THE POTENTIAL ROLE OF TRADITIONAL FOOD PLANTS IN IMPROVING NUTRITION AND BROADENING THE FOOD BASE IN UGANDA.

BY

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DECLARATION

I, MIRIAM FERIDA SEBIT, hereby declare that this is my original work and has not been presented for a degree in any other university

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DEDICATION

This work is dedicated to my dear parents particularly my mother who stood strong against a culture that prohibits female education and my beloved cousins, Nancy Ayaka & Ramzi Mali.

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DEFINITIONS & ABBREVIATIONS

DEFINITIONS

FOOD SECURITY: Food Security is defined as access to adequate food in terms of both quality and quantity for all members of the household, for all time.

SUB-SAHARAN AFRICA: This includes all the African countries south of the Sahara desert.

(a) Nutritional problems

Nutrition encompasses processes leading to and involved in the utilization of the nutrients for growth, development, maintenance and activity. Malnutrition results from the inadequate intake of nutrients, and/or disease factors that affect digestion, absorption, transport and utilization of nutrients (UNICEF, 1992).

(b) Traditional food plants:

Traditional food plants are those which are accepted by a community through custom, habit and tradition as appropriate and desirable for consumption. People are used to them, know where to get them, or cultivate them, prepare them and enjoy eating the dishes containing them (FAO, 1987).

(c) Indigenous food plants:

Indigenous food plants are those which are native to a particular area.

(d) Vegetables

The term vegetables comprise several principal types of foods. These include the green leafy plants, such as spinach, amaranths etc. The second group of green vegetables comprise green peas and beans eaten green or in the form of green unripe pods. Another group includes the root vegetables which are sub-divided into (a) the yellow vitamin A active roots, examples are carrots, sweet potatoes and (b) roots such as turnips, swedes and also perhaps onions which have no vitamin A activity.

ABBREVIATIONS

A.N.P	: Applied Nutrition Programme.
D.A.O	: District Agricultural Officer.
D.C	: District Commissioner.
D.F.I	: District Farm Institute.
F.A.O	: Food and Agricultural Organization of the United Nations.
I.D.R.C	: International Development Research Centre of Canada.
I.F.P.P	: Indigenous Food Plants Programme.
I.I.T.A	: International Institute of Tropical Agriculture.
I.F.P.R.I	: International Food Policy Research Institute.
K.R.C.	: Kawanda Research Centre.
U.N.C.S.T	: Uganda National Council for Science and Technology.
S.R.C.	: Serere Research Centre.
SPSS	: Statistical package for Social Science.
T.F.N.C.	: Tanzania Food and Nutrition Centre.
UNICEF	: United Nations Children's Emergency Funds.
WHO	: World Health Organization.

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ABSTRACT:

A cross-sectional /descriptive study was undertaken in Mukono District, Uganda. The study was mainly to observe the use of **traditional food plants** relative to the use of exotic food plants.

Questionnaires were used to establish the familiarity of the community with the traditional food plants. Elders' knowledge of the traditional food plants was obtained using a rapid assessment procedure (R.A.P) using focus group discussion.

Proximate chemical composition of the traditional vegetables was determined, as well as selected nutrients and the antinurient-oxalate, content.

Results of the study indicate that there is considerable change in the use/popularity of traditional food plants grown or collected in the past to some different food plants which are now widely adopted as traditional food plants for the community under study. Although there is a decrease in the use/popularity of the traditional food plants, the study does not indicate much increase in the use/popularity of the exotic food plants.

Chemical composition of the vegetables indicate that local vegetables, particularly the neglected ones, are high in the nutrients determined when compared with some exotic vegetables such as cabbages, lettuce etc. for which values were extracted from various food composition Tables. Ascorbic acid levels of twelve of the fourteen analyzed traditional vegetables fell within the range of 33.3 - 677.4 mg/100g on a dry matter basis. Beta-carotene levels of all the analyzed traditional vegetables fell within the range of 8300 - 242300ug/100g on a dry matter basis, while iron and calcium levels ranged from 4.4 - 15.5 mg/100g and 770 - 2480 mg/100g on a dry matter basis respectively. The levels of the anti-nutrient oxalate in the analyzed vegetables ranged from 10.8 - 93.3 mg/100g on a dry matter basis. These levels are lower than the reported 176-15,766mg/100g levels on a dry matter basis of similar vegetables.

CHAPTER ONE

1 INTRODUCTION

ood plants in general constitute the major bulk of the food ipply for mankind. About 3,000 different plant species have een commercialized in the past. Only 20 of these, however, are onsumed on a large scale, as a result, most food plants are rogressively disappearing. These food plants include most of ne traditional plants on the African continent. Further, little ffort has been made to document and standardize traditional ethods of obtaining and selecting food plants which could rovide high nutritional returns at low cost for many people.

he overall food production in Uganda has been declining since 976. In 1986, food production was only 60 percent of 1976 evel. Available evidence shows a decline in production of welve major food crops of Uganda that causes general concern. he greatest decline was recorded mainly in traditional food lants such as finger millet (Eleusine coracana), sorghum Sorghum bicolor), legumes/pulses, oil seeds, fruits and egetables. The production of the green bananas (plantains) was bserved to have declined by about 30 percent.

t is currently being realized that in Africa, traditional food lants can make a substantial contribution in meeting the utritional needs of both urban and rural communities and their utritional value is being recognized by nutrition scientists.

raditional food plants have been neglected partly due to a lack of knowledge of their dietary importance. Their per capita onsumption has therefore generally declined in Africa. ecently, however, traditional food plants have been receiving ncreasing attention, because their production is more efficient nder harsh ecological conditions than is that of most exotic rops.

n Uganda, about 160 different species of traditional food plants ave been identified (Goode 1985, Backuzara, 1988). This list s, however, not exhaustive. Information about traditional ethods of cultivation, acreage, processing, geographical istribution and marketing as well as nutritional value is acking. An accurate estimation of the importance of traditional egetables and fruits, as complements or supplements to dietary taples or as components of accompanying dish, has not been established.

While information on other food plants such as cereals, root crops, tubers and plantains is available, there is little information on traditional vegetables. Further, information on their contribution to key micro-nutrients before and after cooking is scanty. Research on the nutritional value of traditional vegetables, as well as anti-nutrients, particularly (oxalate) would assist nutritionists in promoting their production and consumption. Activities to promote the production and consumption of traditional food plants are very important. This will help in realizing the full potential of traditional food plants for broadening the urban and rural food base in Uganda.

The current food crisis in Africa and the inability of the lowest income groups in food deficit countries (such as Sudan, Ethiopia, Somalia, Kenya and Uganda) to buy imported food provides justification for encouraging the production and consumption of traditional food plants. This is only possible if their production, use and contribution to the nutrient supply are documented.

Promotion of traditional food plants is likely to benefit the small farmers, women, particularly the low income groups who are normally bypassed by general economic development schemes and who are most affected by malnutrition.

1.2 PROJECT PURPOSE AND OBJECTIVES OF THE STUDY:

The purpose of the study is to provide information to create awareness about the potential role and the importance of traditional food plants and to provide justification for instituting policies to promote these food plants.

1.2.1 OBJECTIVES:

1. To determine the availability of traditional food plants in Mukono District, Uganda.
2. To determine the food plants cultivated/collected in the past and those cultivated/collected now.
3. To determine the nutrient value of some selected traditional vegetables.
4. To determine the content of the most common anti-nutrient (oxalate) in local vegetables

1.2.2 Specific objectives:

1.1 To determine the different types of traditional food plants in Mukono District.

1.2 To determine which of the traditional food plants are now cultivated or collected from the wild.

1.3 To determine the village elders knowledge of traditional food plants.

3.1 To determine the proximate composition of some selected local vegetables.

3.2 To determine the content of selected micro-nutrients (specifically ascorbic acid and beta-carotene) in some selected local vegetables.

3.3 To determine the nutrient content of some prepared traditional food dishes.

3.4 To determine the minerals (iron & calcium) contents of some selected local vegetables.

4.1 To determine the oxalate content of some selected vegetables.

1.3 EXPECTED BENEFITS

The results of this study will be used as baseline information to initiate further research and development activities to promote the production and consumption of traditional food plants in Uganda and elsewhere in sub-saharan Africa.

CHAPTER TWO

2.1 LITERATURE REVIEW

2.1.1 Malnutrition: A global problem

Hunger and strategies to alleviate it

Chronic hunger and malnutrition represent the most compelling dilemma of our times. This dilemma has become a focal point of interest and concern of people around the globe who share a commitment to resolve this problem.

According to reports on the world food situation, it was estimated that the number of people afflicted by hunger and malnutrition is about 500 - 800 million (FAO,1985).

Strategies to combat hunger and malnutrition in developing countries have been guided in recent years by food security principles (FAO, 1984). Food security, whether at a national or household level, means availability of food, its nutritional adequacy and its accessibility by the people.

Programmes for increasing domestic food production and diversifying the food supply have been formulated (FAO, 1985). In this context, traditional food crops have a vital role to play.

Nutritional deficiencies:

During the last 25 years, many experts from the international organizations WHO (1990), UNICEF (1989), FAO (1985) and others have tried to assess the magnitude of malnutrition in the world. Protein-energy-malnutrition, nutritional anaemia, Vitamin A deficiency and iodine deficiency disorders (IDD) are reported to be the most serious nutrition problems (WHO, 1990; UNICEF, 1992).

According to the expert reports, about 150 million children under five years old are under weight, and more than 20 million suffer severe malnutrition. It is estimated that 350 million women have nutritional anaemia. Some 40 million children suffer from Vitamin A deficiency, about 250,000 go blind and others die. IDD afflicts 200 million people with goitre and at least 6 million suffer from cretinism (UNICEF, 1992).

Recent reports suggest that malnutrition is increasing in some parts of the world, particularly in Africa South of the Sahara. It is suggested that this deterioration is a result of the economic crisis and the adjustment most countries are under-taking in Africa. Because of its magnitude, its catastrophic impact on child and maternal survival and development, and the fact that it often results from international, political and economic crises, malnutrition is one of the most significant global problems today (UNICEF, 1992).

2.1.2 Food production and consumption in Africa:

Consumption

In the face of a rapidly increasing population in Africa, per capita food production has been declining (IFPRI, 1985).

Although several reports (Sauma, 1984; IFPRI, 1985), indicated that between 1961 and 1980, increase in food production in the third world out-paced population growth, food consumption expanded faster than food production leading to more than three fold increase in net food imports. Studies indicated that average annual net imports increased from 12 million metric tonnes in between the years 1966 and 1970 to 38 million metric tons between 1976 and 1980 (IFPRI, 1985).

Trends suggest that a 75 to 80 percent of the increase in food consumption can be attributed to population growth and the rest to income growth (IFPRI, 1985).

It is indicated that Sub-Saharan Africa's rapid growth of net imports stemmed from the region's poor agricultural production performance which caused her exports to decline by 7 percent a year (IFPRI, 1985).

Production

In recent years, African countries have been making substantial efforts to increase agricultural production, with a view to reaching self-sufficiency in food. These efforts have been primarily directed towards increasing the production of staple food crops mainly for commercial purposes and cash crops particularly for export. Consequently, several African countries which were once grain exporters have, within the last decade, become major food importers. Government policies, both during and after the colonial era, which sought to accelerate the commercialization of agriculture (Bakuzara, 1988) failed to upgrade and promote production of traditional food plants. A lack of back-up research provided no emphasis for the development of traditional food plants.

Further, throughout the world today, we see massive over-exploitation of natural resources which has resulted in disaster; desertification and destruction of tropical forests and soils. Each day, an average of one animal or plant species becomes extinct (Juma, 1989). It is thought that many species will disappear completely without having been fully utilised. Similarly, many food plants are no longer being grown and are disappearing from the diet.

2.2 Nutritional problems in Africa

Over the past decade, the food, nutrition and health situation in Africa has been characterized by food shortages, famine, high rates of maternal and child malnutrition, morbidity and death. The major nutritional problems witnessed are protein energy malnutrition and specific micro-nutrient deficiencies as mentioned previously in Section 2.1.2 .

The immediate causes of these problems are low dietary intake and concurrent diseases. Nutritional problems result from household food insecurity and inadequate provision of essential human services such as health, education, clean water, better sanitation and better housing (UNICEF, 1992). Underlying the above are the basic causes linked to political, economic, ecological and socio-cultural constraints that act as powerful causes of malnutrition (UNICEF, 1992).

FAO (1993) and the World Bank (1993), have all pointed to declining per capita food production and inadequate access to food in Africa (Salim, 1990). Reports indicate that 30 of the poorest 42 countries of the world are in Africa, where food shortages, poor health and nutritional problems are widespread.

Inadequate nutrition causes slowing down of growth, resulting in reduced adult weight and height as well as impaired resistance to infections, especially in children under five years of age. African mortality rates in this age group are 40 times higher than in the affluent countries. Reproductive performance of the women and work capacity of adults in countries which cannot afford adequate mechanization are also impaired.

UNICEF and WHO have reported very high rates of child malnutrition and maternal and child mortality related to malnutrition, particularly in Sub-Saharan Africa. Nearly a quarter of the current population in Africa is estimated to be under-weight, a sizeable proportion of which lives in Nigeria, Ethiopia, Zaire and Mozambique (UNICEF, 1990). Other countries which are still affected by internal strife such as Liberia, Somalia and Sudan are severely affected.

WHO (1992) estimates that there are about four million deaths of children under five years in the African region per year.

Malnutrition underlines about 2.5 million of these deaths. In a report on children in the frontline states, UNICEF estimates that the highest infant and child mortality rates in the world are found in the frontline states of Angola and Mozambique where the basic problem of under-development has been compounded by war and economic destabilization (UNICEF, 1988; Salim, 1990).

Evidence suggests that if production and income trends continue in the same direction, and if there is not a considerable increase in the internal production of developing countries, their need for imported food will reach unmanageable figures in the next few years (Sauma, 1985).

2.2.1 Food policy in Africa.

It has now become evident that although most developing countries have the prime objective of providing adequate levels of food, hunger has persisted and in some countries, has reached calamitous levels.

The strategy for improving nutrition in developing countries has long been focused on raising agricultural production levels and increasing economic opportunities for rural populations with the assumption that the desired end would follow. Little consideration, however, has been given to traditional methods of obtaining and selecting food which may provide high returns at a low cost for many people (FAO,1985).

The cultivation of traditional crops has been mainly in the hands of women whose role has to be given the necessary priority because of its importance (FAO, 1983; Mascarenhas et al., 1985). If this is recognized, foreign exchange required to introduce exotic technology and to purchase inputs will be halved and need to import food will be reduced (FAO, 1983).

Longhurst (1983), observes that it is weakness in policy design and in linkages between production and consumption that is responsible for the poor food situation in Africa. Most past policies and strategies have assumed that the complex relationship in agricultural production and consumption have been understood, yet problems associated with seasonality or the role of women in food production have not been addressed.
The phenomenon is not recent. It has its roots in the past (Mascarenhas et al., 1985). During the colonial period, there were changes in food patterns brought about by the necessity to feed workers as cheaply as possible on the plantations and in the mines (Mascarenhas, et al.,1985). Troops and allied personnel also brought changes in peoples' tastes. Rice and maize consumption was given a big boost in both West and East Africa.

2.2.2 Food production and consumption in Uganda:

Food production

Uganda is divided into three broad "food belts". First, the plantain/tuber area. Food crops produced in this area include plantain (green bananas), cassava, sweet potatoes and yams.

This region is found in the South and Central provinces. Secondly, the millet/sorghum area which is found in the Northern and West Nile provinces. Thirdly, the pastoralist/cattle keeping area, which is found in the Karamojong and North Eastern Province.

There is a general belief that Uganda is endowed with a great agricultural potential and that it is impossible to imagine a major food crisis taking place in the country. Reports, however, shows a decline in general food production. The decrease was also observed in 1986 (GOU, 1992). The overall food crop production is reported to have declined at an average rate of 2.7 percent per annum over the past twenty years (GOU, 1992). This decline was confirmed by Mukiibi (1986), who reported that food production per capita declined by 35 percent. Food production has been out-stripped by population which was found to have increased by 71 percent between 1966 and 1986 (GOU, 1992) while food production increased only by 10 percent (Mukiibi, 1988).

2.2.3 Vegetable production and consumption in Uganda: Production

Horticultural production in Uganda is of two kinds.

(a) Commercial production of exotic crops for export.

(b) Production of both exotic and local crops for consumption

Intensive vegetable production is a highly commercialized enterprise and is most often operated by large commercial companies, co-operatives or farmers with land near the town. Commercial horticulture forms an important component of overall government policy and demands an efficient technical extension service committed to increased production of selected exotic species for home and overseas markets. Home horticulture, on the other hand is small scale, less extensive and is consequently often overlooked by male extension staff (FAO, 1983). This situation results in a decline in the promotion of home or household gardens.

