time and even discarding the boiled water, for example *Ludwigia stolonifera*. Some leaves have mucilaginous substances (*Corchorus* spp., *Sesamum* spp., *Basella alba*, *Sida acuta* etc) which are often used in softening other hard vegetables like *Vigna* species.

Mixing of different varieties including the exotic ones like kale and spinach is a common practice. In fact it is very rare to find just one species cooked alone. The mixture usually forms what is commonly referred to as "aboka" or "atwago" in Luo.

Frying vegetables in oil, butter or addition of ghee, milk or groundnuts is also common and this preserves their unique characteristics and maintains their texture while making them even more nutritious. For preservation purposes, leaves are dried but this loses some of the nutrients. Sometimes sodium bicarbonate or ash is added. This helps

in softening them and retaining the green colour, but may have an effect on nutritional value. Education and experience, as already mentioned, play a major role in determining the acceptability of the indigenous greens as part of the normal diet. In the rural areas, knowledge of various species is widespread among the old and this used to be systematically passed through the home, but these days the knowledge seems to be limited to women and mostly in the rural areas.

Cultivated and wild species, their seasons, uses and tastes are well known though most of the herbaceous short-lived annuals tend to be considered as weeds and food for small animals like rabbits. Many of these vegetables are also good sources of traditional medicine (Watt and Breyer-Brandwijk, 1962; Kokwaro, 1993) and they are especially used in cases of gastro-intestinal or stomach complaints.

UNIVERSITY OF NAIRU
GHIROMO LIBRARY

1.6 GENERAL CLASSIFICATION

Due to the great diversity of plants, there is need to have a simpler point of reference hence the science of classification. In this work, the plants are simply grouped into families which are in turn arranged alphabetically. This gives enough idea of the nature of plant and at times the characteristics of the leaves.

It is also possible to classify by plant type, for example herbaceous, shrubby, viny, annual or perennial but in this case this method has not been fully adopted since most of the plants dealt with are either annual or perennial and are mostly herbaceous.

Vegetables may also be classified according to the various ways in which they are used, and the following are examples:

- (i) **Salad Vegetables** Normally uncooked as a side dish,
- (ii) **Relish** Small quantities used to contrast other foods,

- | | | |
|-------|---------------------------|---|
| (iii) | Garnish | Used to decorate food, not necessarily eaten, |
| (iv) | Spinach | Cooked and eaten as a side dish, |
| (v) | Pot-herb | Mixed with other vegetables or in stews, |
| (vi) | Spice or Condiment | Used to impart a desired flavour to the main dish |

Most of the vegetables discussed in this study are used as pot-herbs, and to a less extent as spinach.

Another method of classifying vegetable is by habit:

- | | | |
|-------|--------------------------|--|
| (i) | Wild | Growing in their natural habitats without human manipulation, |
| (ii) | Semi-domesticates | Seeds collected from the wild and grown in farms, some still capable of growing in the wild. |
| (iii) | Domesticates | Cultivated together with other crops. |

1.7 EFFECT OF HUMAN POPULATION ON WILD PLANTS INCLUDING VEGETABLES

Africa was self-sufficient in food production about 20 years ago. Currently the population grows at the rate of over 3.0% per year in most countries, though production expands at the rate of 1.8% per year (Juma, 1989).

This has led to a wide range of ecological and economic problems manifested in extensive ecological degradation and limited basic resources such as food and energy. In the process, a number of plants have been destroyed (Hoyt, 1988).

In Western Kenya, most little known weedy species have been known to be useful to the local people, particularly in the dry seasons (Gomez, 1982; Kokwaro, 1990; Johns and Kokwaro, 1991).

Very few of these are semi-cultivated e.g *Gynandropsis gynandra*, *Solanum nigrum*, *Corchorus olitorius*, *Crotalaria brevidens* var. *intermedia*, *Amaranthus* spp. etc. Others are weeded out when on peoples' farms yet wild plants have been shown to have highly advantageous and special characteristics (Sigmund & Gustav, 1991). Hoyt, (1988) recorded some uses of wild species; part of the tomato's good nutritional value is its high vitamin content, which comes from the gene of a rare wild species from Peru. From other wild tomatoes comes genes that intensify the fruits colour. Wild varieties of *Crotalaria* have been used to produce leaves of better quality and other plants have helped crops resist pests and diseases. Therefore, these wild relatives of crop plants are now needed more than ever before to feed a hungry rapidly expanding human population. These plants can be deliberately cultivated alongside other crops. Other effects leading to habitat destruction in Kisumu District are construction of roads and paths, homes and small factories, floods (common in the Kano region), and deforestation.

1.8 OBJECTIVES OF THE PROJECT

- (i) To establish which indigenous vegetables are consumed in Kisumu District.
- (ii) To record their methods of preparation and other uses (other than as vegetables).
- (iii) To establish the threats to their survival.
- (iv) To analyze their nutrient (mineral) composition e.g calcium, iron, magnesium and phosphorus.

CHAPTER 2

2.0 LITERATURE REVIEW

About 800 species of plants from the wild are used as food in Kenya. Only twenty five percent (about 200 species) provide the vegetables (Musale and Irongi, 1993; Maundu, 1994).

Before 1970's little was recorded on indigenous vegetables of Kenya. The published information available was hidden in more general publications concerning tropical gardening or useful plants especially under medicinal plants or foods for wild animals (Purseglove, 1968). But as food for humans very few authors discussed them in detail. Terra (1966) gave a comprehensive list of both major and minor vegetables of the tropics and sub-tropics. Tindall (1983) and Dalziel (1937) provide considerable information on a variety of indigenous and introduced green leafy vegetables of West Africa and Tallantire and Goode (1965) also gives information on these plants of Uganda.

In Kenya, earlier work started in the late seventies (Abe and Imbamba, 1977). Detailed work was done in the eighties (Imungi and Potter, 1983; Imungi, 1989; Juma, 1989). In Western Kenya, Kokwaro (1990) and together with Johns (1991) have carried out extensive Ethnobotanical Surveys on these vegetables. Many others have done similar work in the Coast, Eastern and Western Kenya. These include various non-governmental organizations especially Indigenous Food Plants Programme (IFPP) under the National Museums, Kenya Energy and Environmental Organization (KENGO) in conjunction with Food and Nutrition Department of the University of Nairobi, Organic Farming, World Neighbours (WN) and Jomo Kenyatta University of Agriculture and Technology.

2.1 UTILIZATION AND PROMOTION OF INDIGENOUS VEGETABLES IN KENYA

The economic history of Kenya has been extensively studied in the context of colonization and land alienation. From the early days of development of Kenya's modern agriculture, there was a preference for imported crops and tree species. Indeed the choice of the so-called "White highlands" for colonial settlement was based on eco-climatic similarities with sections of Europe and therefore offered the promise of establishing temperate crops. In such areas there is minimum utilization of indigenous greens, the exotic crops being more established.

Between 1964 and 1985, the country imported 380 genetic resource vegetable accessions used for breeding. Only 91 local accessions were used (Juma, 1989). This reflects the limited research devoted to promotion of indigenous vegetables. Due to serious food shortages in 1980 and 1992, the government has become more sensitized leading to emphasis on drought resistant crops which have turned out to be the local species.

Communities with a culture rich in utilizing herbaceous plants for food include Luo, Luhya, Giriama and Pokot. The Maasai and Turkana use them mainly as herbal tonics. Over the years the trend has been a turn towards modern feeding habits and discarding traditional ones. This has gradually led to low regard for indigenous plants, monoculture and less variety in diets hence malnutrition and loss of genetic diversity of local food species and loss of traditional knowledge about the plants, resulting in a decline in cultural diversity.

Public perceptions are now starting to change as more local communities work in conjunction with various government and non-governmental organizations. Still there

is a need to create conditions which would enable these communities to work closely with the scientific community to improve local varieties.

2.2 AGRONOMIC POTENTIAL OF THE LEAFY VEGETABLES

Vegetable crops make up a major portion of the diet of humans. World attention has focused mainly on cultivated species but the nutritional or industrial potential of the wild species has not been studied in detail. In Kenya, the East African Seed Company has tried to promote utilization of indigenous and exotic vegetables through demonstrations in local agricultural shows. The indigenous ones are just as competent in production as the exotics. The flavour, texture and food quality of *Amaranthus* species is very similar to other vegetables. Plates 1b, 2, 3a, 10a, 13, and 14b, show these vegetables grown at the Nairobi International Show ground (1996) to promote their usage and production.

Imungi (1989) compared some of the exotics like *Brassica oleracea* var *capitata* and *Spinacea oleracea* with semi-cultivated indigenous vegetables like *Gynandropsis gynandra*, *Vigna unguiculata* etc. The latter ranked high in protein, vitamins A and C and minerals like calcium and iron. As already indicated the Leguminosae, Amaranthaceae, Compositae, Cucurbitaceae, and Acanthaceae are the most important families for sources of vegetables based on the number of species collected from the wild and those semi-cultivated.

These vegetables play an essential role in maintaining the nutritional well being of local rural populations (Abe and Imbamba, 1977; Gomez, 1981; Chweya, 1985). However, the tendency has been to concentrate on agronomic research on other subsistence crops especially the cereals. Efficient methods of improving yield and nutritional value of these crops is to improve the land races or weedy species being

grown through selection and/or breeding (Hoyt, 1988). This should be combined with developing more efficient agro-management systems with minimum, but appropriate input application (Chweya, 1994). To accomplish this, genetic stocks must be available for evaluation and analyses, and basic biological, ethnobotanical and agronomic information should be known. Unfortunately no systematic genetic collections have been made in indigenous vegetables and very little research on their agronomic potential has been conducted. Opole *et al.*, (1991) shows how well the plants are adapted to local environmental conditions, are intercropped easily, need little land for domestication and minimal labour therefore managing them should be much easier.

2.3 CONSERVATION STATUS

Generally there is loss at farm and village level, particularly in the agricultural areas of Kenya. This is due to clearance of vegetation for the more popular cash generating crops, hence decreased use of the indigenous vegetables.

Currently more and more organizations are promoting utilization, preservation and planting of indigenous vegetables. The plants with additional advantages e.g shade, medicinal etc stand a better chance for planting and conservation. Despite all these, many little known vegetables are diminishing while the survival of some rare ones is at stake as humans encroach on the natural habitats (Maundu, 1994).

The old women in the rural areas are the “banks” of information on identification, utilization, growing habits, cultivation requirements, harvesting, nutritional value and fruiting. There is need for us to collect this information and scientifically evaluate it for local, national and global utilization.

In Western Kenya, most little known weedy species have been known to be useful to the local people, particularly in the dry seasons (Gomez, 1982; Kokwaro, 1990; Johns and Kokwaro, 1991).

Very few of these are semi-cultivated e.g. *Gynandropsis gynandra*, *Solanum nigrum*, *Corchorus olitorius*, *Crotalaria brevidens* var. *intermedia*, *Amaranthus* spp. etc. Others are weeded out when on peoples' farms yet wild plants have been shown to have highly advantageous and special characteristics (Sigmund & Gustav, 1991). Hoyt, (1988) recorded some uses of wild species; part of the tomato's good nutritional value is its high vitamin content, which comes from the gene of a rare wild species from Peru. From other wild tomatoes comes genes that intensify the fruits colour. Wild varieties of *Crotalaria* have been used to produce leaves of better quality and other plants have helped crops resist pests and diseases. Therefore, these wild relatives of crop plants are now needed more than ever before to feed a hungry rapidly expanding human population. These plants can be deliberately cultivated alongside other crops. Other effects leading to habitat destruction in Kisumu District are construction of roads and paths, homes and small factories, floods (common in the Kano region), and deforestation.

1.8 OBJECTIVES OF THE PROJECT

- (i) To establish which indigenous vegetables are consumed in Kisumu District.
- (ii) To record their methods of preparation and other uses (other than as vegetables).
- (iii) To establish the threats to their survival.
- (iv) To analyze their nutrient (mineral) composition e.g. calcium, iron, magnesium and phosphorus.

CHAPTER 2

2.0 LITERATURE REVIEW

About 800 species of plants from the wild are used as food in Kenya. Only twenty five percent (about 200 species) provide the vegetables (Musale and Irongi, 1993; Maundu, 1994).

Before 1970's little was recorded on indigenous vegetables of Kenya. The published information available was hidden in more general publications concerning tropical gardening or useful plants especially under medicinal plants or foods for wild animals (Purseglove, 1968). But as food for humans very few authors discussed them in detail. Terra (1966) gave a comprehensive list of both major and minor vegetables of the tropics and sub-tropics. Tindall (1983) and Dalziel (1937) provide considerable information on a variety of indigenous and introduced green leafy vegetables of West Africa and Tallantire and Goode (1965) also gives information on these plants of Uganda.

In Kenya, earlier work started in the late seventies (Abe and Imbamba, 1977). Detailed work was done in the eighties (Imungi and Potter, 1983; Imungi, 1989; Juma, 1989). In Western Kenya, Kokwaro (1990) and together with Johns (1991) have carried out extensive Ethnobotanical Surveys on these vegetables. Many others have done similar work in the Coast, Eastern and Western Kenya. These include various non-governmental organizations especially Indigenous Food Plants Programme (IFPP) under the National Museums, Kenya Energy and Environmental Organization (KENGO) in conjunction with Food and Nutrition Department of the University of Nairobi, Organic Farming, World Neighbours (WN) and Jomo Kenyatta University of Agriculture and Technology.

2.1 UTILIZATION AND PROMOTION OF INDIGENOUS VEGETABLES IN KENYA

The economic history of Kenya has been extensively studied in the context of colonization and land alienation. From the early days of development of Kenya's modern agriculture, there was a preference for imported crops and tree species. Indeed the choice of the so-called "White highlands" for colonial settlement was based on climatic similarities with sections of Europe and therefore offered the promise of establishing temperate crops. In such areas there is minimum utilization of indigenous greens, the exotic crops being more established.

Between 1964 and 1985, the country imported 380 genetic resource vegetable accessions used for breeding. Only 91 local accessions were used (Juma, 1989). This reflects the limited research devoted to promotion of indigenous vegetables. Due to serious food shortages in 1980 and 1992, the government has become more sensitized leading to emphasis on drought resistant crops which have turned out to be the local species.

Communities with a culture rich in utilizing herbaceous plants for food include Luo, Luhya, Giriama and Pokot. The Maasai and Turkana use them mainly as herbal tonics. Over the years the trend has been a turn towards modern feeding habits and discarding traditional ones. This has gradually led to low regard for indigenous plants, monoculture and less variety in diets hence malnutrition and loss of genetic diversity of local food species and loss of traditional knowledge about the plants, resulting in a decline in cultural diversity.

Public perceptions are now starting to change as more local communities work in conjunction with various government and non-governmental organizations. Still there

is a need to create conditions which would enable these communities to work closely with the scientific community to improve local varieties.

2.2 AGRONOMIC POTENTIAL OF THE LEAFY VEGETABLES

Vegetable crops make up a major portion of the diet of humans. World attention has focused mainly on cultivated species but the nutritional or industrial potential of the wild species has not been studied in detail. In Kenya, the East African Seed Company has tried to promote utilization of indigenous and exotic vegetables through demonstrations in local agricultural shows. The indigenous ones are just as competent in production as the exotics. The flavour, texture and food quality of *Amaranthus* species is very similar to other vegetables. Plates 1b, 2, 3a, 10a, 13, and 14b, show these vegetables grown at the Nairobi International Show ground (1996) to promote their usage and production.

Imungi (1989) compared some of the exotics like *Brassica oleracea* var *capitata* and *Spinacea oleracea* with semi-cultivated indigenous vegetables like *Gynandropsis gynandra*, *Vigna unguiculata* etc. The latter ranked high in protein, vitamins A and C and minerals like calcium and iron. As already indicated the Leguminosae, Amaranthaceae, Compositae, Cucurbitaceae, and Acanthaceae are the most important families for sources of vegetables based on the number of species collected from the wild and those semi-cultivated.

These vegetables play an essential role in maintaining the nutritional well being of local rural populations (Abe and Imbamba, 1977; Gomez, 1981; Chweya, 1985). However, the tendency has been to concentrate on agronomic research on other subsistence crops especially the cereals. Efficient methods of improving yield and nutritional value of these crops is to improve the land races or weedy species being

grown through selection and/or breeding (Hoyt, 1988). This should be combined with developing more efficient agro-management systems with minimum, but appropriate input application (Chweya, 1994). To accomplish this, genetic stocks must be available for evaluation and analyses, and basic biological, ethnobotanical and agronomic information should be known. Unfortunately no systematic genetic collections have been made in indigenous vegetables and very little research on their agronomic potential has been conducted. Opole *et al.*, (1991) shows how well the plants are adapted to local environmental conditions, are intercropped easily, need little land for domestication and minimal labour therefore managing them should be much easier.

2.3 CONSERVATION STATUS

Generally there is loss at farm and village level, particularly in the agricultural areas of Kenya. This is due to clearance of vegetation for the more popular cash generating crops, hence decreased use of the indigenous vegetables.

Currently more and more organizations are promoting utilization, preservation and planting of indigenous vegetables. The plants with additional advantages e.g shade, medicinal etc stand a better chance for planting and conservation. Despite all these, many little known vegetables are diminishing while the survival of some rare ones is at stake as humans encroach on the natural habitats (Maundu, 1994).

The old women in the rural areas are the “banks” of information on identification, utilization, growing habits, cultivation requirements, harvesting, nutritional value and fruiting. There is need for us to collect this information and scientifically evaluate it for local, national and global utilization.

CHAPTER 3

3.0 AREA OF STUDY

3.1 LOCATION

Kisumu District lies within longitude 33° 20' E and 35° 20' E and latitudes 0° 30' S and 0° 15' N (Figure 1). It is in Nyanza Province and is bounded by Siaya, Kakamega, Nandi, Kericho, Kisii and Rachuonyo Districts and also by Lake Victoria. It has a total land area of 2093 Km² and is the largest of the nine districts of Nyanza Province. The District lies in a depression that is a part of a large lowland. It is around the Nyanza gulf, a protruding part of Lake Victoria at the head of which is Kisumu town. East of Kisumu town is the featureless Kano plains, occasionally broken by low ridges and rivers. The processes associated with the formation of the Rift Valley are believed to have influenced some of the notable physical features, for example the scarps in the north, east and south and the associated hill slopes and piedmont plains that spread across the vast Kano plains (Mwendwa, 1984).

3.2 CLIMATE

3.2.1 RAINFALL

The lowland area forms a trough of low rainfall, receiving a mean between 1000 mm and 1800 mm annually (Figure 2, page 23). The area has two rainy seasons a year, with the long rainy season occurring in April/May while the short rainy season reaches its peak in August/September and averages between 450 mm and 600 mm. The reliability of the short rainy season is low and scattered over a long period such that the cultivation of second crops is difficult.

The mean annual rainfall varies with altitude and proximity to the highlands of the Nandi escarpment and Tinderet. Maseno enjoys a mean annual rainfall of 1630 mm, Kisumu of 1230 mm, Ahero of 1260 mm, Kibos of 1290 mm, Muhoroni of 1525mm and Koru, 1103 mm. There is a sharp decline in the lake shore areas and the central portion of Kano plains.

Kombewa (in Seme) is characterized by rocky terrain with mostly sandy soils and has a mean annual rainfall of 660 mm, Awasi of 560 mm and Pap Onditi of 712 mm.

3.2.2 TEMPERATURES

Mean annual maximum temperatures range from 30° to 24° C and mean minimum range from 18° to 9° C.

3.3. SOILS

The soils are dominated by former lake sediments commonly called vertisols. In the western part of Kano plains, the soils are of gleysols types commonly associated with swamps. These two soil types constitute more than 70% of all soil types found in Kisumu District (Sombroek *et al.*, 1982). On the slightly elevated grounds and piedmont plains are the pianosols or its complexes of moderate fertility. On the uplands are the combisols and luvisols which are derived from intermediate igneous rocks, for example andesites.

The North-Western part of Kisumu (e.g Nyahera) has gerralsols and acrisol soils which have developed from the granites of the rocky south Kakamega uplands. The soils are of very low fertility, have rock base not more than 80 cm from the surface.



Fig. 1: Adiministrative boundaries of Kisumu District.

On the fringes of Winam Gulf, and the Lake Victoria beach ridges are soils of varying fertility, most of which are susceptible to waterlogging. The soils are commonly called solonchaks arenosols.

3.4 PHYSIOGRAPHY AND GEOLOGY

The district can be physiographically divided into three: the two faulted strips on either sides of the Nyanza Gulf and a Central portion including the Nyanza Gulf and the Kano plains. The Nyando scarp is surmounted by a dissected uplands 1800 m in altitude which is residual upon the submiocene surface. In the south the Nyabondo phonolites rest on the surface at an altitude of 1500 m. The drainage across the submiocene surface is East to South-West indicating a depression along the Kavirondo Gulf (Figure 3).

3.4.1 ROCK TYPES

These are numerous and include lavas, basic to acid in character and banded iron-stones from the Nyanzian system sheared and highly folded. The magic granite masses intrude into the Nyanzian rocks, for example the Miriu, Oyugis, Asembo, Maragoli and Kisian intrusions. The Maragoli and Kisian masses form the large tors which dominate the scenery on the northern side of the Nyanza Gulf. The main rock types are recent in origin and form superficial deposits, black cotton, latent iron-stones and land latenzed red soils.

3.5 VEGETATION

Remnants of savannah woody vegetation, dominated by *Acacia* spp. and scattered *Balanites aegyptiaca* are found in the Kano plains. It is believed that the climax vegetation over the clay soils of Kano plains was dominated by *Acacia seyal* and *A. polyacantha*, *A. drepanolobium* and *A. fistula*. This vegetation has been modified mainly by human activity to the extent that what now remains are scattered thorny woodlands and occasionally sighting of *Euphorbia candelabrum*.

UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

3.6 AGROCLIMATIC ZONES

Figure 5 shows the agroclimatic map in Kisumu District which also shows rainfall and evaporation rates.

3.7 HUMAN POPULATION

The human population number, distribution and density is from 1989 national population census (Central Bureau of Statistics, 1990) - (Figures 6 and 7 on page 26). The District was projected to have an estimated 830,000 people at the end of 1993.

THE PEOPLE

The Luo or JaLuo constitute the only river-lake or Western Nilotes in Kenya, but are the second largest of all the ethnic groups in the country, with a population of about 3.5 million.

About 830,000 come from Kisumu District. The economic aspect of the total culture has changed in emphasis from the traditional considerable dependence on cattle towards a predominantly agricultural involvement in pursuit of livelihood. The Luo ancestors must have emphasized pastoralism, leading a seasonably migratory life of transhumance. But a progressively increasing population, the limited movement imposed by the boundaries instituted during the colonial times, the resulting shortage of land and the introduction of new crops (maize, cassava and cash crops such as cotton and sugarcane) to supplement the traditional ones of sorghum and millet brought about the shift in emphasis from pastoralism to agriculture.

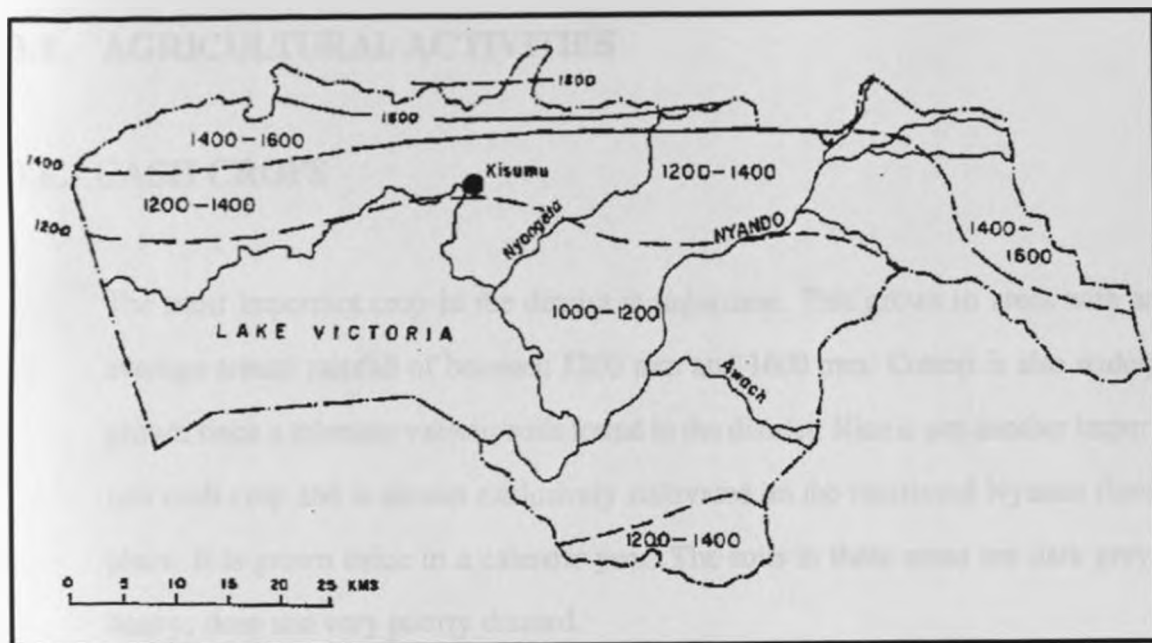


Fig. 2: Average annual rainfall (mm) for Kisumu District.

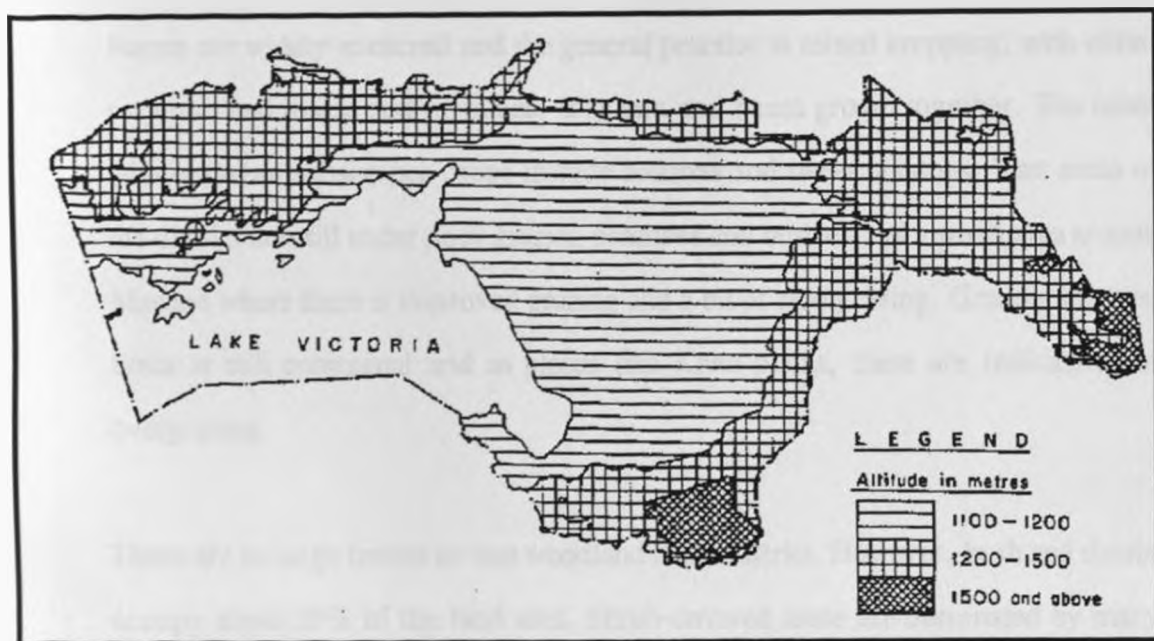


Fig. 3: Altitude (m) of Kisumu District.

3.8 AGRICULTURAL ACTIVITIES

3.8.1 CASH CROPS

The most important crop in the district is sugarcane. This grows in areas with an average annual rainfall of between 1200 mm and 1600 mm. Cotton is also widely grown since it tolerates various soils found in the district. Rice is yet another important cash crop and is almost exclusively cultivated on the reclaimed Nyando flood plain. It is grown twice in a calendar year. The soils in these areas are dark grey, heavy, deep and very poorly drained.

3.8.2 SUBSISTENCE FARMING

Farms are widely scattered and the general practice is mixed cropping, with either sorghum and maize and/or maize, sorghum and beans grown together. The other widely grown subsistence crops include bananas and sweet potatoes. Vast areas of the district are still under poor grazing practices and bush except a small area around Maseno where there is improved grazing and a bit of zero grazing. Grazing in most areas is still communal and in places like Kano plains, there are indications of overgrazing.

There are no large forests or vast woodland in the district. However, bush and shrubs occupy about 20% of the land area. Shrub-covered areas are dominated by many species notably the *Acacia* spp., especially *Acacia seyal* and *Cassia* spp.

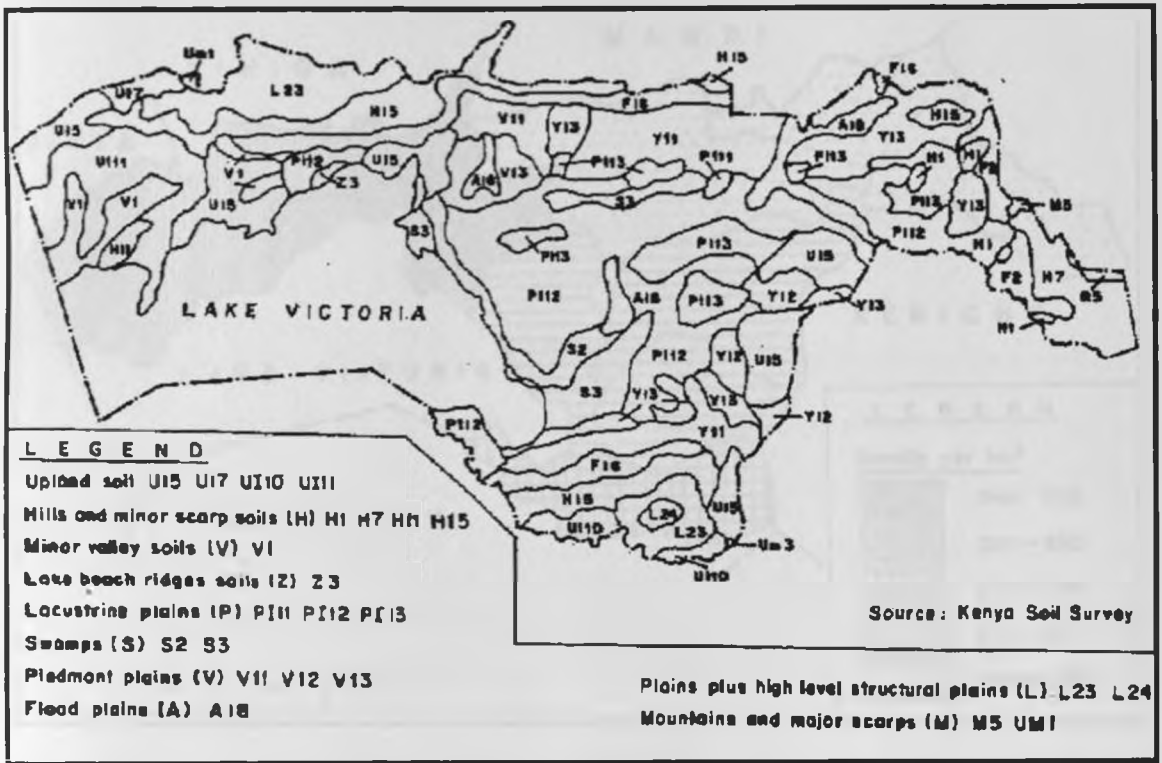


Fig. 4: Soil map of Kisumu District.

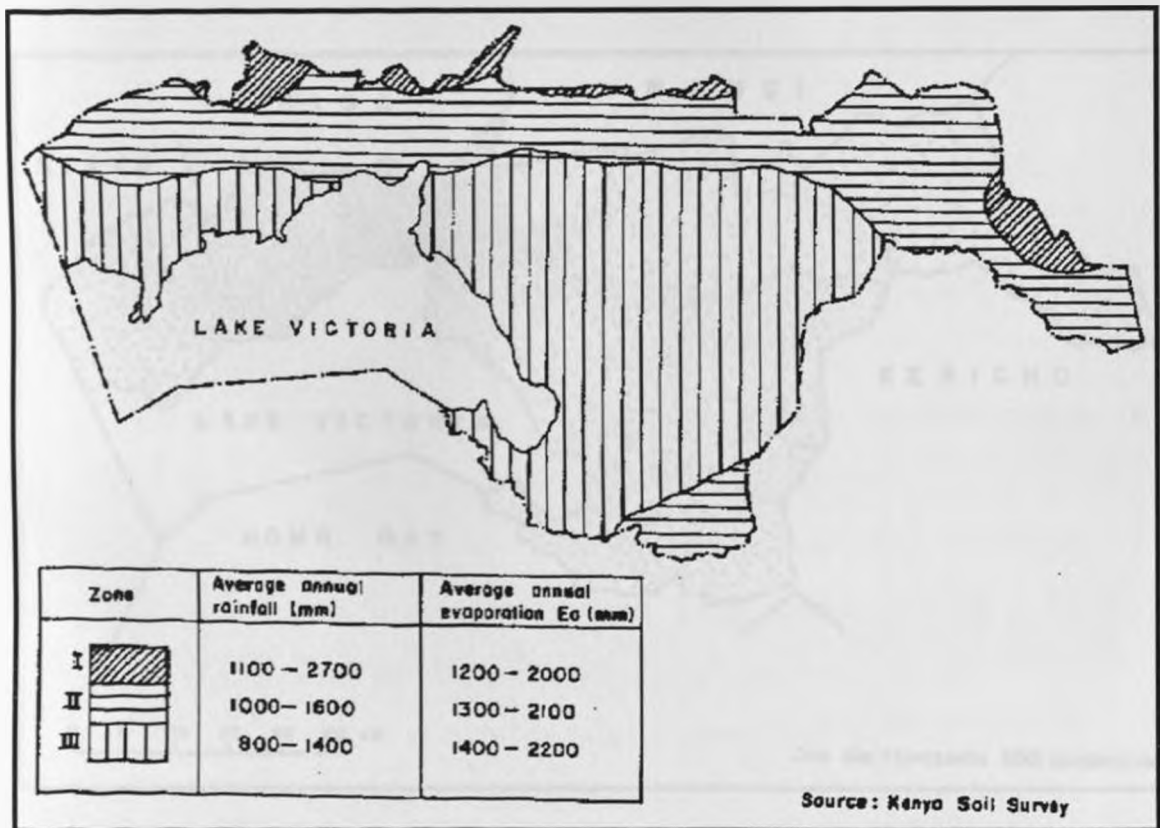


Fig. 5: Agro-climatic zone map of Kisumu District.

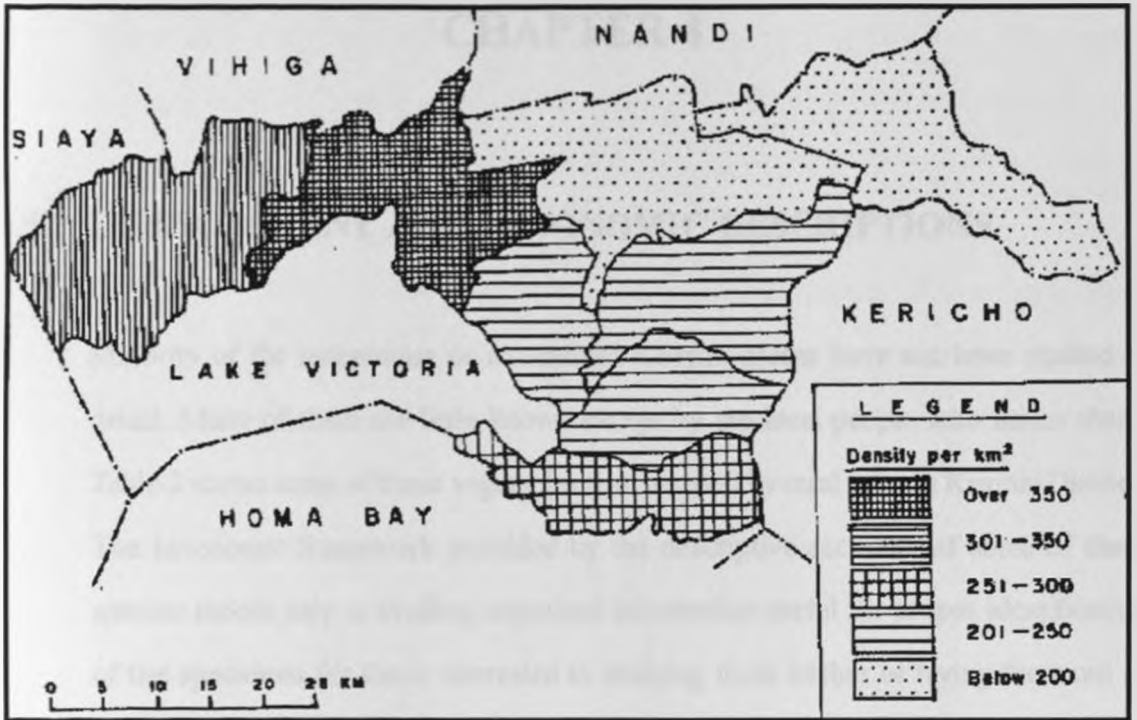


Fig. 6: Population density of Kisumu District (1989 census).

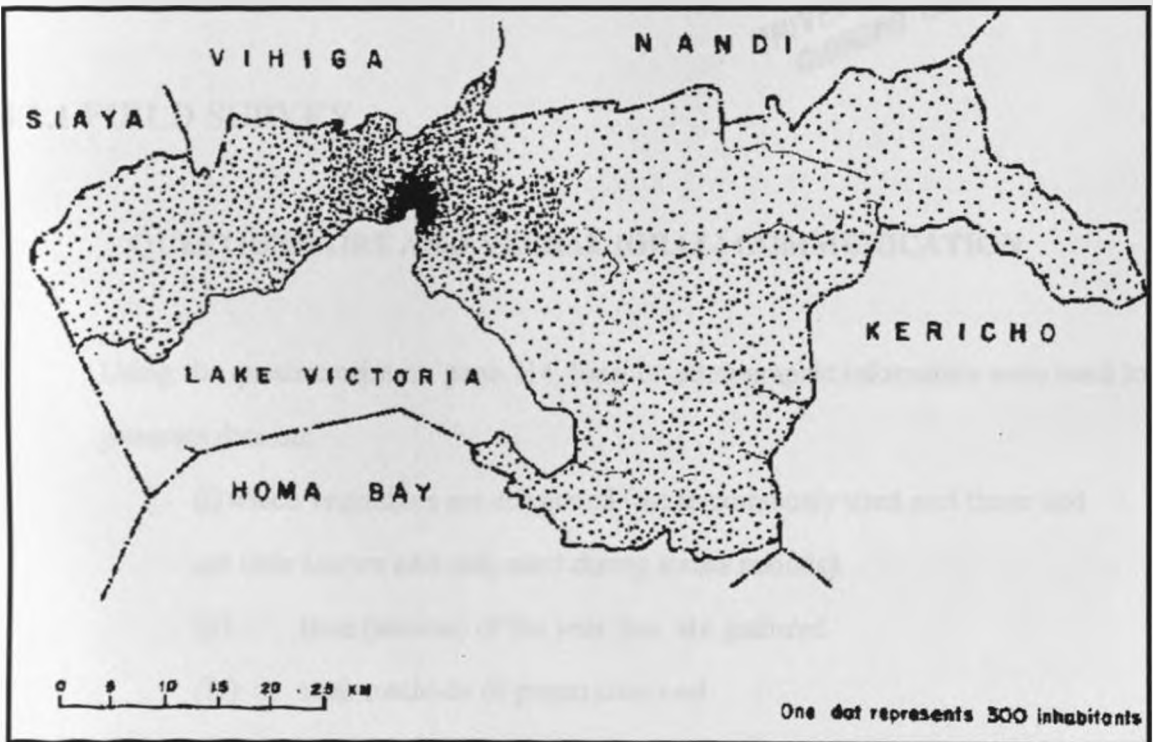


Fig. 7: Population distribution of Kisumu District (1989 census).

CHAPTER 4

4.0 ETHNOBOTANY AND TAXONOMIC DESCRIPTIONS

Majority of the indigenous or naturalized Kenyan greens have not been studied in detail. Many of them are little known except by the local people who utilize them. Table 2 shows some of these vegetables that are used by rural folks in Kisumu District. The taxonomic framework provided by the descriptive accounts of some of these species should help in availing organized information useful for proper identification of the specimens for those interested in studying them further or trying them out as vegetables.

4.1 METHODS OF SURVEY

4.1.1 FIELD SURVEY

QUESTIONNAIRE AND VERBAL (ORAL) COMMUNICATION

Using the questionnaire on page 114, local or ethnographic informants were used to generate data on:

- (i) which vegetables are consumed (those commonly used and those that are little known and only used during stress periods).
- (ii) time (season) of the year they are gathered
- (iii) their methods of preparation and
- (iv) their traditional uses in general.

UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

The work was carried out in Kisumu District of Nyanza, Western Kenya. The regions covered included Kisumu rural - Seme, between July to August 1992/1994 and Kano -Nyakach areas in April - May 1993 and July - August 1994.

Sometimes I had to deviate from the questionnaire when it tended to be restricting/limiting to informants. Much of the material was gathered from women. This is because women in the study area are the traditional gatherers and cooks.