Traditional leafy vegetables are gathered from cultivated land near the homestead or from uncultivated bush nearby. In Northern Uganda, it is reported that some plots of one or two different types of these vegetables will be found near the home (FAO, 1983). The Hibiscus spp. and other vegetables are reported to be grown in this way, (Goode, 1985). In Buganda and the eastern part of the country, Solanum species and Gynandropsis gynandra are reported to be the most common local vegetables. Promotion of the production of local vegetables would likely result in increased consumption of these vegetables.

Green leafy vegetables can be grown with minimum effort in small plots and many species are familiar items in the diet. The leaves, however, are very perishable and get spoiled easily after harvesting. If proper means of preservation are not developed, urban people will be in a less favourable situation as the leaves some times are out of season.

2.2.4 Malnutrition and food consumption in Uganda

Malnutrition

One of the major health problems in Uganda as in other developing countries is Protein-Energy-Malnutrition (PEM). According to a UNICEF report (1992), 45% of the under-fives are chronically malnourished and about 5-10% are severely malnourished. Most of the chronic form of malnutrition is reported in the plantain (banana) and cassava growing areas (GOU, 1992).

The major cause of malnutrition has been reported to be inadequate food intake coupled with a high prevalence of infectious disease. Micro-nutrient deficiencies have been reported in parts of the country (UNICEF, 1992).

Protein, vitamin and mineral deficiencies are widespread in both urban and rural communities of Uganda (Mukiibi, 1988). For a greater part of the population, nutrient intakes are low as is evident from the smaller quantities of low quality foods eaten. According to Mukiibi (1988), a typical meal in Uganda consist of two items, a carbohydrate based food such as matooke (plantain) or ugali (thick paste made out of millet flour, cassava flour, maize flour or some root crops such as sweet potatoes or fresh cassava accompanied by a little sauce or soup. Apart from salt or occasionally onions, little else is ever added to these meals.

Mukiibi (1988), pointed out that the Ugandan diet is monotonous and it lacks colour, flavour, aroma or taste. An adequate, well balanced and pleasant meal with minimum effort can be realised if a full potential of traditional food plants are exploited adequately (Mukiibi, 1988).

2.2.5 **Consumption of food plants and their contribution to nutrient intake:**

A change in food taste among Africans threatens to obliterate the knowledge about traditional food plants. Food aid and food imports have a negative impact on our ability and capacity to be self reliant in our food supply (Mukiibi, 1988).

Indigenous vegetables and fruits which were popular in the past are being used less frequently (Jansen et al., 1987). The amount of traditional food plants has steadily diminished as more intensive cultivation has taken place. Exotic vegetables are being planted on a large scale in certain areas (Jansen et al., 1987).

In Uganda, meat, fish, chicken and eggs are eaten on rare occasions and the quantity is insufficient to provide an adequate protein intake (Mukiibi, 1988). The majority of the people in Uganda especially in rural areas cannot afford these protein-rich foods. The main sources of protein in the majority of people's diets are vegetables that are eaten to accompany the mainly starch based-diets, (Mukiibi, 1988).

Leafy vegetables could contribute to a balanced diet particularly in areas where animal protein is deficient. On a dry matter basis, green vegetable compare very well in protein with legumes, (Oomen & Grubben, 1977). Various reports indicate that legume protein ranges from 20 -30 % while that of vegetables has been reported to range between 20 - 45% on a dry matter basis, (Leung, 1968; Oomen and Grubben, 1977). In addition to their considerable amount of protein (Rice et al.,1986), leafy vegetables contribute significant amounts of beta carotene and ascorbic acid (Vitamin C), and minerals, particularly calcium and iron (Rice et al., 1987).

Protein content of the local vegetables of Uganda has not been determined. Likewise, the protein quality of vegetables in general has not been determined. However, work has been done on leaf protein concentrates from tropical green vegetables, (Fafunso & Bassir, 1976). Results from a comparison of numerous vegetables indicated that vegetable protein, especially that of green leafy vegetables, were comparable to that of soya bean protein. This is predicted from their amino acid composition. It was also reported that vegetable protein is high in the amino acids lysine and tryptophan, these two amino acids are limiting in cereals (Muroki, 1992). Vegetable proteins are therefore as good a complement to cereals as are legumes (Jellife & Jellife, 1973).

Vegetable foods are not only the sole source of certain vitamins like ascorbic acid and minerals like calcium, iron and others for the poor rural populations but are also the main source of unsaturated fatty acids such as linoleic, linolenic and arachidonic which do not contain cholesterol (Goode,1987).

More important still, is that vegetables, fruits, root crops and tubers contain many compounds essential for preservation of health. Research findings show that vegetable foods have many desirable compounds like fibre and other non-digestible carbohydrates (FAO, 1987). Further, research has shown that food plants are important source of esterols, flavone and isoflavonoid, trace elements, tocopherol, anti-oxidants, saponin etc. which in certain circumstances play a valuable role in nutrition and the overall health of human beings (Goode, 1987).

The green leafy vegetables are widely available in the wet tropics where they provide protective functions by supplying proteins, vitamins and minerals which are essential to human growth development and prevention of diseases (Latham, 1966; Jellife and Jellife, 1973; Srinkantia, 1973). The vegetables are particularly rich in calcium, iron, carotene (provitamin A), folacin, riboflavine and niacin, Imungi (1983).

2.2.6 <u>Vegetable Consumption in Uganda</u>:

Consumption of green leafy vegetables has been declining in most developing countries and Uganda is not exceptional , (Jellife and Jellife, 1973). This is probably due to the fact that they are considered low status foods, perhaps because they are inexpensive, grow wild or are minimally cultivated in home gardens.

Although Uganda is a country where leafy vegetables can be grown more or less throughout the year, previous nutrition surveys do not indicate any significant consumption of these vegetables (Cooper, 1946; Grand, 1957; (cited in FAO, 1985). Reports indicate that a well-off family used green leaves only once a year while a middle income group used green leaves 16 times a year and poor families used green leaves 14 times a year (Grand, 1957), cited in (FAO, 1985). In a survey carried out in 1968, in four districts of Uganda (Ankole, Busoga, Masaka and West Nile), only four varieties of vegetables were found to be commonly used, these were the ntula berries (Solanum gilo), pumpkin leaves (Cucurbita pepo) and doodo (Amaranths species). Data related to requirements and consumption of vegetables indicate that among a very large proportion of the population, the quantities of vegetable consumed are inadequate (Grand, 1957), cited in FAO (1985).

In Uganda, the predominal diet consist of starchy staple food plus what is referred to as "side dish or sauce". The staple food crops in the South and Western Uganda is the plantain or green banana and in the East and Northern Uganda is a grain crop usually finger millet or sorghum. The two main staples, the starchy roots and tubers, the plantain and the grain crops provide the energy required by the body but these crops are low in protein and other nutrients. Protein content of plantain and cassava is (1.5g and 1.2g) respectively.

The cereal crops although better in protein quality than maize, they are low in vitamins A and C, calcium and iron (FAO,1985), hence vegetables are good supplement for those staples.

There is therefore the need to encourage vegetable production and consumption particularly locally available plant species; and to promote their use in the diet.

2.2.7 **The role of traditional food plants in increasing household food security:**

Food insecurity is one is one of the major under-lying causes of malnutrition. Traditional food plants such as sorghum, millet and cassava are drought resistant, they can be grown under harsh ecological conditions (FAO, 1985). Millet and sorghum are cereal crops which contain about 8-9 g protein per 100 g and it is of better quality than the protein found in maize. They are quite rich in calcium, iron and b-vitamins.

Seasonality is one of the major problems that results in household food insecurity. The harmful effects of seasonality are felt by all age groups but the children are more affected because of their vulnerable state. Child mortality has been found to be at its peak in the pre-harvest period (UNICEF, 1980; FAO, 1992). Families headed by women and those with large numbers of children are particularly vulnerable to seasonal changes.

Traditional food plants have higher nutritional value than the exotic food plants (Muroki, 1992). In addition to these, traditional food plants require low inputs. Increased production of these food plants would enhance food security. Vegetables could contribute to improved intake of micronutrient.

whereas information about cereal crops, roots and tubers is available, there is little known about traditional vegetables, their contribution to nutrient intake and their role in alleviating micro-nutrient deficiency needs to be investigated.

Some crops have a dual value both as leafy vegetables and also as fruit or tuber producing crops, examples of such crops are pumpkins, cassava, cocoyams and several leguminous crops.

2.3 Provitamin A (beta-carotene):

Various reports indicate that vegetables and their products could be richer sources of provitamin A (beta-carotene) than the animal products (FAO, 1993) this is an important fact especially for populations who are socio-economically deprived, in that they do not need to rely solely on more costly animal sources and products for this vitamin.

Other reports also indicated that in many regions carotenes provide the largest share of vitamin A in diets (80% in Africa and 86% in Asia) (FAO, 1993).

Evidence collected shows that when dark green leafy vegetables are considered as sources of beta-carotene, their physiological condition is as significant as their species. The time lapse between harvest and consumption is obviously an important factor and its effect on beta-carotene should be studied with all the green leaves in the market. It is argued that there is little point in making leaf protein for adults when as much protein and beta-carotene could be supplied by increased use of the dark green leafy vegetables.

2.4 Ascorbic acid

Serious Vitamin C deficiency has not been reported in Uganda. This is probably because all fresh plant tissues utilized for food contain ascorbic acid and Uganda is blessed with a variety of edible plants (Goode, 1983) both wild and cultivated. Sub-clinical state of malnutrition may however exist.

Ascorbic acid (Vitamin C) is a water soluble nutrient which human beings have to obtain from their diets. Lack of ascorbic acid in humans results in scurvy, a condition characterized by numerous haemorrhages (Davidson and Passmore, 1976).

The Vitamin C content of vegetables is comparable to that of fruits and in some cases is higher (Omen and Grubben, 1977) particularly in dark green leafy vegetables (Jellife & Jellife, 1973; Srinkantia, 1973; Oser et al., 1976; Fafunso, 1976; Sreeramulu et al., 1982; Imungi and Potter, 1983; Mwajumwa, 1990). Similarly, vegetables are the main sources of vitamins as well as the provitamin beta-carotene. Leaf vegetables even in small quantities per day, could easily satisfy the Vitamin C, requirements of children and adults

2.5 Anti-nutrients in vegetables:

In vegetables, one of the most common anti-nutrients is oxalic acid which lowers the availability of minerals by forming oxalate salts with them. In general, foods with a high content of oxalic acid contain insufficient calcium to combine with the acid (Mwanjumwa, 1990). This excess oxalic acid will thus react with calcium from other sources in the diet making it unavailable for the body's absorption.

Among 37 leafy vegetables, in the Philippines, Amaranths viridis, was found to contain the highest level of oxalic acid; (ie over 2% anhydrous oxalic acid on a fresh weight basis). Talinum triangulare, Portulaca oleracea, Corcorus olitorius and Basella rubra had between 1 and 2% of the acid. Hodkinson (1947) reported that many of the leafy vegetables eaten in Asian countries, are generally high in this acid. Amaranths species are good examples of these vegetables (Mwanjumwa, 1990).

To obtain an adequate amount of nutrients, people should be advised on how best to feed their families with a variety of food plants available in particular area. Appendix 2, provides the recommended intake of certain nutrients by human beings.

CHAPTER THREE

3.1 INFORMATION ON THE STUDY AREA:

The field study and part of the laboratory analyses were carried out in Uganda. Uganda is one of the three East African countries. It is bordered by Sudan in the North, Zaire in the West, Tanzania in the South and Kenya in the East.

Population.

The 1991 population and housing census in Uganda showed a total of 16.6 million people. The average annual population growth rate was 2.5 percent (GOU, 1991), while the crude population growth rate was 2.7 percent (GOU, 1991).

About 90% of Uganda's population lives in the rural areas. Kampala city, with a population of 773,000 is the major town, but there are other 15 urban centres with populations between 20,000 and 61,000 (GOU, 1992).

Resource potential

Uganda covers an area of 241,000 sq. Km. of which 197,000 sq. Km. is land. About 84 percent of this land is suitable for agriculture. Forests cover about 8 percent of the area and national game parks and game reserves cover about 7 percent.

Most observers agree that Uganda has an enormous agricultural potential which could be utilized to develop products for both export and domestic use. The country is endowed with fertile soils and generous rainfall. Temperatures in most parts of the country are conducive to crop and livestock production. There are, however, areas which have low rainfall i.e less than 1000 mm/year. These are most notable in the north, in Karamoja District in particular and also in the south around Mbarara.

Uganda's lakes are rich in fish. Fishing and the related industry provide employment to about 29,000 families (GOU, 1992). The catch between 1990 and 1991 was estimated to be 245,000 tonnes worth, about U.S.$ 34 million.

Uganda has considerable mineral resources. The mining sector is, however, small. There is small scale mining of tin ore, wolfram, bismuth, tantalite, beryl and gold. Exploration for oil, gold, iron ore, cobalt and nickel ore are under way (GOU,1992). The country has a considerable hydro power resource although utilization is said to be negligible. The power generating facilities deteriorated during the period of civil unrest and therefore the Uganda Electricity Board is not able to meet the domestic electricity demand.

Administrative structure

Administratively, Uganda is divided into 10 Regions, 38 Districts, a number of Town Councils, Counties, Sub-counties and villages. The administrative structure consists of two lines. One under the Ministry of Local Government which operates from the District level downward to the villages and the other under the technical line ministries which operate from the Regional level downward.

Economic Structure

The economy of Uganda is predominantly agriculture, and food crops account for 80 percent of the gross domestic production. Livestock accounts for 13% and the traditional activities each account for 3%. The agricultural sector employs about 80 percent of the economically active population and contributes about 67 percent of the Gross Domestic Products (GDP) and more than 90 percent of the export earnings. Sixteen percent of the households, however, neither own nor have access to any land.

Agricultural production is primarily undertaken by the small holders working in low cash input and low risk production systems, producing different food and cash crops and integrating crop production with livestock keeping. Generally, yields are reported to be low and the marketed surplus is limited. There are reported to be only a few large specialized farms with intensive production systems. Small holders produce food primarily for their own consumption although certain food crops have become important cash/export crops for them.

3.2 STUDY SITE

The study site was in Mukono District which is located in the central region of Uganda, 19 miles East of Kampala, the capital city. It lies between the longitudes 32 30°E and 33 26°E and latitudes 0 13°S and 1 27°N (GOU, 1992).

Mukono District borders the following Districts: Jinja and Iganga in the East, Kamuli in the North - East, Lake Kyoga or Lira in the North, Lake Victoria in the South and Mpigi and Luwero in the West.

Mukono District has an area of 14,242 sq. kms, of which 84,960 hectares is covered with forests. The rest is an arable land.

Soils

The soil of Mukono District is said to be naturally fertile. It is composed of the red and brown sandy loams. It is mixed clay and sand in the drier areas and heavy clay loam in the wetter areas.

Vegetation

On the slopes, elephant grass is the predominant vegetation while equatorial forests and papyrus are predominant in the valleys. The drier areas towards the North have short grasses with scattered savanna bushes on the slopes. Natural farm land consist of mainly Brancharia ruzizies (Kifuta) with patches of Cynnadom dactylon (Kalandalugo).

Climate

The District has a hot tropical climate. Temperatures vary between 16_o and 27°C with a peak temperature of 28°C in February (GOU, 1992).

Rainfall

The District has a bimodal rainfall each year. There are heavy rains between March and May and light ones between July and November. There are, however, some variation which occur in different places (GOU, 1992).

Population

There are 816,200 people in Mukono District (GOU, 1992), 407,900 of whom are female and 408,300 are male. The population in the urban area is 93,000 while 723,200 are in rural areas (GOU, 1992).

Mukono District has seven counties with a total of 30 sub-counties. The main language spoken is Luganda.

Economic activities.

The economic activities of the District are mainly based on agriculture with an emphasis on the following :-

Cash crops: cotton, coffee, sugar cane, tea.
Food crops: cassava, sweet potatoes, beans, maize, finger millet, groundnuts, soya beans, bananas, sorghum, simsim, cow peas, pigeon peas and yams.

Fruits and vegetables:- Tomatoes, onions, pineapples, vanilla, chilies, passion fruits and cabbages (GOU, 1992).

CHAPTER FOUR

4.1 RESEARCH METHODOLOGY

A cross- sectional study / descriptive in nature was conducted in Mukono District, Buganda region, in the central part of the country. The study was conducted in a community whose main economic activity is agriculture.

4.2 Sample population and sampling procedure:

The sample size was agreed upon by the researcher and the supervisors taking into account plausibility of results since the prevalence of lack of familiarity with the traditional food plants was not known. The study was carried out in 3 counties. The main study unit was the household. A total of 100 households were selected for the study. The households were selected with the help of the agricultural assistants and were distributed as follows:- 34 households in Nakifuma county, 33 households in Buikwe county and 33 households in Mukono county . In each household, the head of the household was interviewed, and in his/her absence, the eldest son/daughter. The average number of households selected in each village was sixteen.

4.3 Sampling procedure:

Buikwe, Nakifuma and Mukono counties were purposively selected, with the help of the District Agricultural Officer (DAO), because they were said to be the main food producers in the district (GOU, 1992). Secondly, they are reported to have similar climatic conditions and more or less produced similar types of food crops. Thirdly, logistic limitations were also considered.

Sampling was done as shown in Figure 1 (a). In each of the three counties, three out of 6 sub-counties were selected by simple random sampling. Further, from the sub-counties four parishes were selected from the sub-counties by simple random method. From the 4 parishes, two villages were also selected using the simple random method. The sampling units were the households, a list of which had been obtained from the agricultural assistants. Systematic method of sampling was used for the selection of the households.

4.3.1 **Figure 1**

SUMMARY OF SAMPLING PROCEDURE

MUKONO DISTRICT

(COUNTIES) BUIKWE MUKONO NAKIFUMA

Purposive Sampling

6 SUB-COUNTIES 6 SUB-COUNTIES 6 SUB-COUNTIES

Random Sampling

PARISHES 4 4 4

villages

2 2 2 2 2 2

1 1 1 1 1 1

(Simple random sampling)

HHS 16 16 18 18 16 16

6 villages selected

Buira
Namaliiri
Kigayaza
Mindi
Namuyenje
Grammar

100 Households selected by systematic method of sampling

4.4 Type of data:

The data collected / analyses carried out were:

(a) Information on demographic characteristics of the community in the study area.

(b) Information about the use of traditional food plants, production and consumption levels.

(c) Limitations on production and consumption of traditional food plants

(d) Proximate chemical composition of local vegetables

(e) Vitamins, minerals and oxalate contents of selected vegetables

4.4.1 (a) Tools used:

Data were obtained using the following procedures

(i) Rapid Assessment procedure (R.A.P)

(ii) Questionnaires (Appendix 5).

(iii) Laboratory Analysis

4.4.1 (b) Focus Group Discussion (R.A.P):

Focus group discussion was used to obtain information about traditional food plants from the elders. The group discussions were carried out in the three counties. Each discussion had 15 elders both males and females of about (45-65) years old. The elders discussed in their own native languages. The discussions were tape recorded and later translated. The elders did not object to the recording and if anything they were very delighted to hear their voices again.

4.4.1 (c) **The questionnaires**

The following information was obtained using the questionnaires: The demographic characteristics of the sample population, information about the traditional food plants, production and consumption levels of the traditional food plants, amounts of food sold etc. Constraints in the production and consumption of traditional food plants were also obtained using the questionnaires.

4.4.2 **Training of enumerators:**

Four agricultural assistants from the different counties were the enumerators. The agricultural assistants were senior leavers who attended a two years training in an agricultural institute in Uganda. They were employees of the Ministry of Agriculture, they were employed as extension workers in the District. I trained them for two days at Mukono District headquarters on how to administer the questionnaires properly.

4.4.3 **Testing of survey instrument**

A pilot study was conducted in an area adjacent to the study area. The questionnaires were pretested and the data collected was analyzed and interpreted. Necessary modifications in the questionnaires were done accordingly.

The field assistants fully participated in the pilot study.

4.4.4 **Validity and Reliability of the data:**

The research was closely supervised, questionnaires were checked at the end of each day for correctness and completion. The recorded discussions of the elders were translated and counter checked by experts who know both English and native languages fluently. The chemical analyses were done in triplicate. These measures were necessary to ensure the validity and reliability of the data.

4.4.5 **Data analysis:**

The survey data was entered and cleaned using the computer package Data Base 111. The data was then transformed into the Statistical Package for Social Science (SPSS) for analysis. Laboratory results were recorded directly in Word Perfect programme, computations were done in (SPSS). Graphs were drawn using the Havard Graphics Package.

4.5 **Laboratory analysis:**

Samples of local vegetables were purchased from local markets in Uganda. Part of the laboratory analysis was carried out in Uganda, at Makerere University, Department of Biochemistry. Vitamins A and C analyses were carried out using the fresh vegetable samples. The other part was completed at the University of Nairobi, Department of Food Technology and Nutrition, using the dried samples of the same vegetables.

4.5.1 **Selection of vegetables for lab. analysis**

Halve the number of the vegetables were selected on the bases that they are commonly consumed by the majority of the people. The other halve were selected because they are no longer being consumed by the community, hence some of the neglected food plants.

4.5.2 Samples of vegetables for preparation:

A number of the assayed vegetables were traditionally prepared to observe the effect of the traditional method of vegetable preparation on the ascorbic acid levels of the vegetables. The selected vegetables were :- cowpea leaves (Vigna unguiculata), African spiderherb (Gynandropsis gynandra), Nakati (Solanum ethiopicum), Ntula (Solanum gilo), Malakwang (Hibiscus sabdarriffa). These are the most commonly used vegetables in different regions of Uganda.

4.5.3 Preparation of vegetables (using traditional methods):

The vegetables used were purchased from the markets and prepared as follows:- .

1. Cowpea leaves (Vigna unguiculata):

   The leaves were sorted, chopped into small pieces and washed. Some water was put in a saucepan and allowed to boil. Some liquid local salt (crude sodium bicarbonate) was added into the water to soften the leaves. The chopped vegetable was placed into the boiling water, and allowed to cook to softness. Excess water was drained off.

2. Ejjobio (Gynandropsis gynandra):

   For this vegetable, both stems and leaves are used. The vegetables were chopped into small pieces and washed and then boiled until soft. Salt was added.

3. Nakati (Solanum ethiopicum)

The vegetables were sorted. Both the stems and leaves are used. The vegetables were chopped into small pieces and then boiled until soft and later fried in 100 ml of oil.

4. Ntula (Solanum gilo):

The ntula berries were washed and cut into small pieces. They were boiled for a while and later fried with onions using 100 ml oil.

5. Malakwang (Hibiscus sabdarriffa):

Leaves and shoots were removed from the stock, washed and cooked until soft. Excess water was drained off to make the vegetable less sour.

4.6 LABORATORY ANALYSES

4.6.1 Proximate and mineral analyses:

Preparation/preservation of samples:

Food samples were lyophilized upon arrival at the laboratory and their moisture content determined. Each vegetable sample was then ground into a homogenous sample and analyzed in triplicate.

Procedure:

Proximate Composition: The samples were analyzed for proximate composition according to AOAC methods, (1980) as follows:

Crude protein: by Kjeldahl nitrogen determination method.

Crude fat : by the Goldfinch hexane extraction method.

Crude fibre : by the acid-detergent method of Van Soest (1963).

Ash : by use of an electric muffle furnace at (500-550 °C).

Iron and calcium: These were determined according to AOAC (1980) methods.

The vegetable samples were dry ashen in a muffle furnace at 550 °C for 12 hrs. The resultant ash was dissolved in 20% HCl, diluted to an appropriate volume and its absorption read in an atomic absorption spectrophotometer at 450 nm. The amount of calcium and iron was determined using appropriat[illegible] (Department of Animal Production), University of Nairobi.

Oxalate: by method developed for chemistry practical, Department of Food Technology and Nutrition, University of Nairobi (Imungi, 1993).

Oxalate Content:

Materials and reagents:

- Dried material (local vegetable) 1g
- 1 N (hydrochloric acid) HCl
- Water bath
- pH meter
- 8 M Ammonium hydroxide (NH_4OH)
- 6 M Acetic acid (CH_3COOH)
- 5% Calcium chloride ($CaCl_2$)
- Centrifuge
- 0.5 M Sulphuric acid (H_2SO_4)
- 0.1 Potassium permanganate ($KMnO_4$)
- Whatman's filter paper No. 1

Method:

1. One gram of the dried material was extracted with 30ml 1N HCl (for total oxalate) by placing the material in a water bath at 100°C for 30 minutes. It was then shaken and filtered through Whatman filter paper No 1 after cooling.
2. The pH was adjusted to over 8 with 8M NH_4OH.
3. The pH was again adjusted to 5.0 - 5.2 with 6M CH_3COOH.

4. A 2x10ml sample was taken and precipitated with 0.4ml of 5% $CaCl_2$. The sample was shaken thoroughly and allowed to settle at room temperature for at least 16 hrs.

5. The sample was centrifuged at 3000 rpm for 15 minutes. The supernatant was then discarded and the sample rinsed with 2ml of 0.35M NH_4OH twice, and the cake was drip dried.

6. The pellet was dissolved in 10ml 0.5M H_2SO_4 and titrated with 0.1M $KMnO_4$ at 60 C to a faint violet colour that was stable for at least 15 minutes.

Standard: 2-3mg oxalic acid, dissolved in 10 ml 0.5M H_2SO_4 was titrated as above using micro-pipette. 0.5M H_2SO_4 was titrated as blank.

4.6.2 Ascorbic Acid (Vitamin C) analysis:

Vitamin C was determined using the method of (Barakat & Sadr, 1955) as follows.

Materials and Reagents:

- 5% Metaphosphoric acid solution.
- 2, 6 - Dichlorophenol-indophenol reagent (prepared by dissolving 0.05g of 2, 6 - Dichlorophenol indophenol in distilled water, diluted to 100ml and filtered).
- Ascorbic acid standard solution (prepared by dissolving 0.05g of pure ascorbic acid in 5% metaphosphoric

acid solution and diluting to 250 ml. with the same metaphosphoric acid solution).

- A balance.
- A blender, filter papers, pipettes and burettes.

Procedure

- 30g of each vegetable sample was macerated in a blender with 100ml of 5% metaphosphoric acid to extract the Vitamin C and to stabilize the macerate.
- This was filtered to separate the residue from the juice, and then a little 5% metaphosphoric acid solution was added to wash down the residue on the filter paper.

Standardization of 2, 6 - Dichlorophenol indophenol Reagent:

- 10% of the ascorbic standard solution was titrated with 2,6 Dichlorophenol indophenol (DCPIP) reagent to a slight pink end point.
- 10ml of 5% metaphosphoric acid was titrated as a blank.
- The amount of ascorbic acid corresponding to 1 ml of DCPIP was calculated using the difference between the two readings above.

The amount of Vitamin C was calculated as follows:

- 10 ml of the juice was titrated with 2, 6-DCPIP reagent. Vitamin C content was calculated and expressed as mg of ascorbic acid per 100g of vegetables on fresh weight basis (Barakat & Sadr, 1955).

4.6.3 Vitamin A analysis:

The Vitamin A activity of the local vegetables was determined by analysis for total carotene content using the official AOAC method (1980) No: 43.014-017 for fresh samples with modifications. **

Determination of beta-carotene in local vegetables

Materials and Reagents

- Fresh vegetables (30g)
- Mortar and pestle
- Funnel
- Filter paper
- Separatory funnel
- Rotary evaporator
- Measuring cylinders
- Pipettes
- Beakers
- Solvent 1: extracting solvent,

  light petroleum (40-60 C) : Acetone

  2 : 1

  Solvent 2: eluting solvent.

  light petroleum : Benzene : Ethanol

  100 : 20 : 7
- Balance
- Standard solution: Made by dissolving 0.05g of Potassium dichromat in 100 ml distilled water.

Procedure:

- 30 g of fresh vegetables was crushed in a mortar with 100 ml acetone and about twice as much light petroleum
- The green pigment was filtered to separate the pigment from the pulp .
- The residue was then repeatedly washed with water into a separatory funnel.
- The organic phase was carefully separated from the aqueous phase.
- The green pigment was dried under vacuum at 60°C.
- While the sample was drying, a chromatography column was prepared as follows:- 30 g of silica gel was weighed. solvent 2, 20 ml was placed in a conical flask and silica gel put into the solvent little by little while the flask was swirled slowly and then vigorously to form a slurry.
- A small plug of glass wool was placed at the bottom of the column .
- 3 ml of light petroleum (40-60°C) was pipetted into the column and then drained until about 1 cm of light petroleum was left at the bottom.
- The slurry was swirled vigorously and poured quickly into the column to form a bed.
- Sides of the column were washed down with light petroleum (40-60°C)
- The pigment was dissolved in 1 ml of solvent 2 and then carefully introduced into the column.
- This was drained into the column bed .

- Beta-carotene was eluted with solvent 2 .
- Beta-carotene ran down the column as a yellow-orange pigment and was the first to be eluted with the mixture of petroleum:benzene: ethanol in the ratio of 100 : 20 : 7
- The pigment was collected in test tubes and then dried under vacuum at 60°C.
- The dried pigment was weighed.
- It was then put into a 50 ml volumetric flask and the volume was made up to the mark with light petroleum.
- The solution was read at 450 nm wavelength in a spectrophotometer.

4.6.4 Vitamin C content of cooked vegetables:

The ascorbic acid content of the prepared vegetables was determined using the same method of analysis used for fresh vegetables above.

CHAPTER FIVE

5.1 RESULTS

In this chapter, the results of both the field survey and the laboratory analysis are presented. In Section A, the field survey results are presented, as demographic characteristics of the population, viz, education levels and employment status. Production and consumption levels, constraints in the production and consumption of traditional food plants are also presented. In Section B, results of laboratory analyses are presented.

5.2. Section A: RESULTS OF THE FIELD SURVEY:

In total, there were 98 households studied, whose distribution in the three counties as follows:- 33.7% of the households were in Buikwe, 33.7% in Nakifuma county and 32.6 % in Mukono respectively.

5.2.1 Distribution of household members by county:

General population characteristics: Altogether, in the 98 households there were 616 persons, of whom 300 (48.7%) were males and 315 (51.3 %) were females.

Of the 98 households, slightly more than three quarters (78.3%) were headed by males while 21.7% were headed by females. This population distribution is similar to that of most populations in Africa.

5.2.2: Educational level of the community members:

The overall literacy level was 77.3 % . The educational levels of the sample population members were distributed as follows:- 36 (5.8%) were non-literate, 334 (54.2%) had primary education, 173 (28.1%) had a higher level of education, and 73 (11.9%) were children of pre-school age.

It is noted that Mukono county had the highest level of education with approximately 12 % at an educational level of higher education plus professional training compared with about 9.0 and 7.6 in Buikwe and Nakifuma respectively. Nakifuma, however, had the highest proportion of children in primary school (22.7%) and it also had the highest percentage of illiteracy (4.5%) compared with Buikwe and Mukono which had 0.8 and 0.5 % of illiteracy respectively.

Table 1: Distribution of educational and training level by county:

County	Education level *									
	0		1		2		3		Total	
	n	%	n	%	n	%	n	%	N	%
Buikwe	5(0.8)		112(18.2)		55(9.0)		31(5.0)		203(33.0)	
Mukono	3(0.5)		82(13.3)		71(11.6)		31(5.0)		187(30.3)	
Nakifuma	28(4.5)		140(22.7)		47(7.6)		11(1.8)		226(36.7)	
Total	36(5.8)		334(54.2)		173(28.1)		73(11.9%)		616(100)	

Note: 0 = no education 2 = higher education level
1 = primary education 3 = Children at pre-school age

5.2.3 <u>Distribution of household members by age group:</u>

The total proportion of the economically active population (15-65 years) in the three counties was 54.1 % while the proportion of the population above 65 years of age was very small (1.6%).

In Table 2, it is shown that Buikwe and Nakifuma counties had higher proportion of the population who were less than 15 years of age (16.2% and 17% respectively) than did Mukono county which had (11%).

Table 2: Distribution of sample population according to age groups by county:

County	Age groups years							
	< 15		15-65		> 65		Total	
	n	%	n	%	n	%	N	%
Buikwe	100	(16.2)	103	(16.7)	0	(0.0)	203	(33.0)
Mukono	68	(11.0)	117	(19.0)	2	(0.3)	187	(30.4)
Nakifuma	105	(17.0)	113	(18.3)	8	(1.3)	226	(36.6)
Total	273	(44.3)	333	(54.1)	10	(1.6)	616	(100)

5.2.4 Occupation of the household members :

As seen in Table 3, 20 % of the population in the study area were farmers, 44.2 % were students and 18.7 % were people not employed. The rest were distributed as seen in Table 4.

Table 3: Distribution of household members occupation by county

County	Occupation							
	1	2	3	4	5	6	7	Total
	%	%	%	%	%	%	%	N
Buikwe	6.8	15	2	0.5	5.3	2.4	1.3	203
Mukono	5.5	12	2	1.1	7.3	3.0	0.0	187
Nakifuma	7.8	18	2	0.8	6.1	1.3	0.6	226
Total	20	44.2	6	2.4	18.7	6.8	2.0	616

* Occupation code.

1 = Farmers

2 = Students

3 = House wife

4 = Professionals (teacher, lawyer, doctors, etc.).

5 = Un-employed

6 = Any other business

7 = No answer.