In Kano (Korowe-Rabuor region) the main informants were Amimo Maritha (49 years), Phoebe Otieno (38), Dorcas Bodo (29), Awino Kasuku (38), Stella Awuondo (65) and Wilkister Mumbo (63).

Kisumu - Seme region had Magdalene Obunga (40), Janet Obosi (42), Wilfrida Moth (35), Mrs. Ochieng (Nyakano - 37) and Florence Onyango (32). School children, with the help of their teachers also helped in gathering the required information from their mothers and relatives.

Plant specimens were collected mainly from Seme (near Maseno) and Kano in the open fields, forests and local gardens with the help of the informants who also provided the local names. Seme was rich in diversity of the vegetables. Data was cross-checked with the help of informants from other areas of Nyanza (Nyakach, Kisumu rural and even other close districts like Siaya).

Threats to the plants survival were identified through field observations and domestication, these were mainly:

- (i) weeding out (in farmland),
- (ii) construction of roads, paths, buildings and small factories,
- (iii) floods,
- (iv) deforestation.

Table 2: Indigenous vegetables of Kisumu District.

FAMILY	SCIENTIFIC NAME	LUO NAME	STATUS	HABIT
ACANTHACEAE	<i>Asystasia gangetica</i>	Atipa	L.K	Herb
	<i>A. mysorensis</i>	Atipa	W.K	"
	<i>Justicia flava</i>	Nyar ner atipa	L.K	"
	<i>J. metammensis</i>	Piu piu	"	"
	<i>Thunbergia alata</i>	Nyawend agwata	W.K	"
AMARANTHACEAE	<i>Achyranthes aspera</i>	Ayucha/Auch auch	L.K	Herb
	<i>Amaranthus graecizans</i>	Ododo	W.K	"
	<i>A. hybridus</i>	Omboga/Ododo	C	"
	<i>A. spinosus</i>	Akuthu	W.K	"
	<i>Celosia schweinfurthiana</i>	Tungu	L.K	"
	<i>C. trigyna</i>		L.K	"
BASELLACEAE	<i>Basella alba</i>	Ndemra/Nderma	W.K/C	Vine
CAPPARACEAE	<i>Cleome hirta</i>	Nyar ner dek	L.K	Herb
	<i>C. monophylla</i>	Deg dani		"
	<i>Gynandropsis gynandra</i>	Dek/Akeyo	C"	
CHENOPODIACEAE	<i>Chenopodium album</i>		L.K	Herb
	<i>C. opulifolium</i>	Nyatigo-tigo	L.K	"
COMMELINACEAE	<i>Commelina africana</i>	Angayo	W.K	Herb
	<i>C. benghalensis</i>	Odielo	W.K	"
COMPOSITAE	<i>Bidens pilosa</i>	Onyiego/Nyanyiek mon	W.K	Woody
	<i>Galinsoga parviflora</i>	Osieko	L.K	Shrub
	<i>Sonchus oleracea</i>	Achak	W.K	Herb
	<i>Tridax procumbens</i>	Ofuch apuoyo	L.K	"
CONVOLVULACEAE	<i>Ipomoea aquatica</i>	Deg pi	L.K	Vine
	<i>I. cairica</i>	Nyaboro	W.K	Creepers
	<i>I. batatas</i>	Mraw/Obok rabuon	C	Vine
	<i>I. eriocarpa</i>	Nyawend agwata	L.K	Creepers
CUCURBITACEAE	<i>Cucumis sativus</i>	Budho	C.	"
	<i>Coccinia udoensis</i>	Mutkuru	L.K	Vine
	<i>Cucurbita maxima</i>	Budho	C	"
EUPHORBIACEAE	<i>Acalypha volkensii</i>	Dindi	W.K	Shrub
	<i>Erythrococca bongensis</i>	Hariadho/Siriadho	W.K	"
	<i>Manihot esculenta</i>	Muogo/Mariwa	C	"

Table 2(cont): Indigenous vegetables of Kisumu District.

FAMILY	SCIENTIFIC NAME	LUO NAME	STATUS	HABIT
LEGUMINOSAE	<i>Arachis hypogaea</i>	Njugu	C	Herb
	<i>Cajanus cajan</i>	Mbas	C	Shrub
	<i>Senna bicapsularis</i>	Ang'or	W.K	"
	<i>Cassia occidentalis</i>	Nyayado/Ohingla tiang'	W.K	Herb
	<i>Crotalaria brevidens</i> var. <i>intermedia</i>	Mitoo/Mtoo	W.K/C	"
	<i>Phaseolus coccineus</i>	Bo	W.K	"
	<i>Tephrosia pumila</i>	Nyang'or	W.K	"
	<i>Vigna unguiculata</i>	Bo	W.K/C	Trailing
MALVACEAE	<i>Hibiscus esculentus</i>	Dania madongo	C	Herb
	<i>Sida alba</i>	Nyayuora	W.K	"
	<i>S. acuta</i>			
ONAGRACEAE	<i>Ludwigia stolonifera</i>	Obera/Nyasugumba	W.K	Herb
OXALIDACEAE	<i>Oxalis corniculata</i>	Awayo	W.K	Herb
PEDALIACEAE	<i>Sesumum angolense</i>	Onyulo madongo	W.K	Herb
	<i>S. angustifolium</i>	Onyulo matindo		
	<i>S. indicum</i>	Nyim	C	
POLYGONACEAE	<i>Oxygonum sinuatum</i>	Nyatiend gweno	W.K	Herb
PORTULACACEAE	<i>Portulaca oleracea</i>	Obwanda	W.K	Herb
SOLANACEAE	<i>Capsium frutescens</i>	Pilipili/apilo/hamlar	W.K	Herb
	<i>Nicandra physaloides</i>	Osuga (mar wasungu)	L.K	"
	<i>Physalis peruviana</i>	Nyatonglo	L.K	"
	<i>Solanum nigrum</i>	Osuga (Nyaluo)	C/W.K	"
TILIACEAE	<i>Corchorus africana</i>	Apoth	W.K	Herb
	<i>C. olitorius</i>	"	W.K/C	"
	<i>C. trilocularis</i>	"		"
ZYGOPHYLLACEAE	<i>Tribulus terrestris</i>	Okuro	L.K	Trailing

(L.K. - Little Known, W.K - Wild but known, C-Common)

4.1.2. HERBARIUM WORK

Standard herbarium techniques were used for collection, identification and mounting of plants to be used as voucher specimens. East African Herbarium (EA) and Nairobi University Herbarium (NAI) were used for confirmation of the species scientific names, with the help of Simon Mathenge and Onesmus Mwangangi. Photographs of the plants together with the voucher specimens in the herbaria helped in the identification.

4.1.3 FIELD TRIALS

An attempt was made to propagate some of these vegetables. Their seeds were broadcasted though sowing in lines can also be done especially when growing them with other crops.

Collected seeds of *Amaranthus hybridus* were sown on a small plot (plate 1b, page 43). The first harvest after one and a half months produced relatively larger leaves compared to what is observed. Unfortunately, an unknown person harvested all the leaves before photographs were taken. But after two weeks, the plants had again developed foliage. Therefore, when harvesting is controlled, the plants can do much better, especially if done on fortnight basis. Intercropping with other crops is also possible though the yields may be slightly lower.

Deflowering the plants during growth period increases their leaf yields and extends the harvesting period.

4.2 TAXONOMIC DESCRIPTIONS OF THE VEGETABLES

The morphological descriptions given under this heading have been based on an ex-

amination of living material of the individual plants, herbarium specimens and for some, published descriptions.

The plants have been arranged alphabetically according to families and species.

Figure 8 attempts to show the general distribution of each vegetable species described in the following taxonomic accounts. The map is an old figure designed in the 1950's when the revision of the Flora of the Tropical East Africa was initiated by the British Government during their rule in East Africa. The same map is still being used in the publication of the Flora parts to-date, hence the need to follow the same sequence. Kisumu District is in K5 according to this map.

ACANTHACEAE

1. *Asystasia mysorensis* (Roth.) T. Anders.

Syn. *Asystasia schimperi* T. Anders.

Local Name: Atipa (Luo).

Botanical Description

A much branched annual (rarely perennial) herb 10-30 cm long/high; stem erect or scrambling; tap root present leaves are opposite, obovate or elliptic, with stalks and pubescent. Inflorescence a terminal spike of white flowers of which only 1 to 3 per spike are usually open at any time; corolla funnel-shaped up to 14 mm long, often with green or brown markings on the lobes; bracts surrounding the flower are longer and broader than the sepals; no flower stalk. The fruit is a capsule splitting when ripe to release 1-4 seeds; seeds are rough, flattened and irregularly shaped, about 4mm long, ornamented and light to dark brown.

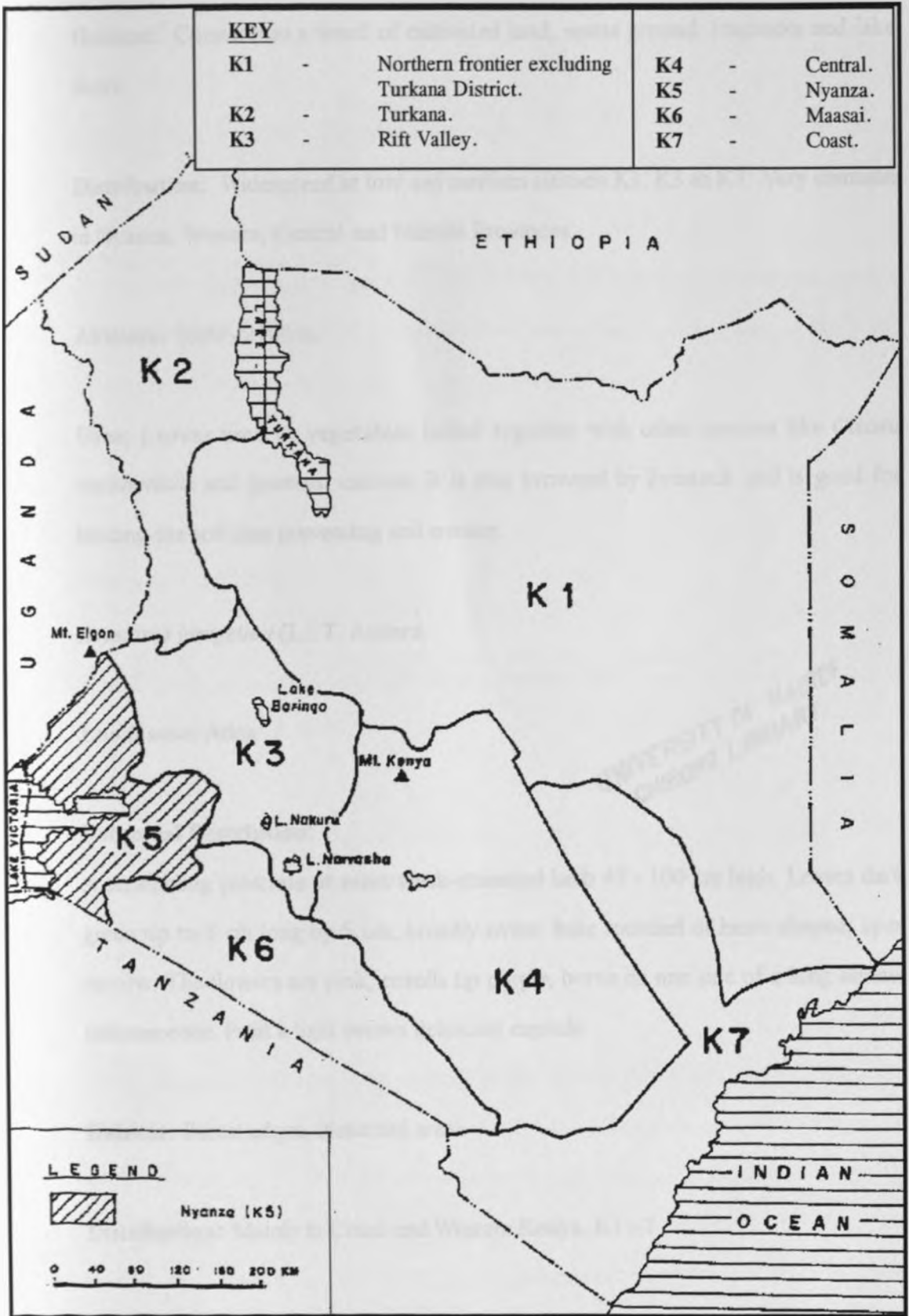


Fig. 8: Geographical divisions of Kenya as used in the flora of tropical East Africa.

Habitat: Common as a weed of cultivated land, waste ground, roadsides and lake shore.

Distribution: Widespread at low and medium altitude K1, K3 to K7. Very common in Nyanza, Western, Central and Nairobi Provinces.

Altitude: 1600 - 2100 m.

Uses: Leaves used as vegetables boiled together with other species like *Cassia occidentalis* and *Ipomoea cairica*. It is also browsed by livestock and is good for binding the soil thus preventing soil erosion.

2. *Asystasia gangetica* (L.) T. Anders.

Luo Name: Atipa

UNIVERSITY OF NAIROBI
CHIRONG LIBRARY

Botanical Description:

A scrambling prostrate or erect weak-stemmed herb 45 - 100 cm high. Leaves dark green up to 8 cm long by 5 cm, broadly ovate, base rounded or heart-shaped, apex narrow. The flowers are pink, corolla tip purple, borne on one side of a long slender inflorescence. Fruit a light brown dehiscent capsule.

Habitat: Forest edges, disturbed areas

Distribution: Mainly in Coast and Western Kenya, K1 - 7

Uses: In Kenya, the plant is eaten as a vegetable in the same way that *A. mysorensis* is used. It is also browsed by ungulates, and the leaves are crushed, boiled in water and the decoction drunk as a cure for intestinal worms (Kokwaro, 1993).

3 *Justicia flava* (Forssk.) Vahl.

Luo Names: Nyar ner atipa; Atipa omlongo.

Botanical Description:

An erect or straggling perennial herb to about 1 m high; leaves ovate, pointed, usually 4 - 6 cm long; spikes dense, terminal and the flowers bright yellow; 8 to 11 mm long, subtended by linear to lanceolate bracts; capsule to 9 mm long.

Habitat: Farmland, roadsides, waste ground.

Distribution: Widespread, K 1 - 7.

Altitude: 1 - 2260 m.

Uses: Leaves are burnt to ash to produce a vegetable salt. Fresh leaves are also occasionally used as a pot-herb.

4. *Justicia anselliana* (Nees) T. Anders.

Syn. *Justicia metammensis* (Schweinf.) Oliv.

Local names: Piupiu; yadh sasia (Luo)

Botanical Description:

A hairy annual with extending or erect stems and elliptic to obo-lanceolate leaves; spikes usually four-flowered. Flowers in a single row on one-sided axillary leafless spikes. Stems with 2 lines of pubescence on each internode, peduncles rarely reflexed in fruit. Leaves broader and usually lacking the marginal hairs, the leaves are less than 4 cm long, oblong to elliptic; sepals globus; largest sepal under 5.5 mm long; capsule finely pubescent all over.

Habitat: Common in sandy soil in disturbed bushland.

Distribution: K1 - 7.

Altitude: 1300 - 2200 m.

Uses: Leaves used as vegetable, together with other *Justicia* species.

Other Uses: The plant is believed to be used by women to cause quarrels in their co-wives houses (sasia). The plant is uprooted and fixed somewhere in the house to perform this job (Rus).

5. *Thunbergia alata* Bojer ex Sims.

Common Names: Black-eyed susan, Susana (English).

Local Name: Nyawend agwata (Luo)

Botanical Description:

Twining perennial herb with triangular to lanceolate or ovate petiolate leaves having a cordate base with hastate or rounded lobes and broadly or very narrowly winged petiole form two fifths of the length of the lamina to equalling it; flowers usually orange but local forms with white, yellow or red corolla limb and purple tube do occur; seeds reticulate at maturity (Agnew, 1994).

Habitat: Bushland and thicket, usually in partial shade, farmlands, grasslands, roadsides and waste ground.

Distribution: K1 - 7.

Altitude: 100 - 3000 m.

Uses: With other indigenous vegetables, it is boiled to make mixed vegetable “aboka” or “atwago”.

Other Uses: Leaves crushed and added to water. The liquid is then given to children with pains in the mouth and tongue to drink. Leaves pounded, mixed with ghee, then used for treatment of hydrocele, backache and pains in joints. Leaf juice applied on skin diseases.

AMARANTHACEAE

1. *Achyranthes aspera* L.

Common Names: Rough chaff flower, Devil's horsehip (English)

Local Names: Ayucha, Auch-auch (Luo)

Botanical Description:

An annual or perennial scandent herb with opposite ovate-obtuse to lanceolate - acute more or less pubescent leaves tapering at both ends and shortly stalked. The stems tough, becoming woody at the base. Flowers are small, white, pink or reddish-green in colour, forming dense terminal spikes. (Agnew, 1994).

Habitat: Common weed in the vicinity of villages, hedges, roadsides and shaded habitats.

Distribution: Indigenous plant found widespread in many parts of Africa. K5,7.

Altitude: 1-3080 m.

Uses: Leaves edible but not so commonly used in Kisumu District.

Other Uses: Leaves used medicinally to treat colds, they can also be dried by fire and ground up then the powder, mixed with commercial salt, is applied on cuts made with a blade, in cases of ankle sprains. The roots are chewed and applied on

cuts to stop bleeding. The root decoction eases constipation in children and cures stitch (Kokwaro, 1993).

It is also medicine for headaches; the ash of burned leaves is applied on boils and also used for warding off evil spirits. Pounded root is steeped in hot water, and the extract drunk cold as a cure for venereal disease. The roots with those of *Albizia coriaria* and *Lannea stuhlmanii* is made into a decoction and drunk for general illness.

Amaranthus spp.

There are about 60 species of *Amaranthus* in the world. Out of these, 13 have been reported to be occurring in the wild in Kenya. More have been recently introduced by research workers (NAS, 1975).

Various species are generally called by the names “omboga” or “ododo” in Luo land. Among Kenyan and most African communities, Amaranths are a major traditional vegetable. Though much of it is still collected from the wild and continue to be termed as weeds, virtually all the thirteen species are used as a vegetable, some rarely though. Probably, the earliest species to be used as a source of food amongst most Kenyan ethnic groups are *Amaranthus thunbergii*, *A. sparganiocephallus* and *A. graecizans* (NAS, 1975). The first two are most likely indigenous to the country and no cultivation of these species has taken place. The other species have been introduced, mostly from America and a large number have become naturalized, these too are now adopted and used in the same way as all the native ones.

Majority are used as a spinach, in most cases boiled and fried together with other indigenous vegetables and even exotic ones like kale and spinach. In Kenya, the seeds are not commonly used as a source of grain.

The vegetables are mostly picked from the wild. Others are picked from the gardens where they sprout by themselves but are spared during weeding. Deliberate planting may be done near the home by broadcasting. Health workers are currently using the Amaranths to counter malnutrition in various communities in Kenya (Patrick Maundu, Pers. Comm. 1994). They are a popular choice for people during convalescence, especially mothers during pregnancy and after delivery.

2. *Amaranthus graecizans* L.

Common Names: Amaranth, tumble weed (English).

Local Names: Omboga/Ombok alikra (Luo).

Botanical Description:

A small erect or decumbent annual herb up to 70 cm high with few or no hairs. It has a tap root and the leaves are variable from elliptic to obovate, up to 4 cm long and 2 cm wide, with a finely undulate margin, tapering into the leaf stalk.

Inflorescence consists of flower clusters up to 5 mm in diameter, always in leaf axis; perianth members (sepals) on female flower 3, 1-1.5 mm long with very short, pointed tips. The fruit is a capsule, splitting around the middle. Seeds are lens-shaped, 11.5 mm in diameter, shiny black and sharp edged.

Habitat: Roadside, weed of cultivation and forest edges, along river banks etc. Can grow in partially shaded areas under trees.

Altitude: 1 - 2000 m.

Distribution: Found in both dry and humid lands and from sea-level to about 2000m. It is found all over Kenya, K1-7.

This is Kenya's tastiest Amaranth.

Uses: In Luo land, the leaves and young tender shoots are mixed with other species like *Gynandropsis gynandra*, *Vigna* spp. etc. Though the leaves of this species are small and getting enough for a meal takes a bit of time, this vegetable is reputed to be the most palatable amaranth in Kenya. The Turkana and Pokot eat the boiled vegetable with butter or milk. The species is also good fodder for livestock.

Propagation: Rubbing the flower heads with the hands releases the seeds. Passing a light current of air through them cleans them of the particles. The seeds are planted by broadcasting and sowing should be done soon after the onset of the rains; the vegetable can be intercropped with other species as it is shade tolerant. In the wild, this Amaranth sprouts easily soon after the onset of the rains, grows fast, seeds dry as fast, hence, it is mostly common in dry areas.

3. *Amaranthus hybridus* L. (see Plates 1a and 1b).

Syn. *A. hypochondriacus* L.