5.3 **Main sources of food crops in Mukono District:**

The results in Table 4 show that only three crops were consistently ranked as the first, second or third most important crops. Cassava, sweet potatoes and matooke respectively were ranked as 1, 2 or 3 by 93, 92 and 74 % of the respondents.

Cassava was the most important crop and was ranked number 1 by 60.2 % of the respondents, matooke and sweet potatoes were ranked number 1 by smaller proportions (ie 26.5 % and 7.1 % respectively).

Although some people (26.5 %) mentioned matooke as the first most important crop, many more people (63.3 %) mentioned sweet potatoes as the second most important crop compared with (9.2 %) who mentioned matooke as the second most important crop. Thus sweet potatoes are apparently the second most important crop while matooke is the third most important crop. It was mentioned by 37.8 % as the third most important crop compared with 22 for sweet potatoes.

This trend was also evident when the ranks were converted to scores (6 to 1) as seen in the footnote for Table 6. According to the scores, cassava had the highest mean score of (5.4), followed by sweet potatoes (4.7), then matooke (3.9). Beans, maize and groundnuts had the fourth fifth and sixth mean scores respectively. Support for the rankings was evident during the researcher's observation. The staple food crops are eaten in accompaniment with beans, groundnuts and others.

Table 4: **Proportion of persons giving foods different ranks according to their importance as main food sources:**

N = 98

Rank	Types of food crops and proportions reporting them					
	Cassava	Matooke	Sweet potatoes	Maize	Beans	Ground nuts
	n %	n %	n %	n %	n %	n %
1	59 (60.2)	26(26.5)	7 (7)	2 (2)	0 (0)	0 (0)
2	23(23.5)	9 (9)	62 (63)	0 (0)	1 (1)	0 (0)
3	13(13.3)	37(38)	22 (22)	14 (14)	9 (9)	0 (0)
4	1 (1)	8 (8)	5 (5)	18 (18)	39(40)	0 (0)
5	1 (1)	7 (7)	2 (2)	15 (15)	18(18)	22 (22)
6	1 (1)	0 (0)	0 (0)	12 (12)	14(14)	9 (9)
Total	98(100)	87(89))	98(100)	61(62)	81(83)	31(32)

Food plants are arranged in descending order of importance
MSF = Main source of food according to rank:
Rank= 1, 2, 3, 4, 5, 6.

Table 5: **Total and mean scores of different food crops**:

Crops	Total scores	Mean Scores
Cassava	527	5.4
Matooke	387	3.9
Sweet potatoes	459	4.7
Maize	164	1.7
Beans	208	2.1
Groundnuts	53	0.5

This Table is derived from Table 5
Scores given to each rank: 1 = 6, 1 =5, 3 = 4, 4 = 3, 5 = 2, 6 =1

5.4 Food production in Mukono District and quantities produced/year:

Most people produce the staple crops in amounts varying from 1000 - 5000 kgs/year, while beans, groundnuts, rice, yams and other foods were produced by practically all the respondents (88-94) in quantities of 500 kgs or less, Table 6(a). The highest production reported was that of cassava. This was above 100,000 kgs/year. It is, however, noted that this was reported by only one of the respondents. If the total food production is taken, Table 6 (b), cassava appears to be the most widely produced food crop in the study area, followed by sweet potatoes and matooke. This confirms the observation made earlier [Section 5.3]. It is also evident in Table 6, that maize, beans, groundnuts, yams, rice and other crops are produced in quantities less than 500 kgs/year. Only small proportions of the respondents reported quantities up to 5000 kgs/year. Maize and rice are reported to be mostly purchased at the time of need and are not produced at the household level (Table 8).

Table 6(a): Number of persons producing different amounts of different types of food plants.

Amount in kgs per year	Types of Food Crops								
	Cassava	Matooke	S. Potatoes	Maize	Beans	G.nuts	Yams	Rice	Others
< 500	11	25	17	94	88	93	94	98	94
501 - 1000	15	12	12	2	3	2	3	-	3
1001 - 5000	27	35	32	2	6	1	1	-	1
5001 - 10000	16	9	12	-	-	1	-	-	-
10001 - 25000	14	11	21	-	-	-	-	-	-
25001 - 50000	11	2	4	-	-	-	-	-	-
50001 - 100000	3	4	-	-	1	-	-	-	-
>100000	1	-	-	-	-	-	-	-	-
TOTALS	98	98	98	98	98	98	98	98	98

(-)' designates missing figures, because foods are not produced [N = 98]

Table 6 (b) Total production levels of different food crops:

Amount in kgs per year	Types of Food Crops								
	Cassava	Matooke	S. Potatoes	Maize	Beans	G.nuts	Yams	Rice	Others
0 - 500	2750	6250	4250	23500	2200	23250	23500	24500	23500
501 - 1000	11257.5	9006	9006	1501	2251.5	1501	2251.5	-	2251.5
1001 - 5000	162027	210035	192032	12002	36006	6001	6001	-	6001
5001 - 10000	120008	67504.5	90006	-	-	7500.5	-	-	-
10001 - 25000	245007	192505.5	367510.5	-	-	-	-	-	-
25001 - 50000	412505.5	75001	150002	-	-	-	-	-	-
50001 - 100000	225001.5	300002	-	-	1	-	-	-	-
>100000		-	-	-	-	-	-	-	-
Total	1178558	860305	812807	37003	40458	38253	31753	24500	31753

This Table was derived using mid-points of the ranges shown in Table 6.

1.4.1 Different food crops and the amounts consumed

Table 7(a) shows the different food crops and proportion of persons mentioning different levels of consumption. For the staple food crops, the majority of the people consume amounts ranging between 1000-5000kgs /year. For sweet potatoes, levels of consumption of up to 25000kgs/year have been reported by about a quarter of the respondents. Table 7(b) shows the total consumption of different food crops. The data in this table is similar to the data on the production levels of the different crops with only a very slight difference. This shows that most of the food produced is consumed leaving little supplus if any.

Table 7a Different levels of consumption of different food crops by households in Mukono District

Amount consumed in kgs/year	Types of Food Crops								
	Cassava	Matooke	S. Potatoes	Maize	Beans	G.nuts	Yams	Rice	Others
< 500	15	25	20	90	93	95	95	94	94
501 - 1000	18	18	16	4	3	2	2	4	3
1001 - 5000	30	33	40	3	1	1	1	-	1
5001 - 10000	13	11	13	-	-	-	-	-	-
10001 - 25000	13	5	7	1	1	-	-	-	-
25001 - 50000	8	2	2	-	-	-	-	-	-
50001 - 100000	1	3	-	-	-	-	-	-	-
>100000	-	1	-	-	-	-	-	-	-
TOTALS	98	98	98	98	98	98	98	98	98

Table 7 (b): Different levels and total consumption of different food crops by the households :

Amount consumed in kgs/year	Types of Food Crops								
	Cassava	Matooke	S. Potatoes	Maize	Beans	G.nuts	Yams	Rice	Others
< 500	3750	6250	5000	22500	23250	23750	23750	23500	23500
501 - 1000	13509	13509	12008	3002	2252	1501	1501	3002	2252
1001 - 5000	90015	99017	120020	9002	3001	3001	3000	-	3001
5001 - 10000	97507	82506	97507	-	-	-	-	-	-
10001 - 25000	227507	87503	122504	17501	17501	-	-	-	-
25001 - 50000	600008	150002	150002	-	-	-	-	-	-
50001 - 100000	75001	225002	-	-	-	-	-	-	-
>100000	-	100000	-	-	-	-	-	-	-
Total	1107297	763789	507041	52005	46004	28252	28251	26502	28753

Table 7 (b) is derived from Table 7 using mid-points of the ranges.

5.4.2 Mean production, consumption and amounts of food crops sold.

Table 8 shows that most of the food crops produced in Mukono District, the community sell some of it to obtain cash. The data also indicates that only little maize is produced and non of the maize is sold in Mukono county but some little maize is sold in Buikwe and Nakifuma counties. Rice is totally not produced in the study area. This confirms what the community mentioned earlier that rice and maize are purchased during time of need.

Table 8: Mean annual production, consumption, and amounts of different foods sold in kg/year by county:

COUNTIES	BUIKWE			MUKONO			NAKIFUMA		
Main food crops	prod kg	cons kg	sold kg	prod kg	cons kg	sold kg	prod kg	cons kg	sold kg
Cassava	2474	2296	254	17433	6911	9395	19315	14466	1432
Matooke	6915	36825	538	7841	3600	4504	7575	5221	2472
S.potatoes	1793	1297	195	10206	4573	5045	11037	7727	1975
Maize	110	131	000	160	141	145	260	929	117
Yams	190	173	109	141	149	100	120	108	99
G.nuts	145	134	120	1555	291	326	133	128	129
Beans	131	108	105	2368	867	1402	496	314	152
Soy beans	100	97	98	97	91	98	138	103	109
Rice	000	112	000	000	166	000	000	110	000
Others	149	199	158	91	97	97	187	166	105

Prod = production, cons = consumption, sold = amount of food sold.

5.5 **Availability of different food crops:**

The Tables 9(a) and 9(b) give traditional crops and some exotic crops as widely available. It is observed that the most widely available food crops are mainly the staple crops, as shown by the proportion of households growing them, Cassava (Manihot esculenta), was reportedly grown by 100% of the respondents, Matooke (Musa species) by 92.9% ; sweet potatoes (Ipomea batatas) by 91.8% ; maize (Zea mays) by 73.5% ; and "mayuni" (Colocasia esculenta) by 66.3% . Other staples which are less frequently grown are millet (Eleusine corocana) and sorghum (Sorghum bicolor) reported by 21.4 and 6.1 % of the respondents respectively . The most widely grown legumes are beans (Phaseolus vulgaris) reported by 77.6% of the respondents and soya beans (Glycine max) reported by 54.1% of the respondents.

A variety of fruits and vegetables, both exotic and local food plants, are fairly widely grown as indicated in (Table 9b). The least frequently grown food crops are the indigenous food plants that are either cultivated or gathered from the wild (Table 10. In Table 10, it is noted that traditional food plants such as millet and simsim which were reportedly grown by 21.4% and 14.3 % of respondents respectively are not popular in the study area. Local vegetables such as cowpeas, (Vigna unguiculata) and Ejjobyo (Gynandropsis gynandra) were reportedly grown by smaller proportions of the respondents (12.2 % and 11.2 % respectively) than were exotic vegetables such as cabbages (Brassica oleracea), which were mentioned by 23.5% of the respondents.

Most of the traditional food plants were reported to be grown for both consumption and for sale except for a few which were reported to be grown only for consumption. In Table 10, it is noted that most indigenous staples, fruits and vegetables were reported to be grown only for consumption, while most exotic fruits and vegetables were reported to be grown for both consumption and for sale. This suggests the reasons for the downward trend in the production of the indigenous food crops:

The following tables give proportions of persons reporting different food plants as available

Table 9(a). Proportion of the respondents reporting different foods as available:

Common/local name	Scientific name	Type	Proportion of respondents	Status	Kind
1. Cassava	Manihot esculenta	Rc*	100.0	F/C	TR
2. Matooke	Musa spp.	P*	92.9	F/C	TR
3. Sweet Potatoes	Ipomea batatas	Rc	91.8	F/C	TR
4. Beans	Phaseolus vulgaris	L*	77.6	F/C	TR
5. Groundnuts	Arachis hypogea	Os*	58.2	F/C	TR
6. Doodo	Amaranthus lividus	V	40.8	F/C	TR
7. Ensuju (Pumpkins)	Cucurbita maxima	V	32.6	F/C	TR
8. Ebuga	Amaranthus dubius	V	32.7	F	TR

Table 9(b). Proportions of persons reporting exotic crops as available:

		Type	%	Status	Kind
1. Maize	Zea mays	Cg*	73.5	F	EX
2. Soy beans	Glycine max	L	54.1	F	EX
3. Jack Fruit	Artocarpus integer	Fr	50.0	F/C	EX
4 Passion Fruits	Passiflora edulis	Fr	40.8	F/C	EX
5. Mangoes	Mangifera indica	Fr	34.7	F/C	EX
6. Avocado	Persea americana	Fr	34.7	F/C	EX
7. Pawpaws	Carica papaya	Fr	30.6	F/C	EX
8. Pineapple	Ananas comosus	Fr	24.5	F/C	EX
9. Sugar Cane	Saccharum officinarum	B	24.5	F/C	EX
10. Tomatoes	Typersicon typersicum	V	24.5	F/C	EX
11. Cabbages	Brassica oleracea	V	23.5	F/C	EX
12. Irish Potatoes	Solanum tuberosum	V	13.2	F	EX
13. Vanilla	vanilla planifolia		12.2	C	EX
14. Cocoa	-	B	8.2	C	EX
15. Onions	Allium cepa	S	8.2	F/C	EX
16. Tomatoes	L. lycopersicum	V	7.1	F	EX
17. Egg plants	Solanum melongena	V	7.1	F/C	EX
18. Coffee	Coffea arabica	B	6.1	C	EX
29. Jambula	Syzigium jambulana	Fr	4.1	F	EX
20. Tea	-	B	2.0	C	EX

*Note Status : F = grown for food: F/C = grown for both food and cash.
C = grown for cash only.
Kind : EX = Exotic, TR = Traditional
Type : Rc = Root crop, L = Legume , Cg = Cereal grain,
V = Vegetable, Os = oil seeds Fr = fruits
B = Beverage S = Spice foods

Table 10. Proportion of persons reporting various indigenous crops as available:

		Type	%	Status	Kind
1. Mayoni (taro)	Colocusia esculenta	Rc	66.3	F	IN
2. Nakati	Solanum nigrum	V	28.6	F/C	IN
3. Balugu (Yams)	Dioscorea sp.	Rc	24.5	F	IN
4. Millet	Elusine corocana	G	21.4	F	IN
5. Endagu	Dioscorea sp.	Rc	20.4	F	IN
6. Ndiizi	Musa sapietum	P	18.4	F	IN
7. Gonja	Musa sp.	P	17.3	F/C	IN
8. Ntula	Solanum gilo	V	15.3	F	IN
9. Simsim	Sesanum indica	S	14.3	F	IN
10. Epande	Vaandzeia sulterranea	L	13.2	F	IN
11. Bogoya	Musa sp.	P	12.2	F/C	IN
12. Cowpeas	Vigna unguiculata	L	12.2	F	IN
13. Ejjobyo	Gynandropsis gynandra	V	11.2	F	IN
14. Kayinja	-		10.2	F	IN
15. Ebisebe	Dioscorea alata	Rc	9.2	F	IN
16. Bivuvu	-		9.2	F	IN
17. Ntutunu	Physalis peruviana	Fr	8.2	F	IN
18. Nandigoya	Dioscorea sp.	Rc	8.2	F	IN
19. Mpafu	Canarium schweiznfurthii	Fr	6.1	F	IN
20. Bananas (brewing)	Musa sp.	Fr	6.1	F/C	IN
21. Kobe	-		6.1	F	IN
22. Ebigaaga	Phaseolus lunatus	L	6.1	F	IN
23. Sorghum	Sorghum bicolor	G	6.1	F	IN
24. Eggobe	Vigna unguiculata	V	5.1	F	IN
25. Katunkuma	Solanum indicum	V	4.1	F	IN
26. Matungulu	Afranum sangaineum	V	4.1	F	IN
27. Ejerengesa	Acalypha bipatita		4.1	F	IN
28. Kaama	Dioscorea oderassim	Rc	4.1	F	IN
29. Ebisusuti	Sechium edule		4.1	F	IN
30. Enumbu	Plectranthus escalentus		4.1	F	IN
31. Enkolimbo	Cajanas cajan	L	3.1	F	IN
32. Kyetutumula	-		3.1	F	IN
33. Bwanda	Portulaca quadrifida		3.1	F	IN
34. Mushrooms	-	V	2.0	F	IN
35. Omujaja	Osmum suave		2.0	F	IN
36. Ttimpa	Colocasia antquonum	V	2.0	F	IN
37. Ebisoboza	Vigna unguiculata	V	2.0	F	IN
38. Enkenene	Morus alba	V	2.0	F	IN
39. Enderema	Basella alba	V	2.0	F	IN
40. Amamuwanda	-		2.0	F	IN
41. Omuwemba	-		2.0	F	IN
42. Local berries	Fragaria ananassa	Fr	1.0	F	IN
43. Bikongo	Dioscorea sp.	Rc	1.0	F	IN
44. Ensuga	Solanum nigrum	V	1.0	F	IN
45. Gudu	-	V	1.0	F	IN
46. Amavuni	-		1.0	F	IN
47. Field peas	-	V	1.0	F	IN

* Blank spaces designate missing botanic names

*Note Status : F = grown for food: F/C = grown for both food and cash.
C = grown for cash only.
Kind : IN = Indigenous
Type : Rc = Root crop, L = Legume , C = Cereal grain,
V = Vegetable, Os = oil seeds Fr = fruits ,

5.6 Types of food plants grown in the past:

Table 11, gives the proportion of persons reporting different types of food plants having been grown in the past. Unlike the food plants in Tables 9(a), 9(b) and 10, the food crops which are in Table 11 are mainly indigenous crops; mostly different species of yams and other root crops.

The highest proportions among the food crops grown in the past as mentioned by the community are as follows:- About two thirds or more of the people mentioned Endagu (Dioscorea sp.), Balugu (Dioscorea sp.) or Mayuni (Colocasia esculenta). It is evident that Matooke (Musa sp.), and sweet potatoes (Ipomea batatas) were fairly widely grown. These were reported by 62.1% and 57.1% of the respondents respectively. About one third (30.6 - 40.8 %), mentioned the following food crops; Ebikongo (Dioscorea sp.), Epande (Vaandzeia subterranea), Binyeba (Arachis hypogea), Nakati (Solanum ethiopicum). About a quarter of the respondents mentioned the following food crops, Epindi (Vigna unguiculata), Ensuju (Cucurbita maxima), Ebisebe (Dioscorea alata), Ebijanjalo (Phaseolus vulgaris), and Cassava (Manihot esculenta). Almost half of the community mentioned the following food plants; Kaama (Dioscorea odoratissma), Entula (Solanum gilo), Obuyindiyindi (Phaseolus lunatas), Ebuga (Amaranthus dubius), Amakobe (Dioscorea sp.), Kyetutumula (Dioscorea sp.), Ebigaga (Phaseolus lunatus), Katunkuma (Solanum indicum), and Ejjobyo (Gynandropsis gynandra), most of which are indigenous vegetables.

Table 11. **Types of food plants grown in the past and proportions of persons mentioning them:**

Name of food plants	Proportion of persons mentioning them		
Local name	Scientific name	Type	proportion
1. Endagu (Yam)	Dioscorea spp	Rc	75.5
2. Balugu (Yam)	Dioscorea caynensis	Rc	72.5
3. Mayuni (taro)	Colocasia escalenta	Rc	63.3
4. Matooke (Plantain	Musa spp.	P	62.1
5. Lomonde (S.Potato)	Ipomoea batatas	Rc	57.1
6. Ebikongo (Yam)	Dioscorea spp.	Rc	40.8
7. Empande (Legume)	Vaandzeia sulterranea	L	39.8
8. Binyeba (G.nuts)	Arachis hypogea	Os	33.7
9. Nakati (vegetable)	Solanum aethiopicum	V	30.6
10. Epindi (seeds)	Vigna unguiculata	L	27.6
12. Ensujju (pumpkin)	Cucurbita maxima	V	25.5
13. Ebisebe (Yam)	Dioscorea alata/bulbifera	Rc	24.4
14. Ebijanjalo (beans)	Phaseolus vulgaris	V	24.4
15. Cassava	Manihot esculenta	Rc	23.5
16. Kaama (yam)	Dioscorea odoratissima	Rc	18.4
17. Entula (veg)	Solanum gilo	V	16.3
18. Obuyindiyindi	Phaseolus lunatus	L	14.3
19. Ebbuga	Amaranthus hybridus	V	14.3
20. Amakobe	Dioscorea spp.	Rc	14.3
21. Kyetutumula	Dioscorea spp.	Rc	12.2
22. Ebigaaga	Phaseolus lunatus	L	12.2
23. Katunkuma	Solanum indicum	V	12.2
24. Ejjobyo	Gynandropsis gynandra	V	11.2
28. Wuju	-		8.2
29. Bananas(brewing)	Musa spp.	P	7.1
30. Kifudu	-		7.1
31. Ensusuti	Sechium edule		6.1
32. Simsim	Sesamum indicum	Os	6.1
33. Enkolimbo	Cajanas cajan	L	6.1
34. Mpokya	Vigna aerus	V	5.1
35. Ensuga	Solanum nigrum	V	4.5
36. Enkolo	Musa paradisiaca	P	4.1
37. Millet	Elensine corocana	Gr	3.1
38. Embide	Musa spp.	P	3.1
39. Sugarcane	Saccharum officinarum		3.1
40. Enkolorozebitoke	Musa paradisiaca	Rc	2.0
41. Enderema	Bassela alba		2.0
42. Amalamu	-		2.0
43. Ssezira	Portulaca oleracia		1.0
44. Kyebutula	-		1.0
45. Rwiki	-		1.0
46. Emutongo	-		1.0
47. Namunkuli	-		1.0
48. Ndizi	Musa sapientwun	P	1.0
59. Ensaali	Garcinia buchananii		1.0
50. Bwanda	Portulaca quadrifida		1.0
51. Ebigomba	Arachis hypogea		1.0
52. Ziizi	Kedrostis foetidissima		1.0
53. Obubene	-		1.0
54. Gonja	Musa balbisiana	P	1.0
55. Entangawuzi	Zingiber officinalis		1.0
56. Ttimpa (leaves)	Colocasia escalenta	V	1.0
57. Ebunyanya	Lycoperseum spp.	F	1.0
68. Matungulu	Aframomum sanguineum		1.0

Note: Blank space shows food plants whose scientific names are not established. Fr = Fruit, V = Vegetable, P = Plantain, L = legume, Gr = Grain Rc = root crop.

Figure 2, shows the proportion of persons reporting specific food plants as grown in the past and at present. It is derived from Tables 9(a), 9(b), 10 and 11. It is evident that food habits have changed considerably. It is interesting to note that some food crops grown in the past were reported to be grown at present by more respondents than those reportedly grew them in the past. These foods include the staple food crops, cassava, sweet potatoes, and matooke, as well as beans and groundnuts. A number of fruits and some vegetables are among foods which were not grown in the past but are increasingly being grown. The cultivation of some traditional vegetables has changed slightly as shown by the proportions of respondents who grew them both in the past and at present (Figure 4). There is only a slight increase in the production of a few vegetables ie. amaranthus species and pumpkins. There is no increase in the rest of the traditional vegetables.

As seen in figure 2, the three staple food crops, (cassava, matooke and sweet potatoes) plus beans which are the most widely available food crops at present, were also grown in the past but to a smaller extent as shown by the proportions of respondents who reportedly grew them. Maize and soya beans were not grown at all. Except for Endagu species, most indigenous food plants, particularly the yam species, were reported by a higher proportion to have been grown in the past than now. Most fruits mentioned in the study as widely available are the introduced ones. Indigenous vegetables were collected in the past, others are still being collected but in small proportions, while others have declined in popularity. Example of such vegetables are cowpeas and ensuga.

Figure 3, include many fruits which are exotic (ie jackfruit, passion fruit, mango, avocado, pawpaw, pineapple, sugar cane etc. "Jambula" and local berries were reportedly grown by more than one third of the respondent in the past while at present they are rarely mentioned.

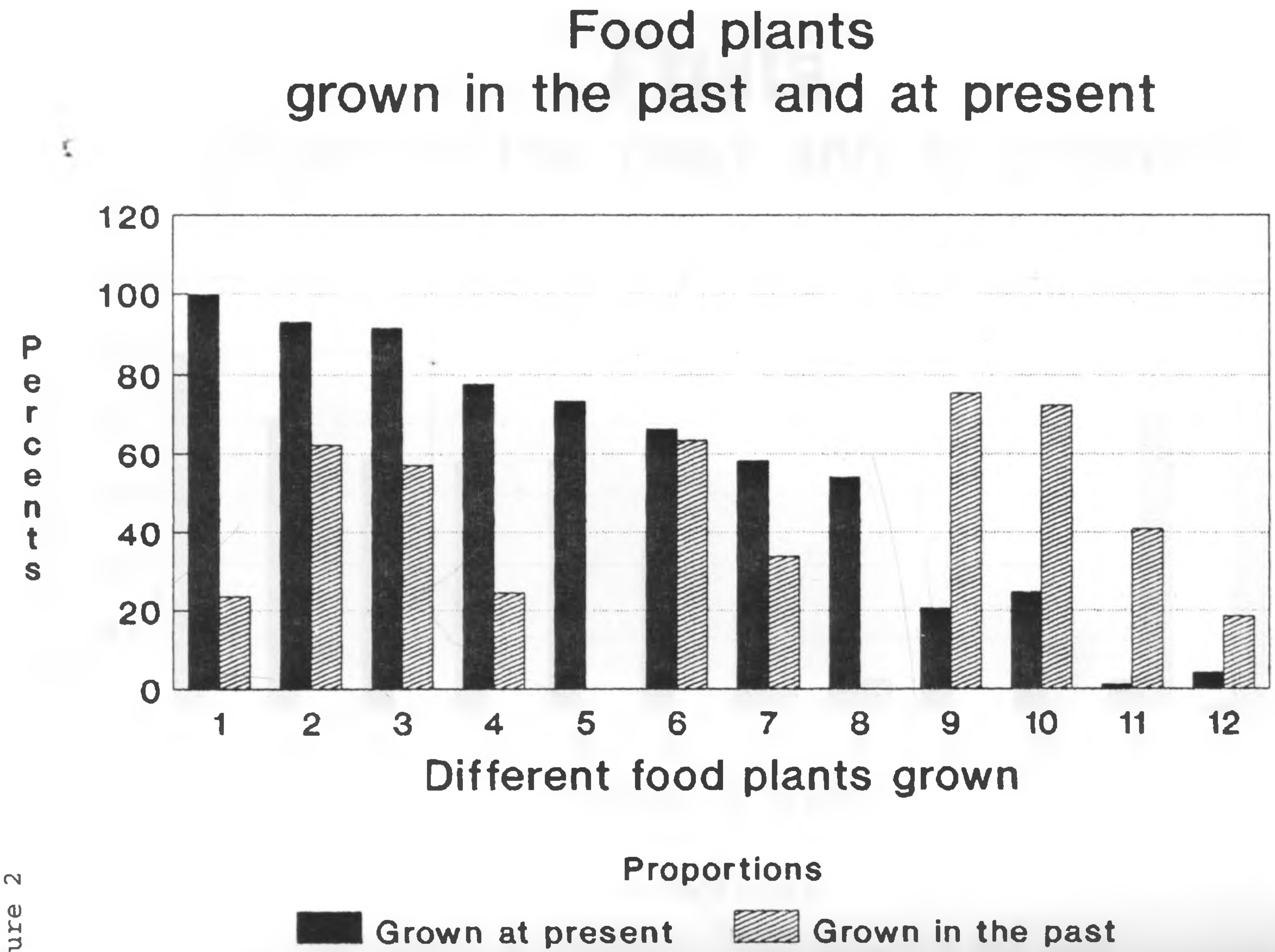
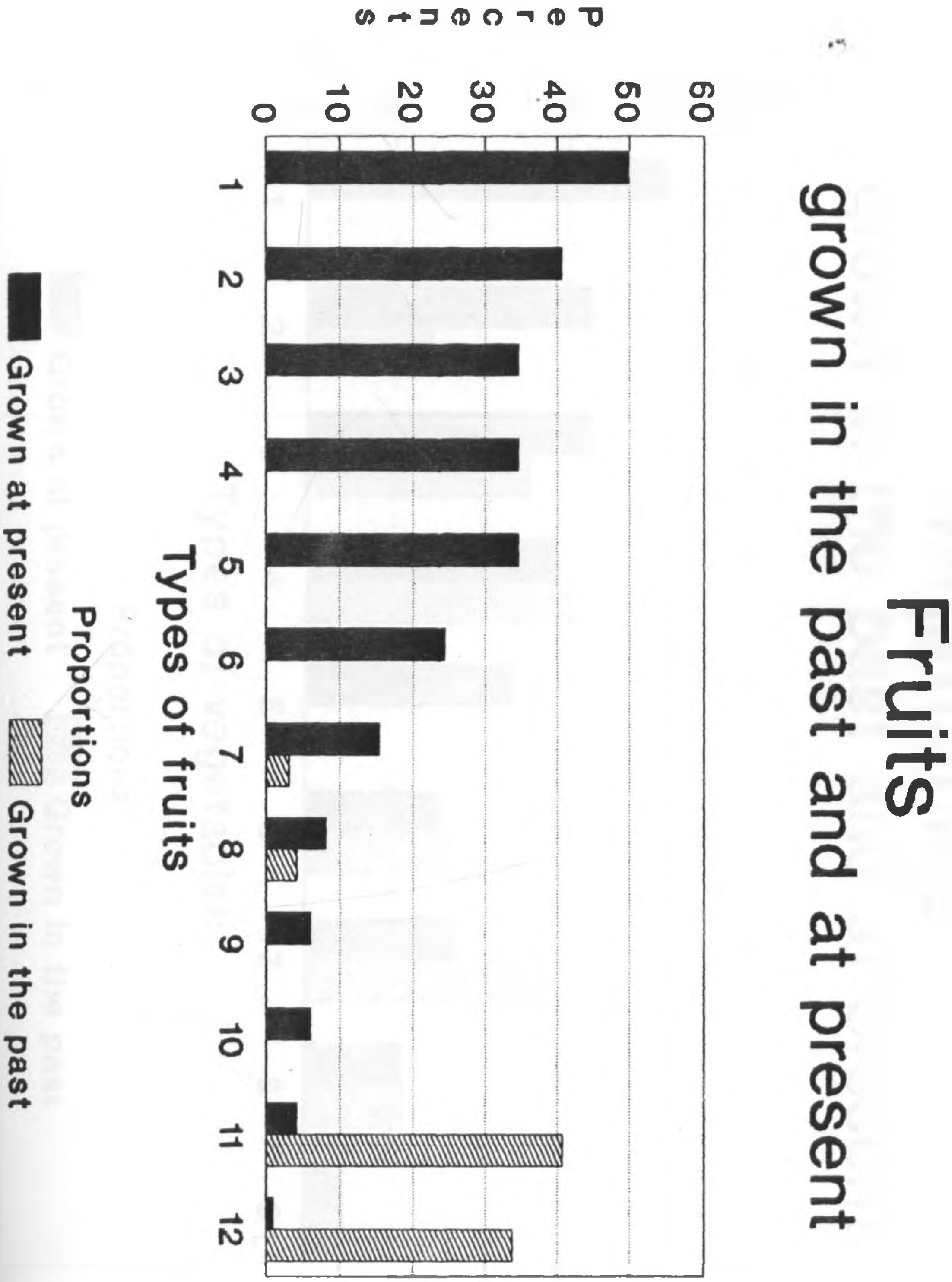


Figure 2

Key: Various food crops:

1. Cassava
2. Matooke
3. Sweet potatoes
4. Beans
5. Maize
6. Mayuni (Yam)
7. Groundnuts
8. Soy beans
9. Endagu (Yams)
10. Balugu (Yams)
11. Ebikongo (Yams)
12. Kaama (Yams)

Figure 3



Key : <u>Names of fruits</u>

1. Jackfruits
2. Passion fruits
3. Mangoes
4. Avocado
5. Pawpaw
6. Pineapples
7. Guava
8. Ntuntunu
9. Mpafu
10. Banana
11. Jambula
12. Local berries