A. patulus Bertol

Common Names: Smooth pigweed, Amaranth, Chinese spinach (English).

Local Names: Ododo/Omboga (Luo).

Botanical Description.

Erect annual herb up to 150 cm high, much branched smooth and sparsely hairy stem, green but sometimes wholly or partly red in colour, often ribbed. Below grounds a deep tap root. The leaves are alternate, lanceolate to ovate, up to 6 cm long and 3 cm wide, tapering at the base into a stalk upto 5 cm long. Inflorescence is a raceme, spike-like, slender (less than 1 cm wide) and leafless towards the tip; flowers are small 2 mm across, in dense clusters with male flowers at the apex of the raceme and female flowers below. The fruit is a capsule splitting around the middle. The seeds are lens shaped about 1 mm wide and shiny black.

A. hybridus occur as 2 sub-species, *A. hybridus* ssp. *hybridus* and *cruentus* but the latter is rare.

Habitat: Found on farmlands as a weed of cultivation and close to homesteads; along rivers and forest edges in humid to sub-humid areas.

Distribution: Widespread, K1-7.

Altitude: 900 - 2000 m.

Uses: Commonest and the most widely used Amaranth as a vegetable with other wild species, sometimes even cultivated in most areas. Much of it is picked from the wild though occasionally the species is spared when found growing as a weed. The vegetable has a high palatability and the leaves are capable of growing very large when apical dominance is reduced. This makes it a very popular vegetable. It thrives during the rainy season and after and leaves are occasionally sold in big cities (Nairobi, Kisumu, Mombasa) and other markets throughout the country.

Propagation: *A. hybridus* grows easily from the small hard black seeds which can be grown by broadcasting or in lines made at 30 cm intervals. Seeds germinate after a few days.

Closely related species, also used as vegetables in Kenya are:

A. dubius Mart (leaves to tip of raceme; sepals of female flower 5, blunt-tipped).

A. lividus L. (raceme leafless near apex; sepals of female flower 3. Leaf apex bilobed).

A. spinosus L. (Raceme leafless near apex; sepals 5 with a long point at the tip; plant usually sprawling on the ground). The latter is also very common in Kisumu.

4. *Amaranthus spinosus* L.

Common Name: Spiny pigweed.

Local Name: Akuthe, Ombok akuthe (Luo).

Botanical Description:

An erect, sparsely branched glabrous annual herb to 1m height; the pair of prophylls in the axil of every leaf frequently thickened into spines; leaves ovate- lanceolate; inflorescence a terminal panicle of spike-like racemes of cymes.

Habitat: Near livestock enclosures, in abandoned settlement, along streams, roadsides, open grasslands and as a weed of cultivation.

Distribution: The species is widely distributed in Kenya, K1-7.

Altitude: 1 - 1900 m.

Uses: Occasionally used as a vegetable in the same way as the other Amaranth species.

5. *Celosia trigyna* L.

Common Name: Silver spinach (English).

Local Name: Tungu, Kitungu (Luo).

Botanical Descriptions

Erect straggling and glabrous or sparsely puberulent annual with ovate leaves and compound terminal racemes of widely spaced cymes of pink or white flowers; stems five-sided and grooved, the weaker branches becoming prostrate. Seeds black and small \approx 4 per fruit.



Plate 1a: *Amaranthus hybridus* intercropped with *Brassica oleracea* var. *acephala*.



Plate 1b: *Amaranthus hybridus* growing at Nairobi International Show ground, (1996).

Habitat: Waste grounds, roadsides.

Distribution: K3,4,5, and 7.

Altitude: 1 - 1900 m.

Uses: The young shoots are boiled together with other vegetables like the *Amaranthus* and even kale.

Other uses: It treats abdominal pains during periods and after delivery (RUS).

6. *Celosia schweinfurthiana* Schinz.

Luo Name: Tungu (Luo).

Botanical Description

Annual or perennial, glabrous, prostrate or scrambling herb with ovate to lanceolate leaves and terminal as well as accessory racemes of well-spaced cymes of pedicellate cream flowers.

Habitat: Climber at forest edges.

Distribution: K1,3,4,5,6, and 7.

Altitude: 1 - 1650 m.

Uses: Leaves, young stems, and young inflorescence are eaten as a pot herb. Much of the pigment is lost on cooking and dark cooking water is produced. Never the less, leaves retain a pleasant green colour. They soften up readily and should not be overcooked. Texture is somewhat soft, and flavour is very mild and spinach-like. Bitterness is entirely lacking.

UNIVERSITY OF NAIROBI
CHIROMBO LIBRARY

BASELLACEAE

1. *Basella alba* L. (see Plate 2).

Common names: Indian spinach, Malabar spinach, Ceylon spinach, Soap spinach (English).

Local names: Nderma/Ndemra (Luo).

Botanical Description

A soft twining perennial plant, stems fleshy green often tinged brownish purple. Leaves heart shaped with a pointed tip; soft, shiny, dark green, blade up to 10 cm long or more; flowers small fleshy cream or white borne on erect inflorescence. *B. rubra* is a red coloured garden variety.

Habitat: Forest, forest edges, wet rock cliffs, sometimes planted on hedges in towns and homes. Some cultivated forms with relatively thicker stems and larger leaves are probably from South Asia.

Distribution: K1, 3, 4, 5, 6.

Altitude: 1 - 3000 m.

Uses: The leaves and young shoots are used as vegetables in Kisumu District and in most parts of Kenya. They are usually cooked together with the coarse vegetables due to its mucilaginous properties.

Other Uses: Leaves are also given to cattle to increase milk. They are also used against constipation in animals.

Propagation: Stem cutting used for propagation.

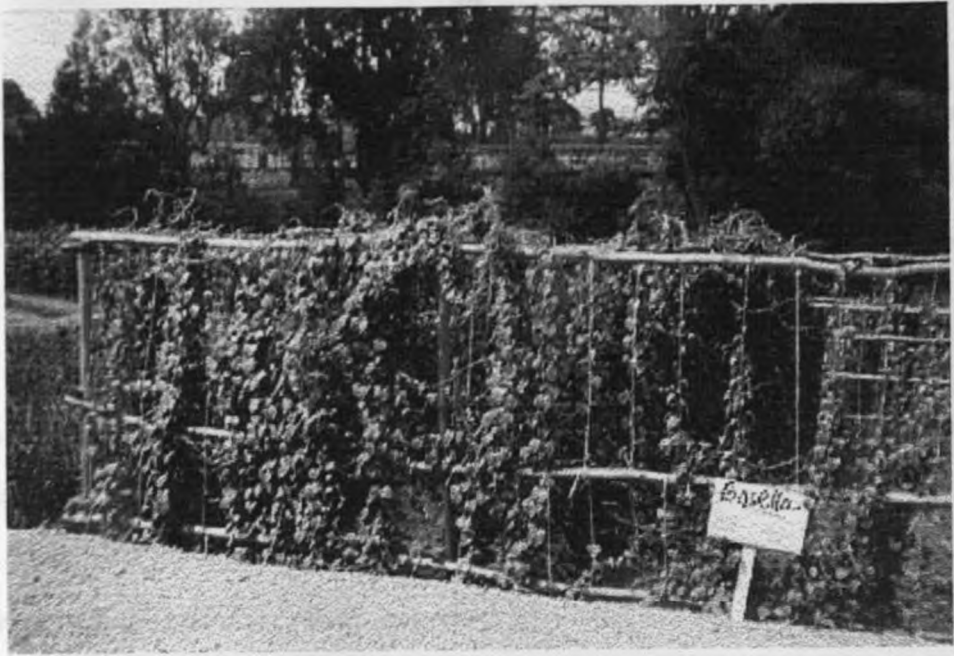


Plate 2: *Basella alba* growing at Nairobi International Show Ground (1996).

CAPPARIDACEAE

1. *Cleome monophylla* L.

Local Names: Deg dani/Nyar ner akeyo (Luo).

Botanical Description:

A hairy erect herbaceous annual 30-60 cm high, leaves simple 2.5 - 8 cm long and narrow, flowers in racemes on slender stems, small, white to pink with a dark spot at the base.

Habitat: Weed of cultivated land, common around villages, especially near cattle kraals.

Distribution: K1 - 7.

Altitude: 30 - 2100 m.

Uses: In Kisumu the leaves are liked, and they are mixed with *Gynandropsis gynandra* or *Amaranthus* spp. to make a nice spinach. The young shoots and blades of older leaves are cooked with tomatoes. Vitamin C content of the leaves is 4.3 mg / 100 gm on a dry weight basis (Burkill 1985).

Other Uses: Whole shoot used as cooked vegetable is considered as good medicine for stomach/gastrointestinal troubles (RUS).

2. *Gynandropsis gynandra* (L.) Briq. (see Plate 3).

Syn. *Cleome gynandra* L. *C. pentaphylla* (L.).

Common Names: Spider weed/cat's whiskers, bastard mastered, African spider flower (English).

Local Names: Akeyo, Dek (Luo).

Botanical Description

Annual herb with a tap root system. Erect up to 90 cm high, much branched, covered in sticky glandular hairs. Leaves alternate on stalks 3 - 11 cm long, palmately compound, with 5 (sometimes 3-4) sessile, obovate, leaflets up to 10 cm long, with entire or finely toothed margins. Inflorescence a terminal raceme bearing stalked flowers which arise slightly in the axils of small leafy bracts; flowers white or pale pink, 2.5 cm across. Petals up to 1.8 cm wide, spindle-shaped, splitting lengthwise, seeds around 15 mm in diameter.

This is probably one of the most popular of all wild vegetables.

Habitat: Common in waste land, roadsides, weed of cultivation and abandoned homesteads.

Distribution: Widespread all over Kenya, K1 - 7.

Altitude: 1 - 2400 m.

Uses: Widely used as a vegetable; leaves and even the flowers are consumed especially in the Western and Coastal regions. Leaves are bitter but well liked, especially when mixed with other vegetables such as kale, spinach, *Amaranthus*, or *Solanum nigrum*.

In Luo land milk is added and left overnight in a pot to reduce the bitterness. Sometimes the leaves mixed with *Amaranthus* are mashed and fried. This is considered a very nutritious meal for women mostly before and after child birth.

This vegetable helps as a cure for constipation. The leaves are considered very good for the stomach and to have antiscorbutic properties. Their vitamin C content has been recorded at 6.0 mg per 100 gm dry weight (Watt & Breyer Brandwijk, 1969). They are rich in mineral content of aluminium (1,399 ppm) and of iron (470 ppm).

Other Uses: All stock browse it readily in Kenya. The younger softer leaves are pounded and the resulting liquid squeezed into aching ears. Same liquid is poured into the ears, nostrils and eyes in case of epileptic fits. Roots are boiled and decoction drunk to facilitate birth; for stomachache, and for treatment of conjunctivitis and severe infections by thread worms (Kokwaro, 1993). The root infusion is used against chest pain. The leaves have medicinal uses everywhere they occur, mostly as a counter irritant for local pain, the leaves being merely rubbed on the part affected or applied as a poultice.

Propagation: Is done by seed either by broadcasting or planting in lines. It is cultivated in small gardens in the homes.

Closely related species which are also used as vegetables are:-

Cleome hirta (Klotzsch) Oliv. (leaves with 5 to 9 leaflets; petals, purple or pink), and, *Cleome monophylla* L. (leaves inclined, narrowly, oblong, petal pink or mauve).



Plate 3a: *Gynandropsis gynandra* growing at Nairobi International Show ground, (1996).



Plate 3b: *Gynandropsis gynandra* growing wild at an open field in Kisumu District.

CHENOPODIACEAE

1. *Chenopodium album* L.

Common Name: Fat hen, Goose foot (English).

Local Name: Tinga (Luo).

Botanical Description:

Annual, grey-mealy herb; leaves very variable mostly longer than broad, rhombic to lanceolate, inflorescence of dense rounded terminal clusters.

Habitat: Common weed of cultivation.

Distribution: K3, 4, 5, 6.

Altitude: 1650 - 2600 m.

Uses: Sparingly utilized as a vegetable. The young leaves and shoots are boiled and fried to be used as a pot herb and spinach (RUS).

2. *Chenopodium opulifolium* Schrad. ex Koch. & Ziz.

Common Name: Round-leaved goose foot (English).

Local name: Tinga/Tinga tinga, Nyatigo tigo (Luo).

Botanical Description:

Grey-mealy annual or perennial herb, often woody below; leaves mostly broad or short-rhombic-ovate; the inflorescence of dense terminal clusters.

Habitat: Common as a weed of cultivation, roadsides and waste places.

Distribution: Widespread, K1-7.

Altitude: 760 - 2300 m.

Uses: Leaves cooked together with *Amaranthus* spp. and fried to make it more palatable. Leaves are also said to be good for treating constipation (RUS).

COMMELINACEAE

1. *Commelina africana* L.

Local Name: Angayo/Ngaya ngaya (Luo).

Botanical Description

A small herb with usually prostrate to ascending branches and thickened fibrous roots; spathes single; flowers rarely white.

Habitat: Grassland, disturbed areas and cultivated land.

Distribution: K2, 3, 4, 5, 6.

Uses: In Kisumu the leaves are cooked and eaten as a vegetable and the plant is grazed by all stock.

Other Uses: In Kwale District, an infusion of the plant is used as a wash to reduce fever.

2. *Commelina benghalensis* L. (see Plate 4).

Common Name: Wandering jew (English).



Plate 4: *Commelina benghalensis* growing at a field in Kisumu District.

Local Name: Odielo (Luo).

Botanical Description:

A herb with ascending or erect branches with usually petiolate and oblique-based leaves. Two forms occur: One with narrow leaves and white hairs on the sheath margins; the other with broad leaves and purple or orange hairs on the sheath margins.

Habitat: Common in wet areas and in shady places during the rainy seasons. Found also in farmland, on roadsides and waste places (disturbed habitats).

Distribution: Widespread, K1-7.

Altitude: 10 - 2600 m.

Uses: The plant has edible leaves used as a relish during dry seasons or at the beginning of the rainy season when the growth is new and fresh but once they mature they are regarded as too acidic and bitter to use.

The plant is succulent and mucilaginous, and resists desiccation. The sap is used for ophthalmia, sore-throat and burns. Liquid from the flower- spathe is used for eye-complaint and in topical application to thrush in infants.

COMPOSITAE

1. *Bidens pilosa* L. (see Plate 5).

Common Names: Black jack (English).

Local Name: Onyiego/Nyanyiek mon (Luo).

Botanical Description:

An erect annual up to 1.5 m high, stem and branches quadrangular, leaves ovate mostly pinnately lobed, disk florets yellow, ligule of ray florets white. Fruiting heads of black barbed racemes which cling tenaciously to clothing.

Habitat: Cultivated land, waste ground/open disturbed ground.

Distribution: Extremely widespread, especially in warm areas. Native of S. America but now naturalized in several areas. K1 - 7.

Altitude: 296 - 2400 m.

Uses: Rarely used as “aboka” (boiled together with other vegetables) in Kisumu District. Commonly used in other parts of Africa where the whole shoot is cooked,



Plate 5: *Bidens pilosa*. Vegetable picking stage.

while in older plants only the leaves are used. Groundnuts and tomatoes are added when available. It is frequently eaten throughout the year because of its abundance and the ease with which it is cooked. It is readily browsed by all domestic stock including poultry and has a high nutritive value.

Other Uses: The leaf sap is squeezed into eyes to treat coughs and jaundice (Kisumu, Kenya).

2. *Galinsoga parviflora* Cav.

Common Name: Gallant soldier (English).

Local Name: Osieko (Luo).

Botanical Description:

An annual herb with shallow fibrous roots. The stem is erect, upto 6cm high, much branched, slightly hairy. Leaves opposite, up to 6 cm long and 4 cm wide, simple, ovate, slightly hairy with 3 distinct veins converging at the base with margin shallowly toothed. Inflorescence consists of flower heads 5 - 8 mm in diameter on stalks 12 - 25 mm long, a regular branched, loose, leafy inflorescence at the stem apex and from upper leaf axis; flower heads 4-5 white, lobed ray florets, surrounded by membrane bracts. The fruit is an achene, angled or flat, black, slightly hairy, about 1.5 mm long, with a pappus of flat, fringed scales about 1.5 mm long.

Habitat: Common as a weed of most crops and wasteland.

Distribution: Widespread, K1 - 7.

Altitude: 300 - 2300 m.

Uses: It is mentioned as one of the herbs mixed with other vegetables to make “aboka” (vegetable mixture) in Kisumu District, but it is not so commonly used though it is very abundant in the area. It is more used as food for small animals like rabbits.

3. *Launaea cornuta* (Hochst. ex Oliv. & Hiern) C. Jeffrey.

Common Name: Wild lettuce (English).

Local Name: Achak (Luo).

Botanical Description:

This is a perennial herb with fibrous roots from base of stem and from rhizomes. The stem above ground is erect up to 1.2 m high, usually unbranched beneath the inflorescence and hairless; below ground it is a branched spreading rhizome. The leaves are arranged in a rosette at ground level and alternate on the stem; they are variable, up to 15 cm long, linear lanceolate or elliptic with 2-4 lobes and slightly

toothed margin: stalk is absent. The inflorescence is much branched, forming a terminal panicle of shortly stalked flower heads up to 8 mm across; the florets are strap-shaped pale yellow, surrounded in compact head by shorter bracts. The fruit is an achene about 5 mm long, with a pappus of long, white hairs.

Habitat: Found as farmland weed, also in waste areas on stony soil.

Distribution: K1 - 7.

Altitude: 20 - 2700 m.

Uses: Mixed with other indigenous vegetables to form “aboka”. The leaves are bitter and are used to flavour food. The cooking water is sometimes discarded.

Other Uses: In medicine, the plant is said to be useful in treating common stomach complaints and the sap is instilled into the ear for earaches. Leaf and root decoction is added for treating sore throat (RUS).

Propagation: By seeds or rhizomes.

4. *Sonchus schweinfurthii* Oliv. & Hiem

Local name: Achak (Luo).

Botanical Description:

An erect or prostrate herb usually 0.5 to 2m high, stems exuding a white latex. Leaves grey, green, narrow, long often with short lateral lobes, edges smooth, irregularly toothed, the teeth sometimes forming short curved points. Leaf base clasping the stem. Flower bright yellow, seeds winged at the tip.

Habitat: Roadsides, cultivated land, disturbed grassland and forest.

Distribution: Common in Western Kenya, K2, 3, 4, 5 and probably K1 and 6.

Altitude: 1200 - 2800 m.

Uses: Leaves cooked together with the other indigenous vegetables especially *Ipomoea cairica*, *Asystasia mysorensis* and *Tridax procumbens*. It is also good fodder for domestic animals and rabbits. The root decoction is used for treating chest problems (RUS).

CONVOLVULACEAE

1. *Ipomoea aquatica* Forssk.

Common Name: Swamp cabbage, Water spinach (English).

Local Name: Deg pi.

Botanical Description:

Prostrate or ascending much branched plant always associated with wetlands. Stems hollow, fleshy with white sap, dirty green, rather fat and with hairy roots arising from nodes when floating in water. Leaves triangular to heart shaped, up to 15 cm long. Apex usually pointed, petioles long; flowers mauve, purple or pink and tubular. Seeds pubescent.

Habitat: Wetlands - lake shores, swampy places, seasonally flooded land, rice fields, on mud etc.

Distribution: K1, 5 - 7.

Altitude: 30 - 1350 m.

Uses: The leaves are used by Luos as vegetable. The young tender shoots and leaves are used as spinach. Vines serve as food for most animals and also for fish.

It has a potential as a bank stabilizer. The plant contains about 90% water. Dry weight analysis shows about 48% carbohydrates, 24% proteins, 13% ash. It is rich in minerals and vitamins, (Burkill, 1985). In large amounts it could be a drastic purgative and toxic irritant.

Propagation: It is propagated by seeds and rhizomes. It grows vigorously and rapidly colonizes any suitable piece of water or damp ground.

2. *Ipomoea batatas* (L.) Lam.

Common name: Sweet potato (English).

Local names: Rabuon/Mraw (Luo).

Botanical Description:

Herb with underground fusiform edible tubers; stems mostly prostrate; leaves triangular in outline, truncate or cordate, entire to palmately shallowly to very deeply 3-5 lobed; inflorescence 1-several flowered; corolla lilac or violet-white above, bell-shaped 3 - 4.7 cm long. The sweet potato is probably South American in origin but it is very widely cultivated in the tropics and can occur as an escape. The plant is a long, trailing climber growing from deep, tuberous roots.

Habitat: Farmland, in cultivation.

Distribution: K 1, 3, 4, 5.

Altitude: 30 - 1660 m.

Uses: Both the roots and young shoots are edible. The roots may be boiled, baked, roasted or used in soups. Being high in carbohydrates, the roots are excellent energy-giving food.