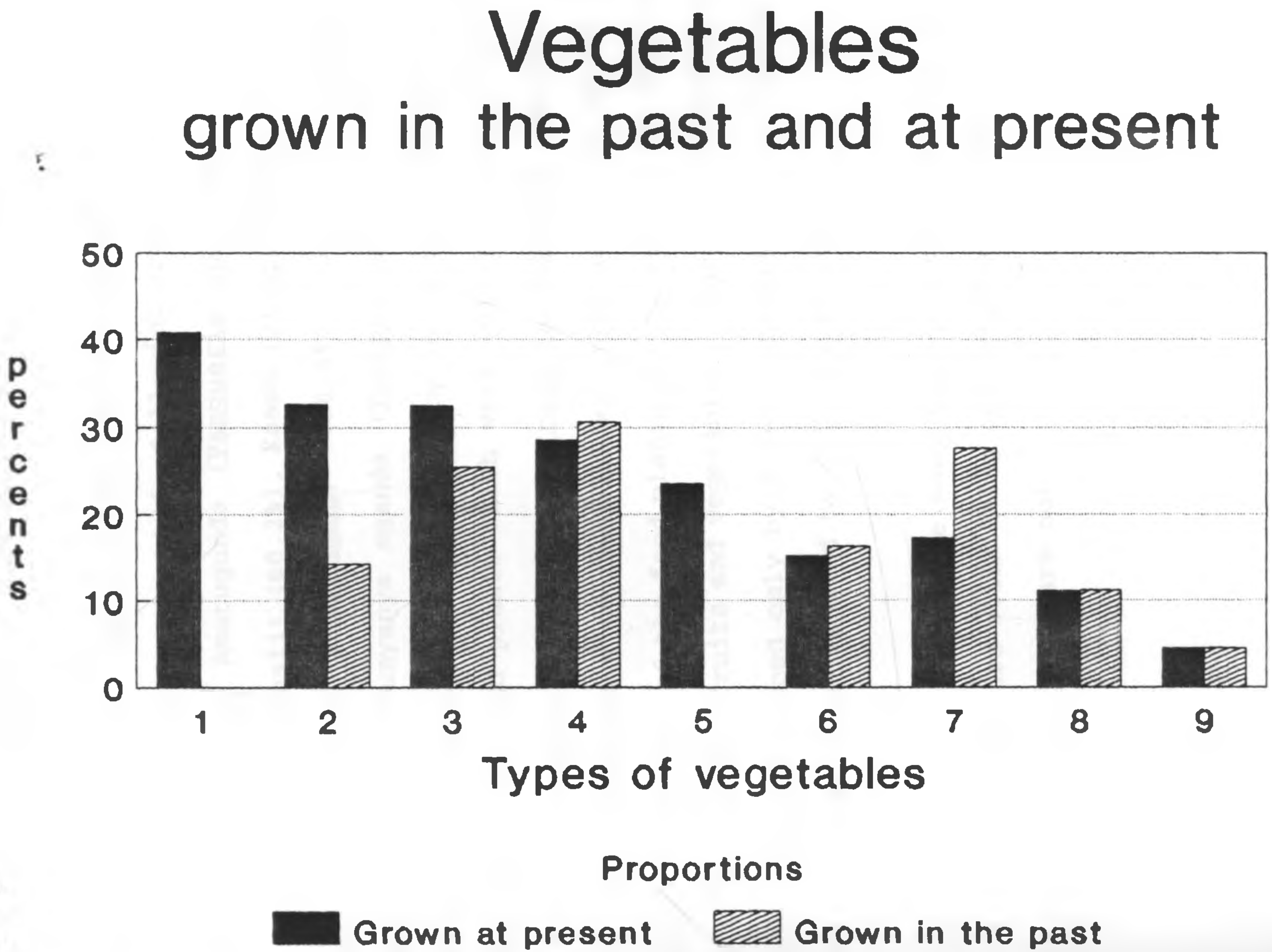


Figure 4

Key:

Names of vegetables

1 Doodo (Amaranthus sp.)
2 Ebuga (Amaranthus sp.)
3 Ensuju (Pumpkins)
4 Nakati (*S. ethiopicum*)
5 Cabbages (*B. oleracea*)
6 Ntula (*Solanum gilo*)
7 Cowpeas (*V. unguiculata*)
8 Ejjobyo (*G. gynandra*)
9 Ensuga (*Solanum nigrum*)

5.7 Food plants reported to be collected in the past:

Table 12, shows the food plants that were collected in the past. About two thirds or more mentioned the following crops as having been collected in the past; Amatugunda (Vanqueria epiculata) (75.5%), Ensaali (Garcinia buchanaii) (60.2%), Kaama (Dioscorea sp.) (58.2%), Amatungulu (Afronomum sanguineum) (58.0%), Jambula (Syzigium jambulana) (40.8%), Obunyanya eganda (Tycoperscum sp.) (39.8%), while Enkenene (Morus alba) was reported by 36.7% of the respondents. The other group of food plants which were fairly widely collected ranged from indigenous strawberries (Fragaria ananassa) reported by 33.7% of the respondents to Obunakanaka reported by 11.2% of the respondents. The rest of the food plants mentioned include some rare species of indigenous fruits and vegetables. Many of the indeginous vegetables were mentioned only by a few respondent. In fact about a quarter of them were reported by only one person.

Table 12, shows that there were many food plants collected in the past. A few of these are still being collected as evident in Tables 9(a), 9(b) and 10 but many are not.

Table 12. **Proportions of persons giving different types of food plants reported to be collected in the past:**

	Local name	Scientific Names	Type	Percentages
1.	Amatugunda	Vangueria epiculata	Fr*	75.5
2.	Ensaali	Garcinia buchananii	Fr	60.2
3.	Kaama	Dioscorea oderassima	Rc*	58.2
4.	Amatungulu	Afromomum sanguineum	Fr	58.0
5.	Jambula	Syzigium jambulana	Fr	40.8
6.	Obunyanya enganda	Lycoperscum spp.	Fr	39.8
7.	Enkenene	Morus alba		36.7
8.	Straw berries	-	Fr	33.7
9.	Enimawa	Citrus aurantifolia	Fr	32.6
10.	Ensusuti	Sechium edule		27.6
11.	Ebikongo	Dioscorea spp.	Rc	26.5
12.	Nandigoya	Dioscorea spp.	Rc	25.5
13.	Kobe	Dioscorea bulbifera	Rc	24.5
14.	Ntula	Solanum gilo	V*	24.5
15.	Enumbu	Plectranthus escalentus		23.5
16.	Katunkuma	Solanum indicum	V	22.4
17.	Ensuga	Solanum nigrum	V	22.4
18.	Ensuju	Cucurbita maxima	V	18.4
19.	Obubaala	Termitomyces microcarps	V	16.4
20.	Kakeje	Haplochromis spp.		14.3
21.	Nkomamawanga	Pumica granatum		13.3
22.	Kinyulwa	Dioscorea spp.	Rc	13.3
23.	Endagu	Dioscorea spp.	Rc	12.3
24.	Obusukunda	-		12.3
25.	Ebuga	Amaranthus dubius	V	12.3
26.	Obunakanaka	-	V	11.2
27.	Mutele (dried)	Musa spp.	P*	10.2
28.	Eggobe(leaves)	Vigna anguiculata	V	9.1
29.	Ebikongo	Dioscorea spp.	Rc	9.1
30.	Ttimpa (leaves)	Colocasia antiquonum	V	8.2
31.	Epande	Vaadezeia subterranea	L*	7.1
32.	Kyetutumula	Dioscorea spp.	Rc	6.1
33.	Kisebe	Dioscorea bulbifera/alata	Rc	6.1
34.	Ekyangwe	Luffa cylindrica		5.1
35.	Obutiko	-	V	5.1
36.	Entuntunu	Physalis peruviana	Fr	4.1
37.	Mayoni	Colocusia esculenta	Rc	4.1
38.	Gudu	Agaricus spp.	V	4.1
39.	Mikooge	Tamarindus indica	Fr	4.1
40.	Enyonza	Carissa edulis	Fr	3.1
41.	Ekiryo	Lagenaria abyssinica		3.1
42.	Ebigaaga	Phaseolus vulgaris	V	3.1
43.	Ejerengesa	Acalypha bipatita		3.1
44.	Enkolozebitoke	Musa paradisiaca	Rc	3.1
45.	Obuberet	-		2.0
46.	Doodo	Amaranthus lividus	V	I.0
47.	Wuju	-		1.0
48.	Enkolimbo	Cajanas cajan	V	I.0
49.	Obulimawa	Citrus anrantifolia	Fr	I.0
50.	Entongolo	-		1.0
51.	Ejjobyo	Gynandropsis gynandra	V	1.0
52.	Omujaaja	Osmum suave		I.0
53.	Nakati	Solamum aethiopicum	V	1.0
54.	Ebitongo	-		1.0
55.	Enderema	Basella alba		1.0
56.	Ziizi	Kedrostis foetidissima		1.0
57.	Mushrooms	-	V	1.0

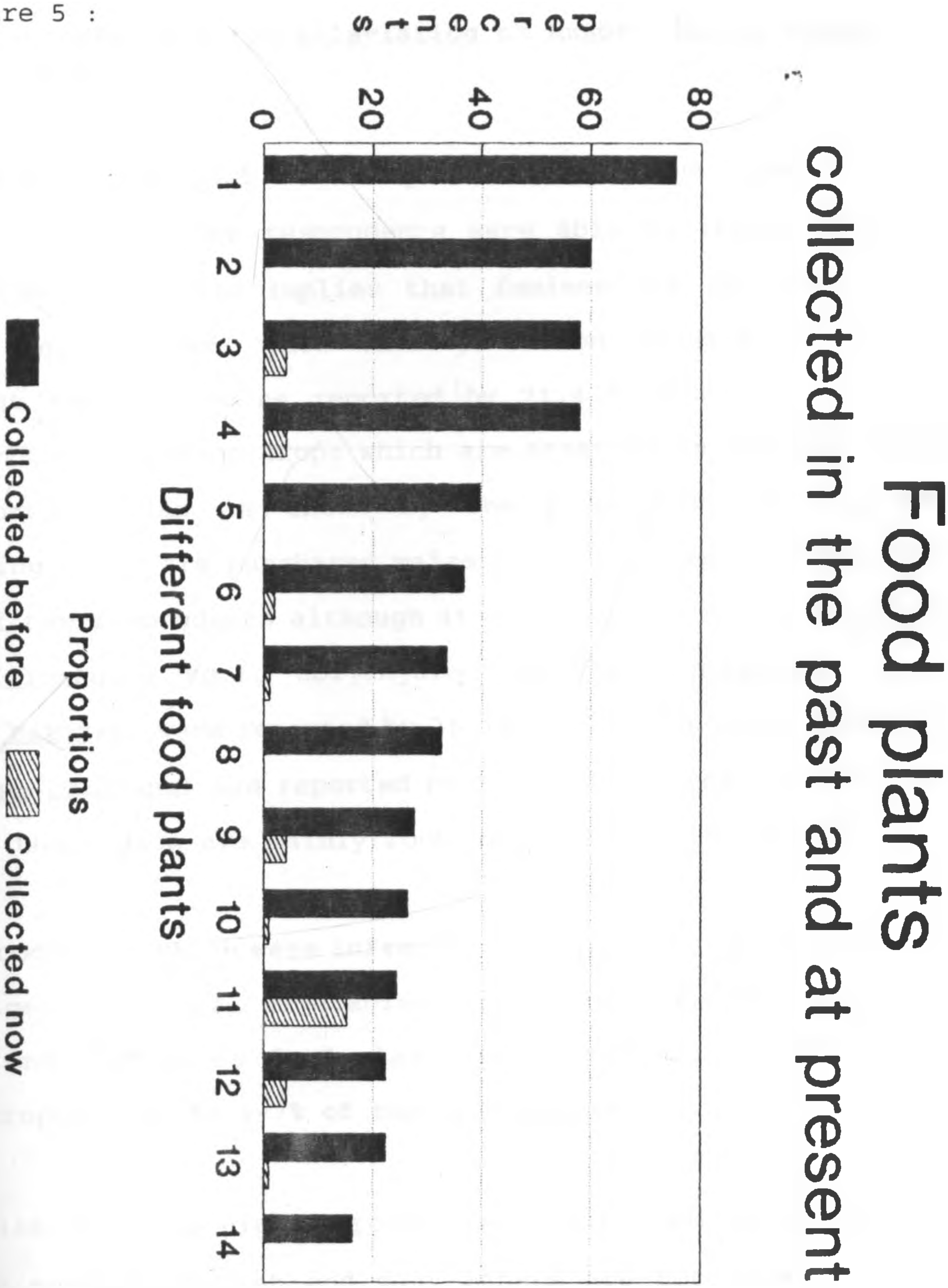
Note: Blank spaces indicate food plants whose scientific names were not found.
* Fr = fruit, Rc = root crop, V = vegetable

5.8 Food plants collected in the past and those collected at present:

Most of the food plants collected in the past are no longer being collected (Table 12). As shown by the proportion reporting, ntula (bitter berries) and ensuju (pumpkins), amaranthus species, nakati (solanum ethiopicum) is being collected on a fairly comparative scale as in the past (Figure 6). Of those that are still being collected, only a very few respondents mentioned them. There were those which were said to be collected and cultivated at the same time. The widely collected food plants which are no longer being collected confirms a decrease in species availability.

Figure 5, indicates that there was a wide variety of indigenous food plants collected in the past but most of them are no longer being collected at the present time. Those which are still being collected are reported by only a small proportion of the respondents.

Figure 5 :



Key: Name of food plants

1 Amatugunda
2 Ensaali
3 Kaama
4 Amatungulu
5 Obunyanya Eganda
6 Enkenene
7 Local straw berries
8 Eminawa
9 Ensusuti
10 Ebikongo
11 Ntula (biter berries)
12 Katunkuma (,,)
13 Ensuga (S. nigrum)
14 Obubaala (Mushrooms)

5.9 **Foods used for alleviation of hunger during famine situations:**

Table 13 shows the list of food plants used by the community during times of famine. Few respondents were able to report foods used during famines. This implies that famines are not common. The results do, however, show that processed cassava is the most important famine crop as reported by 71.4 % of the respondents. Other important famine crops which are arranged in descending order of importance (as is shown by the proportion of respondents mentioning them) are purchased maize flour (Zea mays), mentioned by 45.9% of the respondents although it is not grown in the study area. Kaama (Dioscorea sp.), Ebijanjalo (Phaseolus vulgaris), Lomonde (Ipomea batatas) were reported by 35.7% of the respondents and millet (Eleusine corocana) was reported by 33.6% of the respondents. It is evident that these are mainly root crops and grain legumes.

Other food crops which were infrequently reported represent a variety of indigenous fruits, vegetables and legumes, these include both exotic and indigenous food plants which were mentioned by a very small proportions ie 1-7% of the respondents.

It is clear that the highly drought resistant traditional food plants such as sorghum, millet and many others are not grown on a large scale or utilized by this community.

Table 13: **Food plants reported to be used for alleviation of hunger during famine situations:**

Local names	Scientific names	Proportions	status
1. Dried & stored cassava	Manihot esculenta	71.4	G
2. purchased Maize flour	Zea mays	45.9	P
3. Kaama	Dioscorea odorassima	35.7	C
4. Ebijanjalo ebikalu	Phaseolus vulgaris	35.7	P
5. Lumonde	Ipomoea batatas	35.7	G
6. Millet	Eleusine corocana	33.6	G
7. Ebikongo	Dioscorea spp.	17.3	C
8. Binyebwa	Arachis hypogea	16.3	G
9. Mpunga/mucere	Oryza sativa	15.3	P
10. Amayuni amaganda	Xanthosoma sagittifolium	11.2	G
11. Ensuju	Cucurbita maxima	10.2	G/P
12. Kayinja	-	7.1	C
13. Balugu	Dioscorea spp.	7.1	C
14. Dried matooke	Musa paradisiaca	6.1	G
15. Omuwemba	Sorghum spp.	5.1	G
16. Soy Beans purchased	Glycine max	4.1	P
17. Enumbu	Coleus esculentus	4.1	G/P
18. Ebisoboza (leaves)	Phaseolus vulgaris	4.1	G/P
19. Epindi (seeds)	Vigna anguiculata	3.1	G/P
20. Ensuga	Solanum nigrum	3.1	C
21. Amapapali	Carica papaya	3.1	G/P
22. Ndizi	Musa sapietuum	2.0	G/P
23. Ndagu	Dioscorea spp.	2.0	C
24. Obubwendo	-	1.0	C

* Blank spaces designate food plants whose scientific names are missing.
Status : G = grown, P = purchased, C = collected , G/P = grown or purchased.

Figures given are percentages of persons who mentioned a particular type of food.
Food plants are arranged in descending order of popularity.

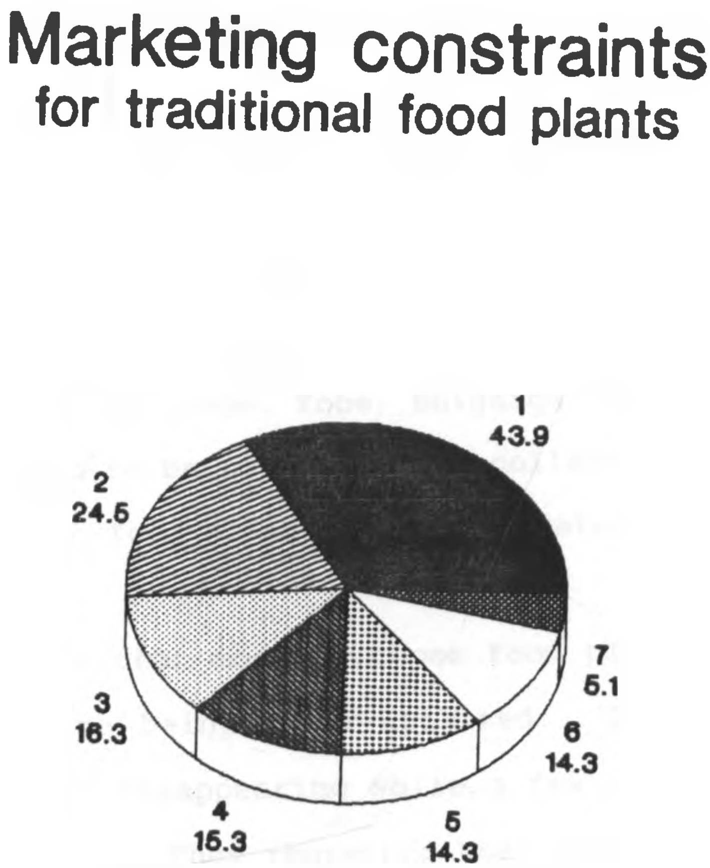
5.10 Limitations in the utilization of traditional food plants:

Figure 6, shows the constraints in the production of traditional food plants. As can be observed in the figure, the proportion of the people who mentioned these constraints is not high. Among the constraints mentioned in this study, unpopularity of the traditional food plants, poor pricing and marketing systems, problems of low yields and lack of improved seeds for the traditional food plants have been mentioned as the major constraints.