The shoots may be eaten raw or cooked. In Kisumu they are eaten cooked. Burkill (1985) states that the vine may be used to feed stock but that it contains hydrocyanic acid and has been known to cause death when eaten in large quantities. In Nyanza, stock feed on them but the herders try to prevent them from feeding on the vines. The leaves are a good source of vitamins and minerals especially calcium and mostly in the purple-leafed varieties. They are antidiabetic and antiscorbutic.

3. *Ipomoea cairica* (L.) Sweet

Common Name: Railway creeper (English).

Local Name: Nyaboro (Luo).

Botanical Description:

Practically or quite glabrous, perennial twinning herb with smooth or warty stems: leaves ovate to round in outline, palmately divided to the base into 5 - 7 ovate to lanceolate or elliptic lobes up to 4 cm long and 1 cm wide, inflorescence lax, 1 - many flowered, corolla purple, red or white with a purple centre, funnel-shaped (3) 4.5 - 6 cm long, seeds with short tomentum and some long silky hairs.

Habitat: Forest clearings, swampy grassland, hedges, waste areas, cultivated ground and lake shores.

Distribution: Widespread at medium altitudes throughout Kenya and tropical Africa. K 1, 3, 4, 5, 6.

Uses: In Kisumu, Kenya, the leaves are picked and mixed with other vegetables, then boiled and fried with tomatoes, if available. The foliage is also eaten by wild animals and goats. It is also fed to rabbits. The violet-purple to white flowers are

attractive and used as ornamental. It can be trained up a post and has been much used as a screen in this manner, hence the name creeper.

4. *Ipomoea eriocarpa* R. Br. (see Plate 6).

Local Name: Nyawend agwata (Luo).

Botanical Description:

Annual twiner, with hairy stems, leaves ovate-cordate to linear-oblong, often sub-hastate pilose or glabrescent, 2.5 to 8 cm long; flowers (1-) to many flowered, usually almost sessile axillary inflorescence; corolla mauve, white or pink or white with a mauve centre, 6 - 9 centre mm long, capsule pubescent.



Plate 6: *Ipomoea eriocarpa*.

UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

Habitat: Disturbed places, cultivated land, roadsides.

Distribution: K4, 5, 6.

Altitude: 30-1350 m.

Uses: The leaves are boiled with other indigenous vegetables especially with other *Ipomoea* spp.

CUCURBITACEAE

1. *Coccinia adoensis* (A. Rich.) Cogn.

Local Name: Mutkuru (Luo)

Botanical Description:

A climber with angular grooved, smooth stem; the leaves are 5-lobed, 8 to 12 cm broad, bright green, studded with green papillae; flower orange-pink corolla 2.5 long; fruits ovoid 2.5 to 5 cm long with smooth, bright red skin.

Habitat: Grassland, often with *Acacia* spp.

Distribution: Widespread in East Africa.

Altitude: 1600 - 2300 m.

Uses: The blades of the leaves are mixed with pumpkin leaves, *Amaranthus* etc. The product is well liked and it is mostly utilized from August to December.

Other Uses: The leaves, with those of *Kigelia africana* ("Yago" in Luo) are pounded then mixed with water and used as a bath for treating sterility in men and women in Kisumu.

2. *Cucurbita maxima* Duch. ex. Lam. (see Plate 7).

Common Names: Pumpkin, Squash gourd (English).

Luo Names: Budho, Leaves - Sewewe/Susa.

Botanical Description:

Annual herb, rarely upright, generally trailing, vines up to 3m in length, stems slightly hairy, soft, cylindrical in cross-section; tendrils branched. Leaves dark green, mainly reniform, cordate, rarely lobed, sometimes with white markings 15 - 30 cm in diameter.

Flowers monoecious and yellow - orange; male flowers smaller than the females, calyx of 5 sepals, fused at base; stamens 3, short, fused; stigmas small, yellows. Fruits large, variable in shape, round or oblong, flesh yellow. Seeds white or brown.



Plate 7: *Cucurbita maxima* planted at a homestead farm in Kisumu District.

Habitat: Waste cultivated ground (also in cultivation), hedges.

Distribution: K4, 5, 6.

Altitude: 1 - 2000 m.

Uses: Young leaves, flowers and fruits are cooked. The leaves, alone or together with *Amaranthus* species are pounded and milk added. They can also be pounded together with starchy foods like potato tubers, cassava or sweet potatoes or just eaten as a side dish with cassava or ugali. As a side dish, the leaves are sometimes mixed with spinach (*Spinacea oleracea*) and fried.

EUPHORBIACEAE

1. *Erythrococca bongensis* Pax. (see Plate 8).

Local Names : Hariadho/Siriadho (Luo).

Botanical Description:

Shrub or small tree up to 5 m high; leaves ovate or lanceolate-ovate up to 7 cm long. Fruits green; flowers green, orange when ripe.

Habitat: Roadside on black cotton soil; in open habitat (hedges).

Distribution: K 1 - 7.

Altitude: 200 - 2440 m.

Uses: Apart from its use as a vegetable, it also provides nectar for bees.

Other Uses: The leaves are pounded, mixed with water and drunk for treatment of Polio (RUS). This can also be used the way it is or mixed with butter as a cough cure. For stomach troubles in humans, leaves are pounded and cooked, ground nuts



Plate 8: *Erythrococca bongensis* hanging on a wall of a hut in Kisumu District.

added then eaten. For “chira” (thinning disease) the leaf decoction together with “oriang” is taken. With *Harrisonia abyssinica* it acts as an antidote.

2. *Manihot esculenta* Crantz. (see Plate 9).

Common Names: Cassava, Manioc, Tapioca.

Local Names : Muhogo/Omuogo/Mariwa (Luo).

Botanical Description:

The cassava is a half-woody or shrubby plant, 1.5 to 3 m. Tall, with fleshy, elongated tuberous roots. Leaves are simple, 7.5 to 20 cm long, alternate, smooth,

usually deeply three to seven, parted into spatulate - or linear - lanceolate acuminate lobes, glaucous beneath, minutely puberulent on veins. Flowers about 1cm long, in panicles, calyx campanulate, shortly or deeply five-lobed, ten stamens in two series. Fruit a capsule, globose, about 1.5 cm long, with six narrow, longitudinal wings.

Habitat: On farmland, in cultivation.

Distribution: Widespread especially in the warm areas K 4, 5, 7.

Uses: The young tender leaves of the sweet variety are used as a source of vegetable. The tubers are edible and are of two kinds - the bitter and the sweet. The bitter cassava contains poisonous hydrocyanic or prussic acid but is made harmless by cooking (boiling), soaking or drying (Martin and Ruberte, 1979). The sweet cassava



UNIVERSITY OF NAIROBI
CHIROMO LIBRARY

Plate 9: *Manihot esculenta* in cultivation at a farm in Kisumu District.

by cooking (boiling), soaking or drying (Martin and Ruberte, 1979). The sweet cassava is not poisonous. Both the bitter and the sweet varieties may be boiled or roasted and have about 26% starch.

LEGUMINOSAE

The importance of this family in the context of human nutrition is very considerable since many of the plants included in the 3 sub-families Caesalpinioideae, Mimosoideae and Papilionoideae provide a source of oil and protein which are not found in other plant families.

The variation in form of many Leguminous crops used as vegetables is considerable but the leaves are normally alternate and compound pinnate or trifoliolate. The flowers are usually hermaphrodite with 5 sepals and 5 petals. The ovary is superior with a single style or carpel. The fruit is normally a pod which may be round or flat, sometimes winged, straight or curved, of variable length, fibrous or fleshy and often splitting open at maturity (Tindall, 1983). Many of the common weeds of the family, Leguminosae bear edible leaves. Probably the edible qualities of many other species of this family remain to be discovered.

Sub-family Caesalpinioideae

The genera *Cassia*, *Senna* and *Charmaecrista* comprises about 600 species of herbs, shrubs and trees throughout the tropics. Many of the species are of ornamental value. Several are useful as green manure crops. The seeds of *Cassia occidentalis* are sometimes roasted as a coffee substitute, (Martin and Ruberte, 1979).

Some are used in folk medicine: *Senna didymobotrya*, *Cassia absus*, *C. alata*, *C. angolense* etc. (Kokwaro, 1993). The leaves of *C. alata* treat skin diseases espe-

cially in ringworm infection. With *Senna didymobotrya* leaves, the two are boiled and the decoction given to baby with upset stomach. Leaf and root decoction of *Cassia occidentalis* is taken for stomach, fever, dysentery and malaria (RUS).

When the glucoside content of the leaves is not high, the leaves of various *Cassia* species are edible. Cooking removes some of the various glucosides and mainly *Cassia occidentalis* and *Senna bicapsularis* are cooked in small quantities with other vegetables. They are considered a tonic, and without doubt exert a regulating influence. Only the young leaves are used.

1. *Senna bicapsularis* L.

Common Name: Rambling cassia (English).

Local Name: Ang'or/Nyang'or (Luo).

Botanical Description:

An erect bushy woody glabrous shrub with 2 to 3 pairs of obovate to oblong leaflets on the leaf and short racemes of yellow flowers; pods cylindrical, indehiscent.

Habitat: Disturbed, dry bushland.

Uses: Leaves mixed with other *Cassia* spp. like *C. occidentalis* and others to form boiled vegetables ('aboka'). Pounded root infusion is given to children with any pain in the stomach.

Sub-family: Papilionoideae.

2. *Cajanus cajan* (L.) Millsp.

Common Name : Pigeon pea (English).

Local Name : Mbas (Luo).

Botanical Description:

A woody short-lived erect perennial shrub, up to 4 m in height. Has a vigorous tap root, the laterals well developed, particularly in the bicolor varieties. The stems are angled and hairy in the early stages of growth; leaves are spirally arranged, trifoliolate; petiole 2 - 8 cm in length, grooved on upper surfaces; stipulate small, ovate, hairy; leaflets lanceolate or elliptic, acute, hairy. Flowers yellow and orange.

Habitat: Farmland-mostly cultivated, also occurs as a cultivation escape in open places, not in forest.

Distribution: Wide, spontaneous or cultivated in certain areas. K 1-7.

Altitude: 1 - 2000 m.

Uses: Fresh leaves are used as vegetable and the immature pods are also cooked. Dried seeds are added to soups and stews. The protein content of the leaves is high. Seeds are rich in carbohydrates, are a fair source of calcium and iron.

The plant also provides fuelwood, fodder, building materials and also provides shade for other crops. Water from soaked boiled leaves is used for coughs, diarrhoea and other abdominal troubles.

3. *Crotalaria brevidens* Benth. var. *intermedia* (Kotschy) Polhill. (see Plate 10).

Common Name: *Crotalaria*.

Local Name: Mtoo/Mitoo (Luo).

Botanical Description:

Erect to spreading annual or short - lived perennial with variably shaped but mostly narrow leaflets and racemes of yellow , reddish-brown veined flowers conspicuously lined; pods sessile, narrowly cylindrical, often a little curved at ends, (3, 5-) 4 to 4.5 cm long; upto 80 seeded. The common large flowered form var. *intermedia* (Kotschy) Polhill, but a smaller flowered var. *parviflora* (Bark. f.) Polhill with the keel only 1.2 to 1.4 cm long occurs around Nairobi is very similar to this species except in keel shape (Agnew, 1994).

Habitat: Farmland, grassland, bushland.

Distribution: K 1 - 6.

Altitude: 600 - 3000 m.

Uses: Many species of *Crotalaria* produce edible leaves. In contrast others are often poisonous and can kill slowly.

Other Uses: The edible vegetable species also act as remedy for general stomach pains and swellings. Many of these are green manure crops.

Tephrosia pumila (Lam.) Pers. Known in Luoland as 'Nyangor', is also a source vegetable. It is an annual or short-lived perennial with 7 to 13 leaflets, small flowers, the standard is under 8mm long. It is often confused with *T. purpurea* from which it is distinguished by the more numerous, more closely packed seeds and the sharply down - curved styled base.

Other Uses: The roots are chewed as a remedy for cold in the chest. The vapour of the plant is used as an inhalant for babies suffering from colds in the head with running noses. Roots are also boiled and the infusion taken in broth as a cure for



Plate 10a: *Crotalaria brevidens* var. *intermedia* (flowering stage).



Plate 10b: *Crotalaria brevidens* var. *intermedia* (fruiting stage) planted at a homestead farm in Kisumu District.

venereal diseases. One glass of the infusion is mixed with one glass of the broth.

4. *Vigna unguiculata* (L.) Walp. (see Plate 11).

Common Name: Cow pea (English).

Local Name: Bo (Luo).

Botanical Description:

Annual or perennial, erect, trailing or climbing herb; stipule submedifixed; leaflets entire or lobed at the base, glabrous or sparsely pubescent on both sides; inflorescence rachis 5 to 40 mm long; pedicel 1 to 2 (-4) mm long; bracteoles spatulate, more or less persistent; calyx glabrous tube 3 to 5.5 mm; lobes 2.5 to 14 mm long, the upper pair joined at base or for up to half length; corolla blue or purple, at least in part, 12 to 33 mm long, or to 90 cm in some cultivated forms; hilum eccentric. Various cultivated forms of this 'cow pea' are grown (mainly ssp. *unguiculata*). wild ones are subsp. *dekindtiana* (Harm) Verdc. (with sepal lobes slightly longer than the tube) and subsp. *mensensis* (Schweinf.) Verdc. (with sepal & lobes much longer than the tubes).

Habitat: Bushland, grassland, often climbing over bushes and small trees. It is not tolerant to flooding.

Distribution: Not very widespread - uncommon in bushland and forest edges. K 3 4, 5, 6.

Altitude: 1 - 2500 m.

Uses: The leaves are widely used as a vegetable sometimes mixed with *Corchorus* spp. to soften it. The latter is more preferable as addition of soda ash reduces Vitamin C content (F.A.O, 1968). To make a good spinach, the leaves must be young and tender. The best are the third and fourth from the apical ends of the shoots. These are washed and chopped alone or with kale and *Amaranthus* spp.,

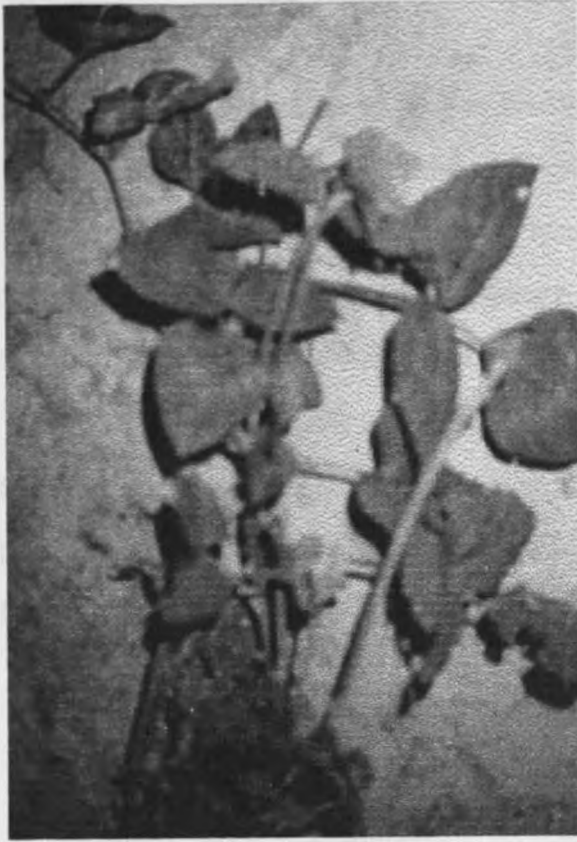


Plate 11: *Vigna unguiculata*.

then boiled to dryness. But if mixed with bitter species, the boiling water is poured out. The mixture ('atwago' in Luo) is then fried. The leaves can sometimes be dried then ground into powder which can be stored for later use.

The plant is widely cultivated as a leguminous crop yielding edible seeds, and it is often very difficult to know if it is truly wild in any particular area. It is considered potential as a fodder crop.

Most varieties are intersown with other food crops. Removing all tender leaves 3 times at weekly intervals, starting 5 to 7 weeks after sowing has no adverse effect on seed yields although flowering may be delayed.

Other Uses: Apart from the nutritional value (leaves cooked have 2/3 protein, 7 times the pro-vitamin A and C of the cooked seeds and equal or more vitamin B content (F.A.O, 1988). The low oxalic acid content of bean and cow pea leaves makes them superior, as source of calcium, to true spinach (*Spinacea oleracea*). Roots are known to have important pharmacological properties for women having difficult labour. In Luoland (Kenya) women having such difficulty are usually given the roots to chew to facilitate uterine muscle contraction and thereby speed the expulsion of the afterbirth; leaves are also crushed and used as a snuff for headaches. Whole plant is also useful as animal feed or forage.

MALVACEAE

1. *Sida alba* L.

Local Name: Nyayuora (Luo).

Botanical Description:

An erect pubescent woody annual, with ovate elliptic to oblong leaves; flowers often on lateral racemes, solitary white or cream; sepals 5 to 6 mm long.

Habitat: Dry grassland, disturbed places, waste ground.

Distribution: K 1 - 6.

Altitude: 550 - 2400 m.

Uses: Leaves used as vegetable, after boiling and frying.

Other uses: They are also used for snake bite treatment (they are chewed and the juice swallowed).

2. *Sida acuta* Burm. f.

Common Name: Prickly sida (English).

Local Name: Nyayuora/Adongo Nyayuora (Luo).

Botanical Description:

Erect, short-lived, sparsely pubescent perennial with short-petiolate, lanceolate-oblong leaves and solitary cream or pale yellow flowers; sepals 6 mm long.

Habitat: Cultivated land, homes, waste areas, roadsides.

Distribution: K2 - 7.

Altitude: 5 - 2100 m.

Uses: Apart from utilization as a vegetable source, the leaves are crushed and applied as a poultice to cuts made in swollen limbs. The twigs also serve as brooms for sweeping compounds.

Sida rhombifolia is also used as a vegetable species. It produces a mucilaginous substance and is utilised in the same way that *Corchorus* is used.

ONAGRACEAE

Ludwigia stolonifera (Guill. & Perr.) Raven.

Common Name: Ludwigia.

Local Name: Nyasugumba/Obera (Luo).

Botanical Description:

A herb which either creeps and roots at the nodes, or float. When floating, it has

swollen, whitish, spongy roots near the water surface. Leaves variable in shape, up to 10cm long. Flowers occurring singly in the leaf axils, up to 3.8cm across; sepals and petals four or five; stamens twice as many.

Habitat: Common round the sheltered edges of open water (streams).

Uses: Used as a vegetable, mostly alone but occasionally mixed with other vegetables. Cooking water poured out severally as the leaves are very bitter and then a lot of milk is added. It is considered a very good medicine for stomach troubles.

PEDALIACEAE

1. *Sesamum angolense* Welw.

Local Name: Onyulo madongo (Luo).

Botanical Description:

A shrubby annual or sometimes perennial herb, 0.8 to 3 m high; leaves subsessile or shortly petiolate, very polymorphic (elliptic or narrowly oblong), margins entire, more or less in-rolled, upper surface glabrescent, lower surface tomentose; Flowers pink to purple with deeper markings. Corolla 3.5 to 7 cm long, 2 to 3 cm diameter at the throat.

Habitat: Grassland, roadside, abandoned cultivated areas.

Distribution: K 3, 4, 5.

Altitude: 350 - 2400 m.

Uses: Leaves mostly cooked for babies and invalids.

Other Uses: Sometimes it is used as soap substitute. The leaves are pounded with water and the liquid poured into the eyes and also over the ears, nose and mouth to cure small pox. An infusion of the roots is drunk at the time of labour to hasten delivery. The roots are chewed and swallowed or pounded, soaked in water and the infusion drunk to counteract vomiting.

2. *Sesamum angustifolium* (Oliv.) Engl. (see plate 12).

Local Name: Onyulo matindo (Luo).

Botanical Description:

Erect herb, generally simple (only strong specimens branched, then sometimes woody at base) 30 - 90 cm high; leaves sessile or subsessile, narrowly linear-lanceolate, 2 - 12 cm long, 0.1 - 1 cm broad, margins entire sometimes lower leaves coarsely and irregularly toothed; fls pink purple, often spotted within; corolla 2 - 3.5 cm long, 0.9 - 1.8 cm in diameter at the throat (Agnew, 1994).

Habitat: Grassland, abandoned cultivated field, waste areas etc.

Distribution: Widespread K3 - 7, probably in K1 and K2 also.

Altitude: 600 - 2000 m.

Uses: Normally mixed with coarse vegetables to soften them.

Other Uses: The leaves rubbed in water give a mucilage used in eye troubles and infant diarrhoea. It is also used to treat burns. Crushed leaves are rubbed in hair while washing to give it a glossy look.

3. *Sesamum indicum* L.

Common Name: Sim-sim or Sesame (English).

Local Name: Nyim (Luo).

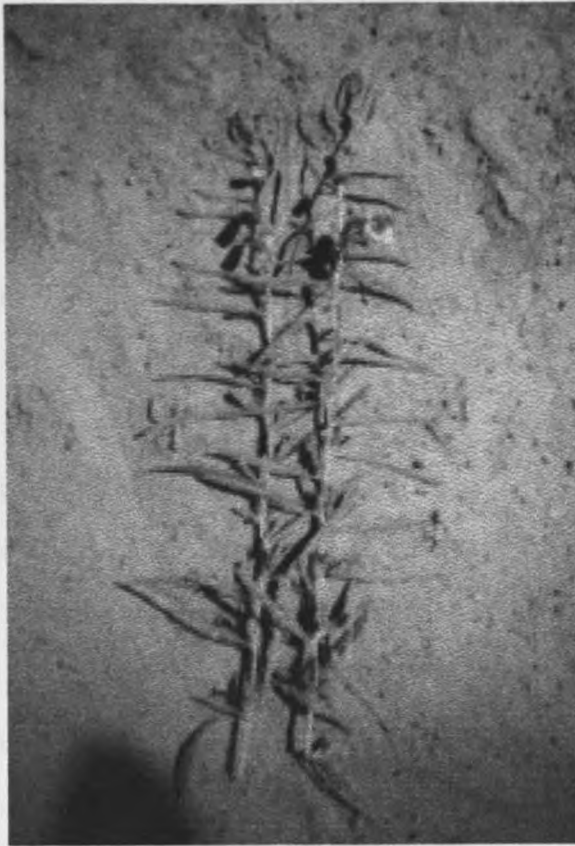


Plate 12: *Sesamum angustifolium* flowering stage.

Botanical Description:

The oil crop, Sesame is of African origin but now seeds are cultivated chiefly in India, Asia, S. America and Africa as a source of cooking oil, it is also a source of edible leaves. The plant is an erect annual herb raised from the seed. The leaves are quite hairy, which for most persons produces an uncomfortable feeling in the mouth.

Uses: The young leaves are regularly eaten.

Other Uses: The edible seeds are a source of sesame oil. The semi-drying oil is of high quality and is used as a substitute for olive oil, as a salad and cooking oil. Purselove (1968) records its use in the manufacture of margarine and compound cooking fats and proper grades in soaps and paints, and a source of lubricants and illuminants

POLYGONACEAE

1. *Oxygonum sinuatum* (Meisn.) Dammer.

Common Name: Double Thorn (English).

Local name: Awayso, Nyatiend gweno (Luo).

Botanical Description:

A sprawling annual herb 30 to 60 cm high, notable for its spiny fruits which can injure feet of man and his animals. Has a tap root; the stem is much branched, prostrate near base, becoming erect. It is hairless or pubescent and greenish to reddish brown. The leaves are variably ovate, usually divided into deep, irregular lobes; stalk 1 - 2 mm long, widening at base to wrap around the stem in an alternating manner. The inflorescence is up to 30 cm long, arising, from axils of the upper leaves. The flowers are small, 1 - 2 mm across, pink or white in colour. They emerge in groups of 2 to 4 from tubular bracts fringed by stiff hairs. The flowers are tubular with 4 to 5 petal-like lobes, 8 stamens and an ovary with 3 styles. The fruit is angular, 5 to 6.5 mm long, pointed at each end with three spreading prickles near the center, usually covered with fine hairs.

Habitat: Farmland, roadsides, waste areas.

Distribution: Widespread K, 2 - 7.

Altitude: 600 - 2200 m.

Uses: Leaves occasionally used as a vegetable source. Similar species also utilised as vegetable in times of vegetable scarcity is *O. stuhlmanii*. (Leaves elliptic and entire or with shallow lobes), *O. sinuatum* is also used as an antidote for snake bites.

SOLANACEAE

In this family the genus *Solanum* (nightshade) provides most of the vegetable species. It is a large and varied genus which includes both weedy and non-weedy species as well as a number of well-known edibles like the Irish potato, *Solanum tuberosum* and ornamental cultivars. As a group they are easily recognised from their flowers with a characteristic cone of 5 anthers on very short filaments.

Leaves and fruits of many species are poisonous due principally to the presence of glycoalkaloids (Watt and Breyer - Brandwijk, 1962). Sometimes they disappear as the fruit ripens. These are used directly both in traditional and modern medicinal practices. Some of these, for example *Solanum nigrum* are commonly or sporadically cultivated for the edible leaves but most are weeds.

1. *Solanum nigrum* L. (see Plate 13).

Common Name: Black nightshade (English).

Local Name: Osuga (Luo).

Botanical Description:

An annual herb, with a taproot; stem erect, up to 60 cm high, branched and mostly hairless. The leaves alternate and are ovate upto 8 cm long and 4 cm wide with wavy lobed margins; stalk upto 2.5 cm long. Filaments are in small hanging clusters on stalks which arise from the stem between nodes, white, 5 - lobed, 5 to 7mm across; stamens yellow, projecting from centre to flower. The fruit is a berry, spherical, fleshy, 4 to 6 mm in diameter, black when ripe, containing many seeds which are flattened, 1.5 mm in diameter, finely pitted, light to dark brown.

The species is extremely variable, occurring throughout Kenya. The ripe berries are often edible. The unripe ones are said to be poisonous. Two forms are easily recognised; a densely hairy type, Form B and the more common sparsely hairy type, Form A. Both are used as leafy vegetables.

Habitat: Roadsides, open grasslands, farmland.

Distribution: K1 - 7.

Altitude: 1 - 3070 m.

Uses: Leaves and young shoots are eaten, including the flowers. When in cultivated land it is normally spared during weeding. It is one of the most popular species used even in large towns like Nairobi, brought from Western Kenya. The edible parts are harvested, cleaned and boiled either alone or with *Amaranthus* spp. The mixture is then fried and milk added (or ghee if available).

Other Uses: The raw fruit is chewed and swallowed for treatment of stomach ulcers (Kokwaro, 1993) or for general upsets leading to continued stomach ache (Rus) in Kenya (Kisumu District). The infusion of the leaves and seeds is rubbed onto the gums of children in cases of development of crooked teeth. Pounded leaves are soaked in water, fermented and used for treatment of boils, ulcers and swollen glands.

Solanum species: Other wild edible *Solanum* spp. include *S. aethiopicum* L. which is also herbaceous. The leaves are glabrous and the small red fruits are also cooked and eaten. Also in Solanaceae family, some weedy species of *Physalis* bear edible leaves.

Physalis species: They are distinguished from other members of the family by the leafy bracts that enclose the fruit until maturity.



Plate 13: *Solanum nigrum* growing at Nairobi International Show Ground (1996).

P. peruviana L. bears pleasant edible fruits which are sometimes compared to the tomato, hence the name “husk tomato”. This was introduced from South America but has become completely naturalized. The leaves are sometimes eaten.

Nicandra physaloides, also known as “Osuga” in Nyanza province is also used as a vegetable. The leaves are much bitter so the cooking water has to be poured out before frying. The flowers are white and purple. It is usually cultivated, but sometimes found as a cultivation escape mostly near human habitation.

TILIACEAE

1. *Corchorus olitorius* L. (see Plate 14).

Common Names: Jews mallow, Bush Okra, Long-fruited Jute (English).

Local Name: Apoth (Luo).

Local Name: Apoth (Luo).

Botanical Description:

A vigorous annual, upright, branching, glabrous and slightly woody herb. Leaves narrow (Lanceolate) and serrate (about 5 to 1.5 cm in length). Flowers small, yellow-petioled and borne in small clusters in the leaf axils. The cylindrical capsules of 2 to 5 cm are produced in large numbers.

Habitat: Wet open ground, weed of cultivation.

Distribution: K4, 5, 6, 7.

Altitude: 550 - 1800 m.

UNIVERSITY OF NAIROBI
GHIRONG LIBRARY

Uses: Many varieties are known. The vegetable types are smaller than the fibre types, and are more branched, but the shoots and leaves of all varieties are edible. Their edible qualities are widely known in Kenya and they are even marketed in big cities. The shoots and leaves are usually combined in stews to be eaten with starchy foods like cassava, potatoes and "ugali". The hard vegetables like *Vigna unguiculata* are softened by combining with *Corchorus* species. Other edible species in Kisumu District include *C. capsularis*, *C. trilocularis* and *C. africana*.

Corchorus species requires little cooking for it rapidly softens and becomes mucilaginous, a characteristic that makes it useful as a softener for fibrous vegetables. The flavour is very good and the green colour is retained. The varieties differ in their cooking qualities and flavour. The most preferred in Nyanza being *C. olitorius*, *C. capsularis* and *C. trilocularis*. The protein content, particularly of older leaves is excellent (5 - 6%, young leaves 1.5%). These and the young shoots are also an excellent source of iron, vitamin C, B, and calcium (F.A.O. 1968).

Other Uses: Scrapings from the roots of this plant are put into hollow teeth to stop

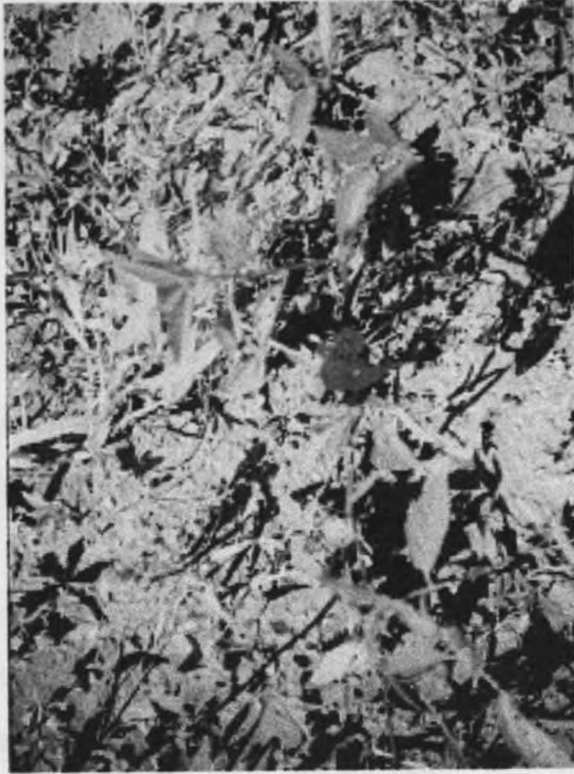


Plate 14a: *Corchorus olitorius* (red stem) growing wild at an open field in Kisumu District.



Plate 14b: *Corchorus olitorius* growing at Nairobi International Show Ground (1996).

them from aching.

ZYGOPHYLLACEAE

1. *Tribulus terrestris* L.

Common Names : Caltrops, puncture vine, devils thorn (English).

Local Name : Okuro (Luo).

Botanical Description:

A hairy annual herb with trailing branches and leaves unequal bearing 4 to 8 pairs of leaflets; flowers are 15 mm in diameter, on stalks up to 10mm long; fruit almost spherical in outline, with sharp horned spines.

Habitat: Common in waste places and trodden earth and painful to bare feet.

Distribution : K1 - 7.

Altitude : 1 - 2300 m.

Use: Occasionally used as a vegetable. Both shoots and leaves are used especially before fruiting. These are mixed with other vegetables, boiled and fried. Goats feed on them before the fruits set.

4.3 SOME COMMON PLANTS THAT ALSO BEAR LEAFY VEGETABLES

Many common plants around us bear edible green leaves. They are used as sources of other foods, for ornamenting our homes, or for shelter and shade but are overlooked for their values as sources of green leaves.

These may not necessarily be indigenous, but as they form part of our natural environment, it is worth mentioning them. They are many and range from herbs to the common trees around us. These are just a few that are most conspicuous in our surroundings.

ANARCADIACEAE

1. *Mangifera indica* L.

The common mango, now displaced from its native habitat in India and S.E. Asia is found everywhere throughout the tropics. It is an evergreen tree producing leaves throughout the year usually beginning with the rainy seasons. The young leaves used are usually coloured with anthocyanin which on cooking is boiled out leaving the leaves pale green. The cooked leaves retain their texture and the flavour is more or less resinous. This plant can supply a source of vegetable throughout the year.

The leaves are usually pounded and cooked with pot-ashes during dry seasons (RUS).

BOMBACACEAE

This is a small family of large trees like baobab.

1. *Adansonia digitata* L.

The species is poorly distributed and little known outside its native regions (Coastal areas) where it is utilised for a diverse number of products. The short wide trunk is composed of a soft wood pulp. The inner bark is fibrous and is used for ropes; the bark is pounded into a soft white paper or a fabric used for mats.

The fruit hangs from a long stem and the pulp around the seeds consists chiefly of tartaric and citric acid. It is eaten fresh, sometimes cooked into a porridge, or made into a drink. The seeds are also dried, ground, and used as a substitute for coffee, or as a meal in times of scarcity (Coast).

The leaf is palmately divided into 5 or 7 segments. The young ones and shoots may be cooked in soups or used as a condiment with other foods (TN).

CARICACEAE

Carica papaya (the papaya) is usually grown mainly for its fruits. Young leaves are cooked (boiled and fried) as vegetable. Dried leaves are used as tobacco substitute and can also be beaten in water to form a soap substitute in Nyanza (RUS).

4.4 RESULTS AND DISCUSSION

The number of species bearing edible green leaves in Kenya is very large (Table 1). In Kisumu District about sixty species across the twenty different dicotyledonous families have been identified (Table 2) but majority of them are little known. These are mainly remembered by the old women who use them occasionally for other purposes (medicinal) other than as vegetables. Many of these were even available during dry seasons (December-March).

Most young people found the local names familiar but could not easily identify the species, especially the rarely used varieties.

The popular species, especially the domesticated ones (shown on page 88) continue

to be grown on small scale. Controlled harvesting, especially if done on a fortnight basis is very beneficial. Intercropping with other vegetable species is also beneficial though the yield for the indigenous ones may be slightly lower. Deflowering the plants during growth period also increases their leaf yields and extends the harvesting period.

The selling of these vegetables in various markets across Nyanza Province has also helped in spreading their types. Species like *Corchorus olitorius*, *Vigna unguiculata*, *Solanum nigrum*, *Gynandropsis gynandra* and *Cucurbita maxima* are in demand all over the country. These help in providing some source of income to those who cultivate them.

Most village women were found to depend on their indigenous vegetables for most part of the year, especially when conditions are dry and pests rampant.

The perennials like *Sida acuta*, *Sida alba*, *Erythrococca bongensis*, *Acalypha volkensii*, *Cassia occidentalis* etc. are used throughout the year. During rainy seasons, their leaves are more luxuriant and they are cooked mixed with exotics like kale and spinach which are then available.

The methods of preparation are more or less the same, involving cutting into smaller pieces where leaves are large, then boiling to dryness or until ready and the cooking water discarded. The latter is mainly for species like *Ludwigia stolonifera*, *Solanum nigrum*, *Gynandropsis gynandra* etc. which have bitter principles. The tough leaved species like *Vigna unguiculata* are mixed with those of *Basella alba*, *Sida acuta* or *Corchorus* spp. with mucilaginous properties, or sometimes magadi soda (or sodium bicarbonate) added to soften them.

SEMI-CULTIVATED VEGETABLES AND THE DOMESTICATES.

SEMI-CULTIVATED (i.e. also collected from the wild).

Botanical name	Common name
<i>Amaranthus</i> spp. especially <i>A. hybridus</i>	Amaranthus
<i>Basella alba</i>	Vine spinach
<i>Corchorus olitorius</i>	Corchorus
<i>C. trilocularis</i>	Corchorus
<i>Gynandropsis gynandra</i>	Spider weed
<i>Sesamum angustifolium</i>	Sesamum
<i>Vigna unguiculata</i>	Cowpea

CULTIVATED VEGETABLES

Botanical name	Common name
<i>Cajanus cajan</i>	Pigeon pea
<i>Crotalaria brevidens</i> var <i>intermedia</i>	<i>Crotalaria</i>
<i>Crotalaria ochroleuca</i>	"
<i>Sesamum indicum</i>	Sim-sim
<i>Ipomoea batatas</i>	Sweet potato
<i>Cucumis sativus</i>	Cucumber

The other species listed in table 2 are collected from the wild.

After boiling, the mixture is fried in oil with tomatoes and onions (if available) and milk (or groundnut sauce) added. If ghee is available, it is added after boiling the mixture in water alone or water and milk.

4.5 CONCLUSION

The Luo of Kisumu District and most rural folks in Kenya still use quite a number of indigenous vegetables almost throughout the year. When conditions are favourable (rainy seasons) they combine them with the exotics. The popular cultivated varieties are then cultivated along with the easily grown 'sukuma wiki' (Kales). It is common to find a garden of *Vigna unguiculata*, *Corchorus olitorius* or *C. trilocularis* intercropped with kale in the rural areas. When conditions are dry the indigenous plants are mostly common as they are resistant to such stress and pests. At this time the perennials are the most available.

Knowledge of their methods of preparation is well known by those who utilize them and currently even modern cooking methods are employed where possible. This is as a result of various workshops held in the rural areas by various organisations (KENGO, WN, IFPP etc.) for the promotion of indigenous vegetables. The popular varieties are used even in the big towns like Nairobi, Mombasa, Nakuru and Kisumu. For medical purposes, they are under utilized.

Though some of the little known varieties may not possess the qualities in the regularly cultivated varieties, they are quite nutritious and when well prepared offer a very agreeable flavour.

Forest clearing, floods, weeding out, construction of paths, roads, buildings and small factories were identified as the main threats to the plants' survival. To reduce this and conserve the sites for these important plants, the local communities should be encouraged to protect their natural environment (Hall *et al.*, 1980).

Areas where *Sesamum angustifolium* and *Sida* spp. occur, often suffer water stress. Often they grow in competition not only with the main crop but also with numerous

types of weeds. They are therefore likely to be a source of tolerance to drought stress and may have heritable competitive ability in high density sowing conditions. Many of the plants are also self-perennating and seem to have gene controlled ability to resist pests and diseases. Therefore they should be monitored and utilised sustainably as a cheaper alternative source of vegetables.

CHAPTER 5

5.0 NUTRITIONAL VALUES

The East African and Nairobi University Herbaria have collected data on plant uses since 1920's and 1960's respectively, mostly on medicinal and chemically interesting plants. But it was not until 1990 that they started looking at wild food plants as substitutes for common crops that cannot be grown sustainably on marginal land. The results show that some indigenous food plants (vegetables) are far more nutritious than exotic ones (Table 4 on page 95).

5.1 METHODS

After the ethnobotanical survey, ten most available and commonly used indigenous vegetables were selected for chemical analysis.

The plants were picked from Seme region of Kisumu District and sun dried, care was taken not to mix the leaves (or shoots) with soil as this could give faulty results. The dried plants were then ground/milled and the ash used for the analysis: standard conditions for atomic absorption by Perkin Elmer instrument was the method used for mineral content analysis. This was done at Kabete Nutrition laboratory department of Animal production. The plants were selected on the basis of: frequent usage by the local people, availability almost throughout the whole year and acceptable flavour.

5.1.1 WET DIGESTION

The plant tissues were digested in glass beakers using a mixture of Nitric and Perchloric acids, filtered into a volumetric flask and then brought to volume with deionised water.

5.1.2 TYPICAL ANALYTICAL PROCEDURE

Sample preparation

- (i) 2.5 g of the sample was weighed into a 600 ml beaker. 25 ml of concentrated Nitric acid was then added and covered with a watch glass. This was boiled gently for 30 to 45 minutes to oxidize all the easily oxidizable material.
- (ii) The solution was cooled, then 10 ml of 70% HClO_4 slowly added. This was then boiled very gently until the solution was nearly colourless. The solution was not allowed to go to dryness. After cooling, deionized water was added, then the mixture filtered and diluted to 100 ml.

CAUTION:

Always add HNO_3 to plant samples and allow this mixture to digest before adding HClO_4 . HClO_4 can react explosively with untreated organic matter.

5.1.3. ANALYSIS

Duplicate samples of the specimens and control were wet and dry ashed. The concentration of the elements were then determined using standard conditions as in Pelkin Elmer's method (AOAC, 1984).

Table 3: Mineral contents (Ca, P, Fe and Mg) of some vegetables of Kisumu District. Samples analysed in duplicate on 15-11-93 at Kabete Nutrition Lab. Nairobi (percentage is per 2.5 g dry weight).

Name of plant	MINERALS (%)			
	Ca	P	Fe	Mg
1. <i>Acalypha volkensii</i> (Euphorbiaceae)	2.97	0.37	0.14	0.75
2. <i>Acalypha</i> sp.	2.57	0.30	0.36	0.62
3. <i>Amaranthus hybridus</i> (Amaranthaceae)	2.42	0.65	0.06	1.07
4. <i>Amaranthus spinosus</i> (Amaranthaceae)	2.86	0.42	0.06	0.93
5. <i>Asystasia mysorensis</i> (Acanthaceae)	3.05	0.22	0.25	1.02
6. <i>Cassia occidentalis</i> (Leguminosae)	1.77	0.39	0.19	0.74
7. <i>Erythrococca bongensis</i> (Euphorbiaceae)	2.43	0.71	0.12	1.08
8. <i>Ludwigia stolonifera</i> (Onagraceae)	0.88	0.20	0.24	0.63
9. <i>Sida acuta</i> (Malvaceae)	2.27	0.42	0.30	0.69
10. <i>Thunbergia alata</i> (Acanthaceae)	1.61	0.22	0.36	0.87

In the final sample solution of the minerals analyzed and standards, 1% strontium was added as this element suppresses the interferences of phosphorous and silicon in the analysis of calcium and magnesium.