5.11 **Marketing constraints**:

Figure 7, shows the proportion of persons who mentioned different constraints in marketing traditional food plants. Lack of good markets for the traditional food plants, transportation problems and low demand of the traditional food plants were most widely mentioned as is shown by the proportion of persons reporting them (ie 43, 24.5 and 16.3 % respectively). Traditional food plants were reported to be disliked by the young generation. Lack of appeal (attraction to the buyers) and low nutritional values were mentioned by 15.3% and 14.3 % of the respondents respectively. It is worth noting that lack of appropriate information was mentioned by the same number of respondents (14.3 %) that mentioned low status.

Figure 7:



proportions of persons mentioning them

Key: <u>Marketing</u> <u>Constraints</u>

1. Lack of good markets
2. Expensive transportation.
3. Demand is low
4. New generation does not like them much
5. Are considered poor variety and therefore have low values
6. Lack of appropriate information such that buyers have no knowledge of them
7. They are difficult to store

5.12 SUMMARY OF THE FOCUS GROUP DISCUSSIONS:

Focus group discussions were conducted to establish the knowledge about indigenous food plants and their benefits to the community.

Most of the food plants mentioned in Table 9 and Table 11, were also mentioned by the elders as the indigenous food plants grown and collected in the past. The elders mentioned that only a few of these food plants were still being grown or collected. Food plants like Kaama, Balugu, Endagu, Ebisebe, Kobe, Ebigaaga, Ntuntunu, Mpafu and many others were said to be wild and were collected from the forest while the rest of the food plants were cultivated.

The elders were aware that most of those food plants are no longer being utilized or are being under-utilized. Some of those food plants are completely disappearing while a few of them could still be found in the forest. They regretted that indigenous food plants which used to be very important to them are no longer being used in the community. They observed that as elders die, knowledge about indigenous food plants disappear along with them.

The elders gave some of the reasons for the declining traditional food plants as follows:-

The effect of urbanization:

" Most of the young generation have gone to urban centres to seek employment and education opportunities. There they learn the white man's ways of life. They eat the kinds of foods that were introduced by the white man. Ways of life have changed as well as their tastes. They no longer appreciate the use and the benefits of indigenous food plants".

The effect of formal education:

Most of the children now go to school. Children used to learn to collect or cultivate these food plants from their parents. Nowadays, they spend most of their time in schools and do not have the time to learn about these food plants.

Lack of informal education on traditional food plants:

Elders used to pass knowledge to the younger generation through story telling and hunting practices. Those practices no longer exist and hence the indigenous knowledge of traditional food plants is gradually disappearing. Further more, the present generation dislikes the cultivation/collection of traditional food plants. They complain that the traditional food plants require intensive labour while their yields are low. The elders therefore requested support and encouragement for revival of the traditional food plants.

Increased use of the more highly yielding seasonal crops (Cassava and sweet potatoes):

The elders mentioned the root crops:- *Endagu, Kaama, Kyetutumula, Ekisebe, Balugu, Cocoyams*, various wild fruits and some selected vegetables as foods for alleviation of hunger during famine situations. In addition, cassava, sweet potatoes, plantains, beans and groundnuts were also mentioned as famine foods. However, the elders mentioned that cassava and sweet potatoes are annual/seasonal crops that may not be there during famine situations. They emphasized the importance of drought resistant indigenous food crops.

Traditional beliefs and taboo about indigenous food plants:

According to the elders, children are prohibited from eating the root crops in general. There is a belief that when children are fed on root crops, they will not develop their teeth. They are therefore fed on plantains and sweet potatoes.

The root crops are not to be dipped into vegetable sauce, because it is believed that this action leads to their disappearance. Root crops especially those that grow in the forest, are to be eaten with a special, locally prepared sauce (odeliwa). It is also believed that pregnant and lactating mothers should not eat certain types of food plants because they are believed to negatively affect milk production. Others lead to difficulty during delivery, while others are believed to cause abortion or miscarriage. Some of them are said to lead to the death of a child immediately after birth. Unfortunately the particular food plants were not identified by name.

Lack of multiplication materials and knowledge of cultivation techniques:

Lack of multiplication materials and knowledge of cultivation practices were mentioned as constraints to production and consumption of indigenous food plants. The elders suggested that:-

Seeds of the declining traditional food plants have to be collected, multiplied and distributed in the various sub-counties and parishes. The elders observed that they have to set an example by cultivating/collecting the indigenous species. Shortage of seeds, low yields were as well mentioned during the field survey as constraints in production of traditional food plants.

The elders admitted that their children under 30 years of age have no knowledge of the indigenous food plants because they are used to purchasing food in the towns. Even those who grow food only grow seasonal exotic food plants, not the indigenous ones. The elders therefore suggested that the young generation has to be educated about the importance of these declining food plants. It was also suggested that information about these food plants could be included in the school curriculum so that children will learn about their values. According to the elders, the Ministry of Agriculture could initiate research and development activities on the traditional food plants and information about the traditional food plants could be disseminated to the general public. Selected cultivars and clones, particularly drought resistant cultivars, could be promoted. This could be done in research centres such as Namulele which are located in the traditional production areas. The elders noted that knowledge of their traditional food plants could be used to educate others on the value of indigenous food plants. The elders used vanilla, a newly introduced cash crop, as an example. They observed that much attention, promotion activities and support have been given to this exotic crop.

The elders recommended that some of the indigenous food crops such as *Nakati (S. ethiopicum), Ejjobyo (G. gynandra), the black night shade (S. nigrum), Amaranthus species, Ntula/Katunkuma (S. gilo)*, and some indigenous fruits and root crops could be promoted.

Medicinal uses of indigenous food plants:

The elders recalled that their grandparents used most of these indigenous food plants as medicines. They therefore believed that some of these food plants had medicinal values. Examples of the food plants believed to have medicinal values and their use were as follows:-

Red Rossele (Hibiscus sp.)	-	believed to cure anaemia
Katunkuma (bitter berries)	-	used as remedy for eye problems.
Ejjobyo (G.gynandra)	-	believed to cure pancreatic problems by restoring the function of this organ.
Amatugunda and mangoes	-	believed to cure eye problems (especially for children)
Various green leafy vegetables	-	Generally believed to keep people healthy
The bitter roots	-	believed to cure malaria

5.4 SECTION (B): Results of the laboratory analyses:

The proximate chemical composition, beta-carotene, ascorbic acid, iron, calcium and oxalate contents of selected local vegetables are presented in this section.

Table 14 is a listing of the vegetables selected for the analysis. These vegetables were selected for analysis because they are commonly consumed in both urban and rural areas. The proximate composition, beta-carotene levels, ascorbic acid levels are given in Tables 15 and 16 while iron, calcium and oxalate contents are given in Table 17.

Table 14: Local, common and scientific names of vegetables that have been analyzed for the selected micro-nutrients:

Local name	Common name	Scientific name
1. Eggobe	Cowpea leaves	<u>Vigna</u> <u>unguiculata</u>
2. Ejjobyo	African spiderherb	<u>Gynandropsis</u> <u>gynandra</u>
3. W. Gwandabi	Cassava leaves	<u>Manihot</u> <u>escalenta</u>
4. Ntula	Bitter berries	<u>Solanum</u> <u>gilo</u>
5. Ttimpa	Cocoyam leaves	<u>Colocasia</u> <u>escalenta</u>
6. R. Gwandabi	Cassava leaves	<u>Manihot</u> <u>escalenta</u>
7. Ebugga	Amaranthus spinach	<u>Amaranthus</u> <u>lividus</u>
8. Doodo	Amaranthus spinach	<u>Amaranthus</u> <u>dubius</u>
9. Alutukubi	Lima beaans leaves	<u>Phaseolus</u> <u>lunatus</u>
10. Nakati	Vergans	<u>Solanum</u> <u>ethiopicum</u>
11. Malakwang	Rossele	<u>Hibiscus</u> <u>spp.</u>
12. Ensugga	Black nightshade	<u>Solanum</u> <u>nigrum</u>
13. Ebugga Ezungu	Amranthus spinach	<u>Amaranthus</u> <u>hibridus</u>

5.4.1 Proximate composition of selected vegetables:

Moisture content:

The moisture contents of the vegetables ranged from 90.52-78.00% . The highest moisture content was that of ntula berries (Solanum gilo) 90.5% , while the lowest moisture content was that of cassava leaves (Manihot esculenta) 78% . As is evident in Table 15, those vegetables with low moisture contents are high in their protein value while those vegetables with high moisture contents are low in protein value. Example of vegetables with a low moisture content are the cassava leaves which have protein values of 35 and 36% respectively while the protein values of (S.gilo) and (Amaranthus lividus), which have high moisture content are 14 and 24% respectively.

Protein content:

The vegetables generally had high protein values when calculated on a dry weight basis. Most of the vegetables had crude protein above 30% . These findings agree with reported (20-40%) protein values for tropical leafy vegetables (Oomen and Grubben, 1978). The protein content of the traditional vegetables is higher than that of the exotic vegetables. Their average protein content was eight times higher than that of the highest of exotic vegetable [Section 5.3.6].

The following vegetables had protein values ranging from 30 to 36% on a dry weight basis. These were cassava leaves (M. esculenta), cowpea leaves (V. unguiculata), amaranthus sp. (A. hybridus), cocoyam leaves (C. esculenta), lima beans leaves (P. vulgaris), nakati (S. aethiopicum), ensuga (S. nigrum), ejjobyo and (G. gynandra), (Table 17). Ntula (S. gilo) had the lowest crude protein ie 14.2% .

Crude fibre:

Green leafy vegetables are known to be high in fibre content. The vegetables assayed had fibre contents between 8.4 and 19.4 %. The highest fibre content (19.4%) was found in (S. gilo) while the lowest fibre content (8.4%) was found in (S. nigrum). The following vegetables were notably high in their fibre contents, S. gilo (19%), P. lunatus (18%), C. esculenta (16%) and M. esculenta (15%). The rest of the vegetables have fibre contents between 11 and 14 % . This findings fall within the range fibre (1.9-22.9%) reported by other researchers (Imungi and Potter, 1983).

Ethereal extracts:

The contents of ethereal extracts of the vegetables ranged between 3.5 and 8.3% . The lowest level was found in (Hibiscus sp). while the highest level was in (M. esculenta). Six of the vegetables had ethereal extracts between 7 and 8% , while the rest of the vegetables had ethereal extracts between 3 and 5 %. This is not very high when compared with other nutrients in vegetables, however, ethereal extracts are of practical importance as far as the keeping quality of vegetable/vegetable products is concerned since they may cause rancidity due to antoxidation (Muroki, 1992).

Fat content of the traditional vegetables is slightly higher than that of the exotic vegetables (Appendix 1).

Total ash:

The vegetables were quite high in ash content. The ash content of the vegetables fell between 5.9 and 21.2 %. The lowest ash content was that of M. esculenta 5.9 % while the highest ash content was that of A. hibridus which was 21.2 % (Table 15). The following vegetables were found to be high in their total ash contents, (A. hibridus), (G. gynandra), (A. lividus), (A. dubius), (S. ethiopicum) and (S. nigrum). The rest of the vegetables have moderate total ash contents (Table 15). These findings are in agreement with the findings for tropical vegetables of other researchers, (Oomen and Grubben,1978) and those shown in, Appendix 1.

Table 15: Proximate chemical composition of selected local vegetables.[a]
% of components

Name of vegetable	Moisture content	Crude protein (Nx6.25)	Crude Fibre	Ethereal extract	Total ash
1 Vigna unguiculata 1	84.75±00	35.44±0.44	14.06±0.11	4.30± 00	13.58±.17
2 Vigna unguiculata 2	84.75±00	34.78±0.22	14.12±0.22	4.33±0.10	13.22±.06
3 Gynandropsis gynandra	89.60±00	30.00±0.22	13.65±0.15	8.27±0.03	19.94±.08
4 Manihot esculenta(w)	78.72±00	35.25±0.44	15.25±0.25	8.33±0.11	5.93±.12
5 Solanum gilo	90.52±00	14.22±0.22	19.40±0.15	4.49±0.01	6.53±.15
6 Colocasia esculenta(L)	81.40±00	32.16±0.66	16.03±0.07	8.20±0.12	9.49±0.17
7 Manihot esculenta(r)	78.50±00	36.31± 00	14.35±0.05	7.84±0.17	7.24±0.13
8 Amaranthus lividus	88.20±00	24.28±0.22	13.20±0.10	7.37±0.17	19.93±.16
9 Amaranthus dubius	84.80±00	29.97±0.22	11.05±0.05	5.33± 00	19.47±.08
10 Phaseolus lunatus(L)	88.20±00	32.81± 00	18.25±0.25	8.17±0.16	10.07±.15
11 Solanum ethiopicum	86.06±00	32.60±0.66	12.65±0.05	5.14±0.17	15.85±.08
12 Hybisccus sp.	81.41±00	23.42±0.23	12.60±0.10	3.48±0.11	9.36±.04
13 Solanum nigrum	85.41±00	32.60±0.66	8.38±0.02	6.51±0.10	14.77±.12
14 Amaranthus hibridus	80.60±00	34.3 ±0.44	12.4 ±0.15	6.19±0.14	21.17±.14

[a] **Mean ± SD (N = 3), Components are calculated on a dry matter basis.**

5.4.2 Beta-carotene and the ascorbic acid content of selected vegetables:

Beta-carotene and ascorbic acid content of some selected vegetables are presented in Table 16. The beta-carotene content of the vegetables fell between 8,300 and 243,300 ug/100g on a dry matter basis, while the ascorbic acid content fell between 33.3 and 677.4 mg/100g on a dry matter basis. It is interesting to note that vegetables which are presently rarely consumed by the community in the study area but highly recommended for promotion by the elders, were high in both beta-carotene and ascorbic acid contents. These were:- A. hibridus, A. lividus, P. lunatus leaves, G. gynadra and Cassava leaves M. esculenta (w) which were notably high in beta-carotene and P. lunatus, G. gynandra, S. ethiopicum, V. unguiculata and A. hibridus had very high ascorbic acid levels. The data on the level of ascorbic acid of the traditional vegetables compared with the exotic vegetables shown in Appendix 1, indicates that the traditional vegetables are much higher in Vitamin C. The lowest of the traditional vegetable is 33.3 mg/100g of edible portion, while that of the exotic vegetable is 8 mg/100g of edible portion. This is also confirmed by the FAO figures shown in the appendix 1. The same observation is made for beta-carotene content.

Table 16: **Mean beta-carotene and ascorbic acid contents of selected local vegetables:** [a]

	Name of vegetables	Beta-carotene (ug/100g edible portion)	Ascorbic acid (mg/100g edible portion)
1	Vigna unguiculata 1	39300±1600	160.7± 0
2	Vigna unguiculata 2	37700±1600	160.7± 0
3	Gynandropsis gynandra	110500±5300	484.2± 0
4	Manihot esculenta(w)	16500± 0	191.7±15.0
5	Solanum gilo	5000±3300	33.3± 0
6	Colocasia esculenta(L)	32300±1100	64.5±75.3
7	Manihot esculenta(r)	18500± 700	125.2±44.4
8	Amaranthus lividus	243300±3300	** **
9	Amaranthus dubius	77000±2700	** **
10	Phaseolus lunatus(L)	209700±6500	677.4±129.0
11	Solanum ethiopicum	17000± 0	189.4± 21.2
12	Hibisccus sp.	8300± 0	51.9± 0
13	Solanum nigrum	25000±1500	44.1± 14.7
14	Amaranthus hibridus	80300±5100	100.7± 7.3

[a] **Mean ± SD (N = 3)**

** It was not easy to determine the reduced ascorbic acid content of two vegetables (Amaranthus lividus and Amaranthus dubius) because of a red pigment already present in these vegetables which interfered with the end point of the titration.