5.2 RESULTS

Mineral salts are important inorganic compounds containing elements which are essential for normal body metabolism. Some of them are required in large amounts, for example:-

- Calcium which is important for formation of bones and teeth, muscle contraction and also for blood clotting.

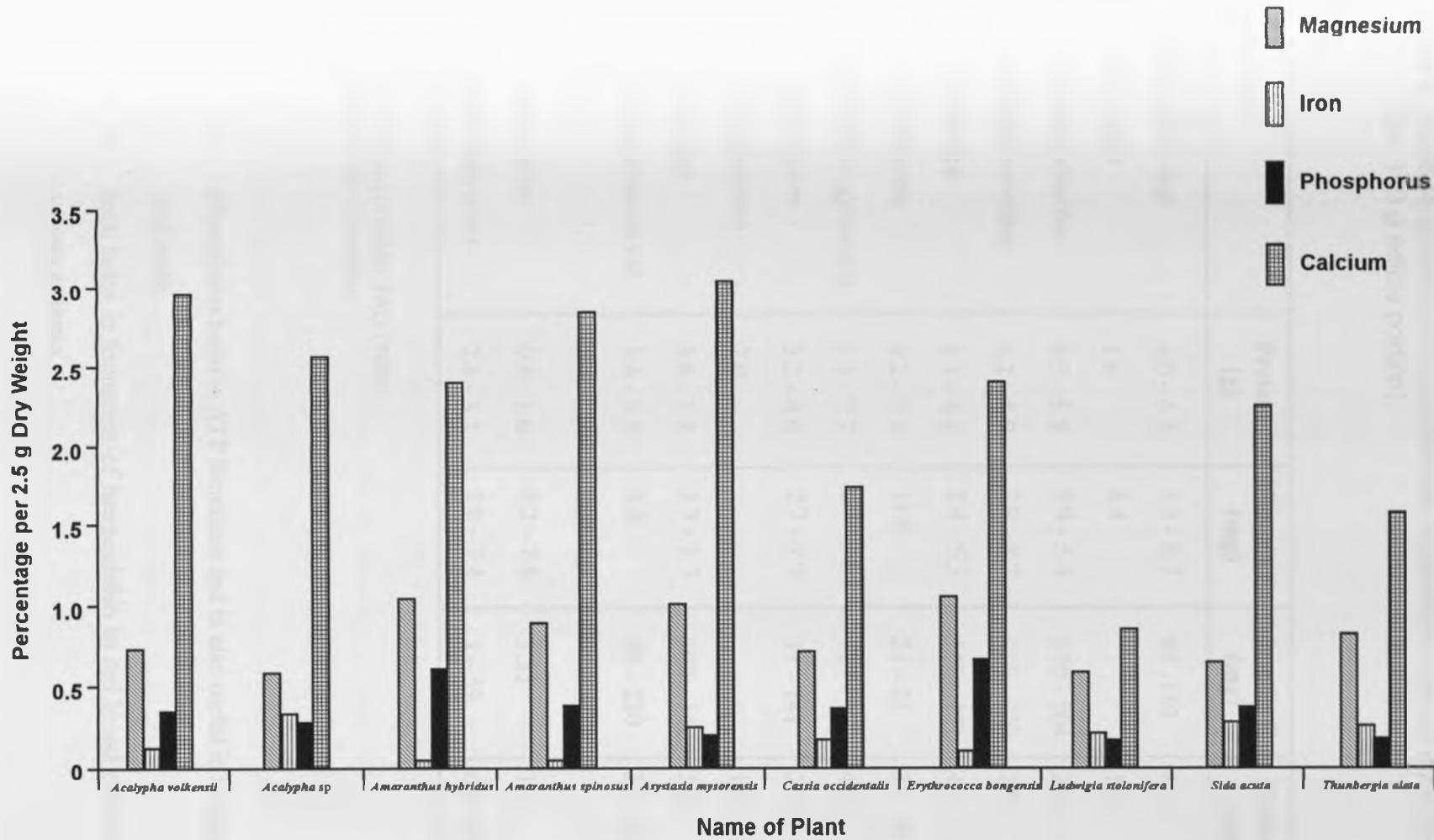


Fig. 9: Minerals percentage of sample plants. (Analysed at Kabete Nutrition Lab).

Table 4: Nutrient contents of some Kenyan vegetables compared with the exotics (per 100 g edible portion).

SPECIES	Protein (g)	Vitamin A (mg)	Vitamin C (mg)	Calcium (mg)	Iron (mg)
1. <i>Amaranthus</i> spp.	4.0 - 4.3	5.3 - 8.7	92 - 159	800	4
2. <i>Basella alba</i>	1.6	3.4		106	1.6
3. <i>Corchorus olitorius</i>	4.5 - 5.5	3.9 - 5.4	170 - 204	250 - 270	4-8
4. <i>Crotalaria brevidens</i>	4.2 - 4.9	2.9 - 8.7	115 - 129	270	4
5. <i>Cucurbita</i> spp.	3.1 - 4.2	2.4 - 5.3	170 - 172	40	2
6. <i>Ipomoea batatas</i>	3.2 - 3.5	11.8	21 - 25	73 - 86	4.5-8
7. <i>Gynandropsis gynandra</i>	5.4 - 7.7	6.7 - 18.9	127 - 177	434	11
8. <i>Solanum nigrum</i>	3.2 - 4.6	2.7 - 7.9	37 - 141	215	4
9. <i>Manihot esculenta</i>	7.0			124 - 303	5-8
10. <i>Brassica</i> spp.	3.6 - 3.8	3.7 - 5.7	102 - 142	520	6
11. <i>Brassica oleracea</i> var. <i>capitata</i>	1.4 - 3.3	4.8	20 - 220	30 - 204	1-2
12. <i>Lactuca sativa</i>	0.8 - 1.6	0.2 - 7.8	3.33	17	1.4
13. <i>Spinacea oleracea</i>	2.3 - 3.1	2.8 - 7.4	1 - 59	60 - 595	1-5

Source:

King (1971); Imungi (1989); FAO (1988).

1-9 Indigenous, 10-13 exotics.

- Phosphorus helps in ATP formation and is also useful in formation of bones and teeth.
- Iron helps in formation of haemoglobin in red blood cells and lack of it causes anaemia.

The above minerals have been found to be available in green leafy vegetables, hence the mineral content analysis carried out. Iodine is also important as it prevents

Table 5: Nutrient contents of some leafy Kenyan vegetables (per 100 g fresh weight).

Species	Energy KJ	Crude protein (g)	Ca (mg)	P (mg)	Fe (mg)	Vit A I.U	Th (mg)	Rib (mg)	N (mg)	C (mg)
<i>Corchorus olitorius</i> (leaves)	200	5.0	250		4.0	3000	0.1	0.3	1.5	100
	*181	5.6	266		7.7	7850				
<i>Ipomoea batatas</i> (Young shoots) Leaves	130	3.5	73	67	8.2	3300	0.1	0.2	0.9	25
	*176	3.2	86		4.5	2700				21
<i>Manihot esculenta</i> young leaves mature leaves	220	7.0	124	82	5.6	10,000	0.2	0.3	0.2	256
	*382	7.0	303		7.6					

Source King (1971)

* FAO results (1988)

occurrence of goitre but it is locally available in iodised table salt and Omena (Million fish) consumed by many in Kisumu District. Table 3 on page 93 lists the plant species analyzed for calcium, phosphorus, iron and magnesium components. Figure 9 on page 94 shows how significant these values are considering the diets of these people. In all the ten specimens, calcium content rated the highest and especially in *Asystasia mysorensis* (Acanthaceae) which is the most commonly used and popular vegetable among the species that grow in the wild. Probably because of its large leaves compared to others, its abundance throughout the year and nice flavour. *Acalypha volkensii* (Euphorbiaceae) and the *Amaranthus* spp. (Amaranthaceae) also have very high values. Phosphorus and magnesium components were found to be moderate in all species. *Erythrococca bongensis* (Euphorbiaceae) recording the highest followed by the *Amaranthus* spp in phosphorus content.

The plant with the highest magnesium content was *Erythrococca bongensis* again, followed by *Amaranthus hybridus*, then *Asystasia mysorensis* closely followed by *Amaranthus spinosus*. Iron content was comparatively low, with *Thunbergia alata* (Acanthaceae) and *Acalypha* sp. scoring equal values (0.36%). Surprisingly, the *Amaranthus* this time had the lowest values recorded (0.06% for both species).

5.3 DISCUSSION

Recently, the stress on the role and importance of indigenous vegetation in nutrition has been minimal if not lacking and as a result various malnutrition oriented diseases which were traditionally arrested by the use of indigenous vegetables are very common among the urbanized low income wage earners despite the advancement in food technology.

In some rural areas in Kisumu District, many of these vegetables are still known but very few are in use. If well used they could supplement the pulses as a source of plant protein. Though most of them contain a high percentage of water (70 to 95%) they have a reasonable amount of protein. Fats and carbohydrates are present in slight amounts (FAO, 1968; Martin and Ruberte, 1979). The nutritive value of the vegetables is increased greatly, however by the presence of the indispensable mineral salts (Table 3) and vitamins, while the roughage value of the various tissues aids digestion. Vitamin A is generally rich in especially dark green leaves. Vitamin C is present in appreciable amounts (Douglas, 1978) but the latter is readily available to the local communities since they collect fresh wild fruits too.

Despite these advantages, most of the plants with such edible leaves are left in the wild with the assumption that they will take care of themselves. Some people consider them as food for children, the very old or for the poor. The nutrient analytical

work carried out on the few vegetables above shows their important contribution in serving as a source of calcium, iron and phosphorus when commonly used in supplementing the normal diets.

They have a higher calcium content and the species *Asystasia mysorensis* (*A. schimperii* - Acanthaceae) commonly utilised in Nyanza seems to have a significant level. The Amaranths and *Acalypha* sp. also have very high values when this is compared to the phosphorus, iron and magnesium contents. The fact that all the species analyzed have reasonable amounts of the minerals required for important metabolic activities in the body, they should be recommended as supplements in the diets of Kenyans.

More studies still need to be carried out especially on protein and vitamin contents of these vegetables. Other studies have indicated that some indigenous greens score high in these nutrients. The cassava leaf, *Amaranthus* and *Gynandropsis gynandra* contain a significant level (Table 4).

Knowledge of the protein contents, together with the minerals and vitamins of these little used but important indigenous greens can be useful in balancing the diet.

Under normal circumstances, three considerations in addition to taste preferences ought to influence the choice of food for a normal diet:

- (i) the caloric requirement (plenty in the starchy staple diet of Kenyans)
- (ii) the protein requirement and
- (iii) the need for vitamins and minerals.

Leafy vegetables are particularly important with respect to the latter requirement, and indeed no other class of edible plants is equally rich in vitamins and minerals. The diet should always include green leaves everyday.

5.4 CONCLUSION

Severe food shortages in the third world especially Africa, have led to considerable suffering and provoke concern for the years ahead. The current crisis encompasses not only the shortage of human food, but also the critical shortage of livestock food. This has been aggravated by the high population trend in these areas.

Considering the potential of the indigenous vegetation as food for both man and his livestock, there's every reason to believe that our dependence on wild species will in fact increase in the years to come. Their tolerance to extreme stress conditions, availability throughout the year, resistance to pests, and diseases and their nutritional value should make them more popular to the local people. Yet very little is known about these species in terms of indigenous knowledge of medicinal utilization, appropriate cultivation techniques, extent and structure of genetic variation and potential for crop improvement via selection or breeding. Therefore every effort should be made to preserve a large bank of genetic diversity as possible for the indigenous greens not only to support the current scientific advances but also as a security for the future.

Some varieties like *Crotalaria brevidens* var *intermedia*, *Gynandropsis gynandra*, *Solanum nigrum* and species of *Amaranthus* have a ready market in the urban areas and large cities in Kenya thus making them a good source of income for the rural folks who cultivate them. The other little known species which grow wild may seem to have little value for mankind today but they may be of critical use in the future. Many of them thrive very well under difficult environmental conditions and are the ones serving as food for our livestock. Ways should be found of making them produce larger leaves, probably plant breeders could try to interbreed them with the popular large leaved varieties for better results.

True security lies in diversity (FAO, 1988); For this reason a variety of foods is necessary to supplement the cereal staples in most parts of Kenya in order to provide a nutritionally balanced diet. Traditional vegetables, together with other food plants form a ready source of essential nutrients being cultivable on small plots with family labour and minimal inputs such as water and fertilizer (Farm manure being best).

Therefore these plants have a great potential in Africa's struggle to attain household food sufficiency and security through increased production and utilization.

Health is another area that warrants our attention. As shown under ethnobotany these vegetables are especially useful in treating gastro-intestinal disorders. There is also evidence in some parts of the world that intake of carotenoids (Plenty in green leafy vegetables) reduces the incidence of cancer (Hicks 1983). These vegetables are the most abundant underused source of *B* carotene. When freshly harvested, the dry matter of some contains 0.2% *B* carotene; many contain 0.05% (Pirie, 1985).

UNIVERSITY OF NAIROBI
CHIROMBO LIBRARY

CHAPTER 6

6.0 CAUTION ON EXPERIMENTATION WITH WILD VEGETABLES

Though the plants producing edible leaves are many and harmless, certain related species which are poisonous do occur and these can be easily confused with the harmless ones. It is therefore very dangerous to believe that by simple trial and error the edible can be distinguished from the inedible leaves. Those with strong interest in edible wild plants should first identify them carefully before testing their edible properties and then to move with extreme caution.

The subject of plant poisoning is a very complex area treated in detail by many texts. Table 6 lists a few of these plants with poisonous leaves. As a general rule, no one family can be singled out as particularly dangerous but some families have more poisonous species than others (Apocynaceae, Boraginaceae, Compositae, Leguminosae, Solanaceae and Rutaceae). Many edible plants are poisonous at times, but not every individual of a species is necessarily poisonous, of a poisonous plant some parts may be poisonous at one time and not poisonous at another. Leaves are mainly poisonous when they are mature, but exceptions exist. Fruits, on the other hand are often most poisonous just before maturity but on maturity the poisonous substances are metabolized. Seeds are particularly likely to be poisonous. Furthermore, plants that are very common and are not thought of as poisonous may be poisonous under certain circumstances eg. when they accumulate toxic substances from the soil. Species of plants that are toxic to some species of animals are not necessarily toxic to other species. Therefore the entire subject of toxicity is complicated by special consideration (Peters *et al.*, 1992) but this is beyond the scope of this work.

The poisonous substances from leaves are extremely varied in nature, physiological action and distribution. There are alkaloids, cyanogenic glycosides, amines, polypeptides, oxalates, minerals like copper, lead, fluorine, manganese, nitrogen etc. Among these the most common in leaves are the alkaloids (Martin and Ruberte, 1979). These are secondary plant substances, always organic in nature and containing nitrogen. The alkaloids are most common in seed bearing plants especially the potato family contain alkaloids but in small or normal quantities those plants are not considered poisonous e.g. *Solanum nigrum*.

At least 10% of the species of plants in every environment bear poisonous leaves but the probability for poisoning is very small since in most cases during the normal course of events contact between plant and human being is too inconsequential to permit poisoning. Eating the leaves provides an intimate contact, but even so, depending on the kind of poison, quantities of some poisonous leaves can be eaten without causing poisoning, especially when proper cooking methods are employed.

The common habit in the rural areas of throwing away cooking water is a way of removing these poisonous substances. One may argue that the procedure leads to loss of nutrients but it is the water-soluble vitamins that are partly lost, the protein and carotene are retained. The general rule for avoiding trouble from these mildly toxic components is to avoid limiting the diet to a single species (Pirie, 1985), which is definitely the method employed by the local people in Kenya. It is extremely rare to find them using only a single species alone!

6.1. Some precautions to be taken when experimenting on leaves for their edibility:

1. Know the species well before attempting to eat the leaves - consult authorities if possible.

2. Avoid plants with milky sap, unless absolutely identified as safe.
3. Do not eat new leaves raw. Cook them, and throw away the cooking water if the leaves are bitter.
4. If the leaves are very sour they may contain excess oxalic acid (Martin and Ruberte, 1979). Avoid eating too much of them.
5. Try out new but identified leaves in very small amounts and progress gradually towards the use of large amounts.
6. Don't experiment with unknown leaves.

Table 6: Some plants with poisonous leaves used as vegetables in Kisumu District

FAMILY	PLANT SPECIES	POISONOUS PRINCIPLE	DEGREE OF POISONING	USES/NOTES
Acanthaceae	<i>Thunbergia alata</i>	Alkaloids	1	Leaves used as vegetable also medicinal.
Amaranthaceae	<i>Amaranthus</i> sp. <i>Celosia</i> sp.	Insignificant quantities of alkaloids	2	Only livestock affected
Anacardiaceae	<i>Mangifera indica</i>	Alkaloids	1	Poisoning due to contact with raw fruit or leaf sap. Young leaves edible when properly cooked.
Caricaceae	<i>Carica papaya</i>	Alkaloids	Sap - 3	
Convolvulaceae	<i>Ipomoea batatas</i>	Hydrocyanic acid	Shoots - 2	Green parts suspected of poisoning livestock.
Leguminosae	<i>Acacia</i> spp. <i>Cassia</i> spp. <i>Crotolaria</i> , <i>Tephrosia</i> , <i>Cassia</i> <i>occidentalis</i> .	Alkaloid	Leaves - 1	Seeds when roasted not poisonous. Leaves used in folk medicine and when boiled and fried used as vegetable. <i>Crotolaria brevidens</i> var <i>intermedia</i> - Leaves harmless and a rich source of vegetable. Also medicinal (gastro-intestinal problems)
Solanaceae	<i>Solanum</i> <i>Physalis</i>	Alkaloids glyco alkaloids e.g Solanine (Solanum	Leaves & fruits -1	<i>Physalis peruviana</i> , <i>Solanum nigrum</i> - leaves harmless and used as vegetable source in Kenya. Raw fruits of the latter are poisonous.
Zygophyllaceae	<i>Tribulus terrestris</i>	Nitrate form nitrite by reducing enzymes	Shoot - 2	Nitrite formed changes haemoglobin to methaohaemoglobin resulting in asphyxia; causes oedema in livestock. Harmless to humans

1 - Very Mild; 2 - Mild; 3 - Very Poisonous

Source: Kokwaro, 1993; Peters *et al.*, 1992, Watt & Breyer-Brandwijk, 1962.

CHAPTER 7

7.0 GENERAL COMMENTS AND RECOMMENDATIONS

1. The ethnobotanical survey has shown that these indigenous vegetables are still remembered by some folks, especially the old people. The young people may know the names but not the real plant species bearing those names. Therefore there is a high risk of losing information about proper identity of the vegetables. For this reason, proper documentation of the species is necessary especially taxonomic information and nutritional aspects of the little known varieties.
2. There is also exaggerated anxieties about the plants' defects for example: difficulty in distinguishing them from their poisonous relatives, bitter qualities, the tiny leaves and rough texture for some. This has in most cases led to their neglect. Proper identification and public awareness of their nutritional qualities should help in solving this problem.

Horticultural research institutes could help in publishing figures demonstrating their intrinsic values. These plants can give unusually large annual yields of edible dry matter including proteins, vitamins and minerals (Table 5) if properly taken care of.

3. Before these vegetables gain proper nutritional attention, it will be necessary to convince consumers that they are not merely sources of vitamin C and minerals. It is necessary to persuade those who compile dietary and production statistics to separate leafy vegetables from other horticultural products, which although may yield more profit per hectare, are of much less nutritive value.

4. Most of these vegetables are under utilized source of medicine. They are especially useful in treating gastro-intestinal disorders. This is an area that is extremely neglected and needs extra attention, probably research institutes like KARI (Kenya Agricultural Research Institute) KIRDI (Kenya Industrial Research Development Institute), KEMRI (Kenya Medical Research Institute) and others could collaborate to help in popularising them by exposing the public to their medicinal and food values.
5. The food organisations could also extract the leaf nutrients, mix them with other foodstuffs and sell them cheaply in local shops. These (e.g protein) can also be extracted from green leafy vegetables which are inedible because of fibre or strong flavour, then coagulating the extract and making a product with an acceptable flavour and texture.
6. Plant breeders have a major role to play: Modern popularly used vegetables like kale and the well known indigenous ones like the black nightshade owe their large leaves and popularity to the several researches done on them.

Selection and interbreeding with other species may help in giving better qualities to the less popular indigenous vegetables.

More pressing is the need for more researches on these plants. Data should be made available concerning their appropriate cultivation techniques, extent and structure of genetic variation, floral biology, indigenous knowledge of medicinal utilization etc. Finally, it is important to emphasize sustainable use of these plants. Those utilizing them for various purposes should remember to conserve them as well in order not to deplete their sources and to also maintain species diversity.

APPENDIX 1: ETHNOBOTANICAL SURVEY FORM**(KISUMU DISTRICT - NYANZA PROVINCE OF KENYA).****LOCAL INFORMANT****No. :****NAME :****AGE :****DATE :****DATA COLLECTION**

- A. (i) Name the indigenous vegetables found in this area.
 (ii) Which parts are utilised ?
 (iii) Do they have other uses apart from being vegetables ?
- B. (i) Where are these plants found ?

 (ii) Are they cultivated or collected from the wild ?

 (iii) Can you identify any of the vegetables you have mentioned in (A) above ? _____

- C. (i) Which ones are commonly used ?
 List: _____

 (ii) Briefly explain how they are prepared.

- D. Are there some species that are eaten during special situation or by special group of people ? (e.g Famine, sickness, pregnancy, breastfeeding, weaning etc.)

- E. (i) Which vegetables do you grow in your shamba ?

- (ii) Are they intercropped with other species, including the exotic vegetables ? _____

F. (i) Are there some plants that were used long ago but are no longer eaten ? Mention them:

(ii) What are the reasons for not using them anymore ?

G. What are the threats to survival of these plants ?

APPENDIX 2: SOME RESPONSES TO QUESTIONNAIRE FOR ETHNOBOTANICAL SURVEY IN KISUMU DISTRICT

No.	Luo Name	Scientific Name	No. of Respondents	Method of Prep.	Other Uses
R 01	Achak	<i>Sonchus schweinfurthii</i>	46	Pot-herb	Root decoction treats chest problems.
R 02	Achak madongo	<i>Sonchus oleracea</i>	57	Pot-herb	Treats sore throat.
R03	Achak matindo	<i>Launaea cornuta</i>	54	Food flavouring tender shoots used	All three treat stomach disorders.
R04	Adongo nyar yuora	<i>Sida acuta</i>	61	Pot-herb	Treats swollen limbs.
R05	"	<i>Sida alba</i>	45	boiled and fried	twigs for making brooms.
R06	Angayo	<i>Commelina africana</i>	53	Pot-herb, Spinach	grazed by all stock.
R07	Ang'or	<i>Senna bicapsularis</i>	65	Pot-herb, used throughout the year	treats stomach-ache in children.
R08	Apoth	<i>Corchorus africana</i>	81	vegetable stew with <i>Vigna. spp.</i>	root scrapings, put into hollow teeth to stop them from aching.
R09	"	<i>C. olitorius</i>	90	"	"
R10	"	<i>C. trilocularis</i>	67	"	"
R11	Atipa	<i>Asystasia gangetica</i>	10	Pot-herb, spinach	Leaves are a cure for intestinal worms.
R12	"	<i>Asystasia mysorensis</i>	84	"	Browsed by livestock, also soil binding.
R13	Awayo	<i>Oxalis corniculata</i>	25	Mostly chewed raw	Helps in stopping nausea.
R14	Ayucha/Auch auch	<i>Achyranthes aspera</i>	29	Leaves rarely, used as spinach	Treats colds and headaches roots applied on cuts to stop bleeding, burned leaves are applied on boils, also wards off evil spirits.
R15	Bo	<i>Phaseolus coccineus</i>	41	Spinach	

No.	Luo Name	Scientific Name	No. of. Respo-ndents	Method of Prep.	Other Uses
R16	Bo	<i>Vigna unguiculata</i>	100	Pot-herb, mixed with mucilaginous types like <i>Corchorus</i> spp.	Roots facilitate quick labour; leaves for headaches & whole shoot used as forage.
R17	Budho/Susa	<i>Cucumis sativus</i>	43	Pot-herb	
R18	"	<i>Cucurbita maxima</i>	79	Spinach, also mashed with starchy foods	For proper digestion.
R19	"	<i>Momordica charantia</i>	04		
R20	Chwaa/Ochwaa	<i>Tamarindus indica</i>	40	Leaves chewed raw, fruits make porridge paste	Raises appetite.
R21	Dania madongo	<i>Hibiscus esculentus</i>	08	vegetable stew	
R22	Deg dani	<i>Cleome monophylla</i>	28	Spinach	Treats stomach disorders.
R23	Dek/Akeyo	<i>Gynandropsis gynandra</i>	97	Pot-herb, spinach	Treats constipation, aching ears, stomach-aches.
R24	Deg pi	<i>Ipomoea aquatica</i>	10	Spinach	Food for fish, bank stabilizer.
R25	Dindi	<i>Acalypha volkensii</i>	55	Pot-herb	Twigs for making baskets, mats etc.
R26	Dindi luga	<i>Acalypha</i> sp.	13	"	"
R27	Hariadho/Siriadho	<i>Erythrococca bongensis</i>	73	Spinach, pot-herb	Provide nectar for bees. Leaves treat coughs, stomach - ache, snake antidote & for thinning disease (Chira).
R28	Mbas	<i>Cajanus cajan</i>	49	Fresh leaves and immature pods used	Treats coughs, diarrhoea, stomach-ache; whole plant is for fodder & provides shades for other plants.
R29	Mitoo	<i>Crotalaria brevidens</i> var. <i>intermedia</i>	90	With <i>Corchorus</i> spp. and/or <i>Vigna</i> spp. as vegetable stew.	Treats stomach disorders.

No.	Luo Name	Scientific Name	No. of Respondents	Method of Prep.	Other Uses
R30	Muogo/Mariwa	<i>Manihot esculenta</i>	48	Mixed with <i>Corchorus</i> spp. & fried	Clears constipation.
R31	Mutkuru/ Mutguru	<i>Coccinia adoensis</i>	42	Pot-herb	Treats sterility in women.
R32	Nderma	<i>Basella alba</i>	63	Mixed with coarse vegetables to form soft	Whole vine increases milk yield in cattle, leaves treat constipation.
R33	Njugu	<i>Arachis hypogaea</i>	50	Pot-herb, ghee added	
R34	Nyaboro	<i>Ipomoea cairica</i>	56	Pot-herb	Ornamental, food for small animals e.g rabbits.
R35	Nyang'or	<i>Tephrosia pumila</i>	29	Pot-herb	Chest problems, venereal diseases.
R36	Nya bo dhok	<i>Vigna membranacea</i>	17	Mixed with mucilaginous species to soften it	
R37	Nyar ner dek	<i>Cleome hirta</i>	20	Spinach	Stomach troubles.
R38	Nya ner atipa	<i>Justicia flava</i>	27	Pot-herb	Leaves burnt, ash produced serves as vegetable salt.
R39	Nyar ner mitoo	<i>Crotalaria ochroleuca</i>	21	With hard vegetables to soften them; Ghee or milk added	Treats stomach pains.
R40	Nyatigo tigo	<i>Chenopodium opulifolium</i>	20	Pot-herb	For constipation treatment.
R41	Nyatonglo	<i>Physalis peruviana</i>	40	Ripe fruits, mainly used, leaves rarely.	
R42	Nyasugumba	<i>Ludwigia stolonifera</i>	31	Boiling water discarded, a lot of milk added	Treat stomach problems.
R43	Nyatiend gweno	<i>Oxygonum sinuatum</i>	32	Pot-herb, leaves also chewed raw	Antidote for snake bites.
R44	Nyayado/ Ohingla tiang'	<i>Cassia occidentalis</i>	59	Vegetable Spinach, Pot-herb	Leaves & roots treat stomach problems.

No.	Luo Name	Scientific Name	No. of Respondents	Method of Prep.	Other Uses
R45	Nyawend agwata	<i>Thunbergia alata</i>	45	Leaves rarely used as vegetable	Mainly medicinal, for backache, pain in joints and skin diseases.
R46	"	<i>Ipomoea eriocarpa</i>	21	Pot-herb	
R47	Nyim	<i>Sesamum indicum</i>	41	Vegetable stew not very popular due to hairiness	Used for eye troubles and infant diarrhoea.
R48	Piupiu	<i>Justicia metammensis</i>	19	Mixed with <i>Justicia flava</i> to make 'atwago'	Little plant used in witchcraft.
R49	Rabuon	<i>Ipomoea batatas</i>	37	Pot-herb	Anti-diabetic.
R50	Tinga	<i>Chenopodium album</i>	30	Pot-herb/Spinach	
R51	Tungu	<i>Celosia trigyna</i>	31	Pot-herbs	Abdominal pains, also for painful menses.
R52	"	<i>C. Schweinfurthiana</i>	20	"	
R53	Obwanda	<i>Portulaca oleracea</i>	13	Pot-herb	
R54	"	<i>P. quadrifida</i>	26	"	
R55	Odielo	<i>Commelina benghalensis</i>	79	Used as pot-herb during dry seasons	Sap for Ophthalmia.
R56	Okuro	<i>Tribulusterrestris</i>	20	Leaves & shoots used as pot-herb before fruiting	Goats feed on it too.
R57	Omboga/ Ombok alikra	<i>Amaranthus graecizans</i>	31	Spinach, milk and	Fodder for livestock. ghee added
R58	Omboga/ Ododo	<i>Amaranthus hybridus</i>	92	Pot-herb, Spinach	
R59	Ombok akuthe	<i>Amaranthus spinosus</i>	45	"	
R60	Ombulu	<i>Abrus precatorius</i>	10	Usually avoided as the fruits are known to be very poisonous	
R61	Onyiego	<i>Bidens pilosa</i>	47	Known but rarely used-makes the stew have a black colour	Leaf sap treats coughs and jaundice.

No.	Luo Name	Scientific Name	No. of Respondents	Method of Prep.	Other Uses
R62	Onyulo madongo	<i>Sesamum angolense</i>	70	For babies and invalids as spinach	Counteracts vomiting, small pox and hastens labour.
R63	Onyulo matindo	<i>Sesamum angustifolium</i>	73	Mixed with coarse vegetables to soften them.	Leaf sap treats eye troubles, infant diarrhoea, burns & is rubbed in hair to give it a glossy look.
R64	Osieko	<i>Galinsoga parviflora</i>	39	Mixed with 'Mitoo' to form a vegetable stew.	Cures colds & is also food for rabbits.
R66	Osuga (Nyaluo)	<i>Solanum nigrum</i>	100	Pot-herb, ghee, milk or groundnut sauce added.	Raw fruit treats stomach ulcers & crooked teeth in children, also for boils and swollen glands.
R66	Osuga (Nyawasungu)	<i>Nicandra physaloides</i>	10	Pot-herb spinach	

Population sample used = 100

Primary school children (through their teachers) Approx. 60 (information from parents and relatives)

Individual adults (mostly women) Approx. 40.

B I B L I O G R A P H Y

- Abe L. and S.K. Imbamba (1977)**, Levels of Vits A and C in some Kenyan vegetable plants. *East African Agric. and For. J.* Vol 42, Non 3, 316-321.
- Acland J.D (1971)**, *East African crops*. Longman group limited, Essex, England.
- Agnew A.D.Q and S. Agnew (1994)**, *Upland Kenya Wild flowers*, (Second.Ed) East African Natural History Society, Nairobi.
- AOAC (1984)**, *Official methods of analysis*. Association of analytical Chemists, Washington D.C.
- Ayensu E.S. (1978)**, *Medicinal Plants of West Africa*. Reference Publications, Inc., Michigan, U.S.A.
- Beentje H.J (1994)**, *Kenya trees, shrubs, and lianes*, National Museums of Kenya Nairobi.
- Blundell M. (1992)**, *Wild Flowers of East Africa (second edition)* Hapercollins Publishers, Hong Kong.
- Bruce E. A (1953)**, *Flora of Tropical East Africa (Pedaliaceae)*, Crown Agents, London.
- Burkill I.H. (1985)**, *The useful plants of West Tropical Africa* Royal Botanic gardens Kew.
- Central Bureau of Statistics (1990)**, *Kenya Population Census, 1989*, Min. of Finance and Planning, Nairobi.

- Chweya J.A (1985)**, Identification and nutritional importance of indigenous green leafy vegetables in Kenya. *Acta Hortic* 153: 99 - 108
- Chweya J.A (1994)**, Potential for Agronomic Improvement of Indigenous Plant Germplasm in African agriculture - A casestudy of indigenous vegetables in Kenya. Safeguarding the genetic basis of Africa's traditional crops. ACTA/IPGRI/KARI/UNEP Nairobi (Kenya).
- Dalziel J.M (1937)**, The useful plants of West tropical Africa. Crown agents for the colonies, London.
- Douglas J.S. (1978)**, Alternative foods. Pelham books Ltd. London.
- Edmonds J.M (1990)**, Herbarium Survey of African *Corchorus* L. species Systematic & Ecogeographic Studies on crop Gene pools IBPGR Rome.
- F.A.O (1968)**, Food and Composition table for use in Africa. Agency Intern. Devpt. U.S.A.
- F.A.O (1984)**, Report on informal group on promoting the consumption of underexploited plant foods. Food policy and Nutrition div. FAO, Rome.
- F.A.O (1988)**, Traditional food plants, F.A.O food and nutrition paper 42 Rome.
- Githinji C.W and J.O Kokwaro (1993)**, Ethnomedicinal study of major species in the family Labiatae from Kenya. *Journ. of Ethnopharmacology* 391 197 - 203.
- Glover P.E J. Stewart & M.D Gweynne (1966)**, Maasai and Kipsigis notes on East African Plants. *East African Agric. & For. Journ.* Vol. XXXII No. 2: 184 - 207, Nairobi.

- Gomez M.I (1981)**, Carotene content of some green leafy vegetables of Kenya and effects of dehydration and storage on carotene retention. *J. Plant foods* 3:231 - 244.
- Gomez M.I (1982)**, Evaluation of fruits and vegetable, resources in the Machakos district in relation to seasonal deficits and micronutrition deficiencies. Technical report.
- Grivetti, L.E (1978)**, Nutritional Success in a semi-arid land examination of Tswana agro-pastoralists of the eastern Kalahari, Botswana. *Am. J. Clin. Nutr.* 31:1204 - 1220.
- Hall, A.V et al.,. (1980)**, Threatened Plants of Southern Africa. S. African National Scientific Programmes, Report No. 45 Co-op. Science Programmes, Pretoria.
- Harrison S.G., G.B. Masefield and M. Wallis (1969)**, The Oxford book of food plants. Oxford University Press.
- Hedberg I. (1979)**, Plant Utilization and Biosphere Conserv., Almquist Wiksell, Stockholm.
- Hicks RM (1983)**, The Scientific basis for regarding vitamin A and it's analogues as anti-carcinogenic agents. *Proc. Nutr. soc.* 42:83 - 93.
- Hoyt E. (1988)**, Conserving the wild relative's of crops IBPGR, IUCN, WWF.
- Imungi J.K. and N.N. Potter (1983)**, Nutrient contents of raw and cooked cowpea leaves *J. food Sci.* 48: 1252 - 1254.
- Imungi J.K. (1989)**, The role of indigenous vegetation in human nutrition in Kenya. Paper presented at indigenous Vegetation Experience sharing Forum, held at Jomo Kenyatta University of Agric. & Technology Juja.

- Johns T. and J.O Kokwaro (1991)**, Food plants of Luo of Siaya district, Kenya. *Econ. Bot.* 45 (1) PP.103 - 113.
- Juma C. (1989)**, *The Gene Hunters - Biotechnology and the scramble for seeds*. Princeton Univ. press, Princeton, New Jersey.
- King K.W. (1971)**, The place of Vegetables in meeting the food needs in emerging nations. *Econ. Bot.* 25, 6 - 11.
- Kokwaro J.O. (1972)**, *Luo - English Botanical Dictionary of plant names and uses*. E.A Publishing House, Nairobi.
- Kokwaro J.O (1979)**, *Classification of East African Crops*. Kenya Literature Bureau, Nairobi.
- Kokwaro J.O (1990)**, Seasonal traditional fruits and vegetables of Kenya. Proceedings of the 12th plenary meeting of AETFAT, Mitt. Inst. Allg Bot. Band 23b S. 911 - 928, Hamburg.
- Kokwaro J.O. (1993)**, *Medicinal Plants of East Africa, Second Edition*. Kenya Lit. Bureau, Nairobi.
- Kuhnlein H.V (1980)**, Food Sample collection for nutrient analyses in Ethnobiological studies. *J. Ethnobiological* 6(1): 19-25.
- Martin F.W and R.M Ruberte (1979)**, *Edible leaves of the Tropics*. Agency for Intern. Devp. Mayaguez, Puerto Rico.
- Martin G.J. (1995)**, *Ethnobotany*, Chapman & Hall, London.

- Maundu P.M (1994)**, Utilization and Conservation status of Wild food plants in Kenya (678 - 683). In The Biodiversity of African plants. Proceedings XIVth AETFAT Congress. Wageningen, Netherlands 22-27 Aug. 1994 (678 - 683).
- Musale J.D. and E.C. Irongi (1993)**, Nutritional situation in Kenya. Indigenous food plants workshops proceedings. April 14 - 16. P11 - 13, National museums of Kenya.
- Mwendwa H.A (1984)**, Land use in Kisumu District. KREMU technical report No. 104, Min. of Finance and Planning Kenya, Nairobi.
- NAS (1975)**, Underexploited Tropical plants with promising Economic value. Washington D.C.
- Ominde S.H. (1971)**, Studies in East African Geography and Devpt. Oxford Univ. Press Nairobi.
- Onayemi O. and G.E.O Badifu (1987)**, Effect of Blanching and drying methods on Nutritional and sensory qualities of leafy vegetables. In Plant food for Hum. Nutrition 37: 291 - 298 Martinis Nijhoff publishers-Netherlands.
- Opole M, J.A Chweya and J.K Imungi (1991)**, Indigenous vegetables of Kenya : Field and laboratory experience report. KENGO KENYA.
- Peters C.R, E.M.O'Brien & R.B Drummond, (1992)**, Edible wild plants of Sub-Saharan Africa. Royal Botanic Gardens, Kew.
- Pirie N.W (1985)**, Comments on importance of green vegetables. In Quality plant foods, Hum. Nutrition 35:73-80, Martinus & Junk Publishers, Netherlands.

- Pirie N.W (1990)**, Leaf protein: production and use, interdisciplinary science reviews Vol.15 No.2 168.
- Potter A. (1994)**, Safeguarding the genetic basis of Africa's traditional crops. C.T.A, the Netherlands. IPGRI, Rome.
- Purseglove J.W (1968)**, Tropical crops, Dicots, Longman Group. London. Reprint (1984) Longman Group. England
- Sigmond R. and E. Gustav (1991)**, The cultivated plants of the Tropics and Sub-Tropics. C.T.A Scientific books. Netherlands.
- Sombroek, N.G., H.M Braun & B.J. Van de Pouw (1982)**, The explanatory solid map and Agroclimatic zone map of Kenya. Scale 1:1m. Report No. E1. Kenya soil survey, Nairobi.
- Tallantire A.C and P.M Goode (1975)**, A preliminary study of food plants of the West Nile and Madi districts of Uganda. The utilization of leaves and fruits of local & mainly indigenous plants in supplementing the staple foods. East Africa Agric. & Fores. J.40: 233-255.
- Terra, G.J.A (1966)**, Tropical Vegetable. Koninkl. Inst. Trop. Amsterdam.
- Terry P.J. and R.W. Michieka (1987)**, Common weeds of East Africa. Food and Agric. Org. of UN, Rome.
- Tindall, H.D (1974)**, Vegetable production research in tropical Africa. Scientia Hortic 2:199-207

Tindall, H.D (1983), Vegetables in the tropics. Macmillan Publishers, London.

U.S.A. (1978), National Academy of Sciences. Unexploited tropical plants with promising economic value. 2nd ed. rev. NA Washington D.C.

Watt J.M & M.G. Breyer - Brandwijk (1962), The medicinal and poisonous plants of Southern and Eastern Africa 2nd Ed, Livingstone. Edinburg and London.

Weiss, E.A (1979), Some indigenous plants used domestically by East African Coast fishermen, Econ. Bot. 33:35 - 51.

UNIVERSITY OF NAIROBI LIBRARY

Tindall, H.D (1983), Vegetables in the tropics. Macmillan Publishers, London.

U.S.A. (1978), National Academy of Sciences. Unexploited tropical plants with promising economic value. 2nd ed. rev. NA Washington D.C.

Watt J.M & M.G. Breyer - Brandwijk (1962), The medicinal and poisonous plants of Southern and Eastern Africa 2nd Ed, Livingstone. Edinburg and London.

Weiss, E.A (1979), Some indigenous plants used domestically by East African Coast fishermen, Econ. Bot. 33:35 - 51.

UNIVERSITY OF NAIROBI LIBRARY