Table 17. **Mean iron, calcium and oxalate content of the selected trad. vegetables in (mg/100gs) on a dry matter basis:**

Name of vegetable	Iron (mg/100g)	Calcium (mg/100g)	Oxalate (mg/100g)
1. Vigna unguiculata	12.3±2.5	1050± 9.0	***
2. Gynandropsis gynandra	9.4±0.6	2050±28.4	84.2±5.3
3. Manihot escalenta (w)	6.8±3.5	860± 7.5	66.9±5.3
4. Solanum gilo	4.4±0.1	1740± 0.4	93.3±8.3
5. Colocasia escalenta(L)	2.8±0.8	770±21.3	10.8±0.0
6. Manihot escalenta (r)	7.6±0.3	840±13.4	64.4±3.7
7. Amaranthus dubius	7.6±0.9	1240±159.2	33.3±0.0
8. Amaranthus lividus	12.3±1.2	1960±56.7	39.2±1.4
9. Phaseolus lunatas (L)	9.3±2.7	2230± 3.8	87.1±16.1
10. Solanum ethiopicum	5.2±1	1150± 3.4	25.9±1.0
11. Hybiscus sp.	8.5±3.5	1450±31.3	21.3±2.1
12. Solanum nigrum	15.5±5	1290±168.4	58.8±5.9
13. Amaranthus hybridus	6.6±0.4	2480± 2.5	***

(N =3)

(r) Leaves of cassava with red peduncles
(w) Leaves of cassava with white peduncles
(L) Stands for the leaves

*** samples of these vegetables were not available for analysis of oxalate.

5.4.4 Ascorbic acid content of traditionally cooked vegetables:

Half the vegetables selected for analysis were also analyzed for ascorbic acid after traditional cooking. These results are presented in Table 18. The results indicate that ascorbic acid is labile during the preparation process.

The percent loss in ascorbic acid was between 70.5 and 94.8 % . Although some green leafy vegetables were found to be high in this nutrient, it is evident that losses using traditional cooking methods are high.

Table 18, Ascorbic acid contents of fresh and cooked of local vegetables [a]

	Vegetable			ascorbic acid contents (mg/100g)	percent loss
1	*S ethiopicum*	(a)	Fresh material	88.8 ± 1.0	
		(b)	cooked material	4.6 ± 0.1	94.8
2	*G gynandra*	(a)	Fresh material	91.7 ± 0.1	
		(b)	cooked material	16.7 ± 0.1	81.8
3	*Solanum gilo*	(a)	Fresh material	20.0 ± 0.2	
		(b)	cooked material	5.9 ± 0.1	70.5
4	*Hibiscus sp.*	(a)	Fresh material	55.6 ± 0.1	
		(b)	cooked material	12.0 ± 0	78.4
5	*V unguiculata*	(a)	Fresh material	97.8 ± 0	
		(b)	cooked material	7.4 ± 0.1	92.4

[a] Mean ± SD (n =3), figures are calculated on fresh weight basis.

5.4.5 Comparison of selected nutrients in local and exotic vegetables

Comparison of values for the analyzed local vegetables and reported values for selected exotic vegetables are shown in appendix 1. It is evident that the local vegetables have higher nutrient values than the exotic vegetables.

A few indigenous vegetables are higher in fibre content than the exotic vegetables. When averages are taken, the indigenous vegetables are twice as high as the exotic vegetables in fibre content. Local vegetables were also observed to be higher in total ash content than the exotic vegetables. Most exotic vegetables are lower in Vitamin C than the local vegetables.

It was also noted that local vegetables are high in selected minerals (ie calcium and iron). (S. nigrum), (A. lividus), (V. unguiculata) were notably high in iron. The respective amounts were 15.5, 12.3 and 12.3 mg /100g respectively. The rest of the analyzed vegetables ranged from 7.6 - 0.4 mg/100g in iron content. All the analyzed vegetables had calcium contents which were 1.5 to 3.2 times higher compared with the cabbage species shown in Appendix 1 which have the highest calcium contents among all the exotic vegetables. When the average for these vegetables are taken, the vegetables, including the three traditional vegetables which are lower in this nutrients (M. esculenta) and Cocoyam leaves (C. esculenta) are 4.5 to 14.5 times higher in calcium contents than the exotic vegetables.

CHAPTER SIX

6.1 DISCUSSION

Throughout the present generation in Africa, and Sub-Saharan Africa in particular, production and consumption of traditional food plants has been declining (IPRI, 1985), (FAO, 1985). This is because traditional food plants, particularly indigenous vegetables are widely believed by urban, peri-urban residents to have low nutritional values, or are considered to be low status or "a poor man's" food.

In this study, it was evident that traditional food plants, particularly the indigenous vegetables, are quite high in nutritional value, particularly in beta-carotene, ascorbic acid, iron and calcium.

While the majority of the people in any urban African setting seem to prefer exotic European types of vegetables, these are very expensive and not readily available. Local vegetables are cheap, and can be acceptable by the majority of the people when proper information is disseminated to the public. Section [5.5], indicates the availability of both traditional and exotic types of food crops.

In Uganda, vegetables are mostly used in preparation of side dishes to accompany carbohydrate based staple dishes of mainly plantain (matooke), cassava, sweet potatoes, yams and cereals (Mukiibi, 1988).

although Goode (1983), identified and enumerated a sizeable number of edible food plants in Uganda, chemical composition data on these edible food plants is scarce. Most researchers carried out work on the European types of food plants which are more profitable than indigenous food plants. To plan nutritional programmes and strategies, data on the nutritional value of the indigenous food plants are required because they are consumed by the majority of the people.

6.2 Food production in Mukono District and its role in alleviation of malnutrition:

The most widely grown food crops in Mukono district, namely cassava, matooke and sweet potatoes, are the **traditional crops,** and require less inputs than maize and rice. Traditional food plants, however, are known to have very low yields. This was also given by the elders as one of the reasons for discontinuation in their production by the present generation. Little research has been done on them. Most likely, varieties with reasonable yields could be developed. In fact, high yields of cassava (Section 5.4) ie over 100,000 kgs a year) were not only observed in this study but have been reported elsewhere (Mascarenhas et al., 1985).

Similarly high yields of matooke (500 -100,000) Kgs/year have been reported not only n this work but also elsewhere (Muroki, 1992). Sweet potato yields as high as 50,000 kgs /year were also reported by the community. Hence these crops are attractive to grow and surpluses are available for sale [Section 5.4].

Mukono District, where the study was conducted appears to be the main supplier of these staples to the capital city which in only 30.4 Kms, away. The other foods, namely beans, groundnuts, yams and others, are grown in small quantities not only because of the low yield but because they also do not generate much cash as reported by the members of the community (Section 5.4). The main staples, nevertheless, are supplemented by these foods, with a side-dish of meat, fish or legumes (Mukiibi, 1988). Reports of malnutrition and diabetes due to consumption of root crop based dishes and plantains are not uncommon (Muroki, 1992).

That these three food crops are the most widely grown crops in this area of Uganda was established by the current survey. Further more, some of them were also mentioned as famine crops. These staples were exclusively home produced. Landless people and those who were not able to produce due to health problems were exceptional cases in this regard. Purchases by all the members of the community showed the same pattern. The fact that maize and rice were mainly purchased during times of famine [Section 5.5], indicates that resources were not diverted to production of these exotic food plants. This may be due to fact that these food crops do not do well here.

Although the production data indicates food sufficiency, this does not, however, indicate nutritional adequacy of the diet, which is generally lacking in proteins, most minerals and vitamins, thus resulting in malnutrition (Mukiibi, 1988; Muroki, 1992). According to Muroki, Malnutrition is very common where root crops and plantains are consumed.

The ready availability of some fruits and vegetables of both exotic and indigenous types, namely, jack fruit, passion fruit, mango, pineapple, jambula, cabbage, tomatoes and indigenous foods namely, nakati (S. ethiopicum), ntula berries (S. gilo), ejjobyo (G. gynandra), malakwang (Hibiscus sp.), cowpea leaves (V. unguiculata), pumpkins (C. maxima), cassava leaves (M. esculenta), etc. is a happy situation in that these would complement the protein and micronutrient deficiency in the widely grown root crops and plantains. It is possible that this complementary effect could explain the fact that to date Vitamin A and Vitamin C deficiency problems are not widely reported in this area.

The observation that the least available food plants include the majority of the indigenous fruits, vegetables, roots and tubers which are either cultivated or collected from the wild, indicates that there has been some change of production trend from formerly indigenous food plants to mostly introduced food plants. These findings are in agreement with what has been reported in literature (Mascarenhas et al., 1985).

Topping the list of foods grown in the past are root crops; Endagu (Dioscorea sp.), Balugu (Dioscorea sp.), Mayuni (C. esculenta), Ebkongo (Dioscorea sp.), followed by legumes, Epande (Vaandzeia subterranean), Binyeba (Arachis hypogea), Cowpeas (V. unguiculata), Beans (P. vulgaris). Fruits and vegetables were mentioned by a lower proportions of the respondents. Plantains and sweet potatoes were reported to have been both cultivated and collected in the past.

Cash crops were rarely mentioned as widely grown crops in the study area. The area is not a typical cash crop growing area (GOU, 1992). This may explain why some of the traditional food plants are still being grown. Observation that exotic crops are among the most widely grown food crops [Section 5.5] is rather disturbing and could reduce the impact of efforts to promote the traditional food crops.

That the food production and food consumption data for the staples are so similar is an indication that the data collected was reliable. Since the study community practices subsistence farming, it is expected that they consumed almost all the food produced.

The decrease in collection of indigenous fruits and vegetables [Section 5.8], is of concern as this would help supplement the mineral and vitamin contents of the diets of these rural communities.

Making the present generation familiar with the plants and availing nutritional data will contribute a lot to the promotional efforts. Increasing the present generation's familiarity with traditional food plants was in fact recommended by the elders during the focus group discussions. The present study makes a contribution to the scant data available on trad. vegetables.

6.2.1 The role of traditional food plants in alleviation of malnutrition:

Protein deficiency has always been a concern of the under privilege in developing countries and Uganda is no exception. Protein deficiency causes increased morbidity and mortality among the vulnerable groups (UNICEF, 1993). Protein is a basic nutrient and a potent adjuvant in nutrition rehabilitation of the sick or those marginally fed (WHO, 1993).

Whereas much work has been carried out on Protein-Energy-Malnutrition (P E M), little work has been carried out on the micro-nutrients deficiency. With the realization that micro-nutrient deficiency is common, is related to morbidity and mortality and that it differentially affects the vulnerable populations, there has been an increased interest in the content of micro-nutrients in various diets (FAO, 1985).

The high nutritional value of traditional vegetables has been reported by a number of other workers, Sreeramulu, Ndossi and Mtotomwema (1982), Watson (1975), Oomen and Grubben, (1976), FAO (1985). The vegetables selected for analysis and others identified in the study have the potential to alleviate malnutrition in view of the fact that they are relatively high in nutritional value compared to exotic vegetables. Indigenous vegetables were also found to be low in oxalate content. Thus the mineral availability from them is higher than that of most exotic vegetables.

6.2.2 Nutrient composition of the selected local vegetables

The proximate chemical composition of the vegetables that were analyzed is shown in [Section 5.4]. The nutrient composition of these local vegetables is similar to that reported by other workers for similar vegetables (Sreeramulu, et al., 1982; Watson, 1975; Oomen and Grubben, 1976).

The contribution of vegetables to protein in the diet has been widely ignored. This study shows that the traditional vegetables had a higher protein content on a dry matter basis (14.2 - 36.3 %) than did either exotic vegetables or legumes [Section 5.5].

The analyzed protein content for most of the traditional vegetables studied fell within the range of protein content reported earlier for similar vegetables (Jellife and Jellife, 1973; Srikantia, 1973; Imungi and Potter, 1983) but are higher than those reported by Brouk (1975) for leafy vegetables. The data obtained by other workers is shown in Appendix 2. This difference may be attributed to differences in the soil, maturity of vegetables, or even the time of harvest. The nutritional potential of leaf protein is well demonstrated by the practice in Zimbabwe of adding sieved leaf powder to infant food (Muroki, 1992).

It is also reported that the protein of dark green leafy vegetables (DGLV) is high in lysine and tryptophan which are lacking in cereals (Muroki, 1992). Therefore, vegetables can supplement cereals in the same way as legumes. Vegetables are also reported to have an anti-pellagragenic effect when consumed with maize (Jellife and Jellife, 1975).

Data on the consumption of vegetables in Uganda (FAO, 1985), indicated that among a large proportion of the population the quantities of the vegetables consumed, only (12-43g) per head per day is not adequate (FAO, 1985).

The present study indicated that on a dry weight basis, vegetables can supply about 30g of protein per 100g. It is recommended that where the protein supply is adequate, 100g of vegetables per head per day is adequate intake (FAO,1985). Where protein supply is low, as is the case with the study area, 500g of vegetables would supply between 20 and 50 grams of proteins. This is a reasonable amount of protein to supplement the protein deficient staple food crops (FAO, 1985). However, this quantity of vegetable can only be eaten if the fibre is modified by grating, drying, grinding and then sieving.

Although fibre is indigestible and cannot be absorbed by the body, it has a very important role to play in our diets. Fibre has a protective role in the prevention of cancer of the colon, large bowel and rectum (Oomen and Grubben, 1976). Fibre is also important in emptying the bowels. The quantity of dietary fibre affects bile salt metabolism and this has a direct bearing on diseases. Thus increased consumption of green leafy vegetables is of nutritional importance as far as fibre is concerned

The analyzed vegetables are quite high in fibre (8.3 - 19.4%). The fibre content of the vegetables studied is in agreement with earlier reported fibre levels of similar vegetables shown in Appendix 2b. (Imungi and Potter, 1983; Jellife and Jeliffe, 1975; Oomen and Grubben, 1976).

About 200gs of fresh vegetables should be able to meet the fibre requirement for adults (Omen and Grubben, 1976). Children may not require so much fibre in their diets.

The ethereal extract and total ash content of the analyzed vegetables are in agreement with values reported by other researchers (Brouk, 1975; Imungi and Potter, 1983). Vegetables are not significant in fat content. The low fat content of vegetables is desirable for their keeping quality especially when they are dried for preservation purposes.

The high ash content of vegetables reflects a high mineral content of the vegetables, this is evident in the high calcium and iron content of the vegetables.

Ascorbic acid

With respect to contribution to micronutrient intake, the traditional food plants have a role to play. They are high in Vitamin C and Beta-carotene (pro vitamin A) which are deficient in most diets in developing countries.

Vitamin C (Ascorbic acid), is a water soluble nutrient. Although Vitamin C is fairly stable in acid solution, it is the least stable of all the vitamins and is very sensitive to oxygen (Davidson and Passmore, 1986). The lability of the nutrient is evident from the observation made in this study (Section 5.7] where very high losses which were well over 70% after cooking were recorded. Vitamin C potency can be lost through exposure to light, heat and air which stimulate the activity of oxidative enzymes (Davidson & Passmore, 1986).

Vitamin C plays an important role in prevention of scurvy. Other functions of Vitamin C are maintenance of collagen, a protein necessary for the formation of connective tissue in the skin, ligament and bones and healing wounds and burns because it facilitates the formation of connective tissue in the scar, Vitamin C also aids in forming red blood cells and preventing haemorrhaging (Davidson and Passmore, 1986).

In addition, Vitamin C reduces bacterial infections and reduces the effects on the body of some allergy-producing substances (Davidson and Passmore, 1986). It also aids in the metabolism of the amino acids phenylalanine and tyrosine. Vitamin C converts the inactive form of (folic acid) into the active form, folinic acid and it may have a role in calcium metabolism (Davidson and Passmore, 1986). In addition, Vitamin C protects thiamine, riboflavin, folic acid, pantothenic acid and vitamins A and E against oxidation. Most importantly, it promotes absorption of iron (Davidson and Passmore, 1986).

The ascorbic acid of the analyzed vegetables as shown in [Section 5.5] indicates that vegetables can supply a reasonable amount of ascorbic acid. Some often neglected local vegetables, are notably high in ascorbic acid. The local vegetables which showed reasonably high values for ascorbic acid were G. gynandra, Phaseolus lunatus, cassava leaves (M. esculenta) and A. hibridus. The other vegetables, showed values in the range of 33.3 to 64.5 mg/100g on a dry matter basis. These results fell within the range of values of ascorbic acid reported earlier by other researchers, (Fafunso and

Bassir, 1976; Sreeramulu et al.,1982; Goode, 1983; Imungi and Potter, 1983; Appendix 2).

The veqetables used for the present study were purchased from the market while earlier studies were conducted using samples freshly harvested from experimental plots. The freshness of vegetables purchased from the market is not guaranteed. Ascorbic acid is labile, being sensitive to light, oxygen, and heat, and therefore losses may occur during the different stages of transportation from the market. Variations in nutrient content of purchased and freshly harvested vegetables have been noted (Watson, 1975).

Since the vegetables are good sources of vitamins [Section 5.3.3], 100gs of most vegetables will be able to supply about 50% of the recommended daily intakes for all the age groups. Ascorbic acid losses during vegetable preparation are, however, high. These losses have been observed by other workers, (Watson, 1975; Fafunso and Bassir, 1976; Sreeramulu et al., 1982). The losses observed during vegetable preparation can be explained by exposure to oxygen, heat and light during preparation. Prior to cooking, the vegetables are chopped into small pieces and then washed, during which ascorbic acid can easily leach into the washing water. Further, chopping could increase phenol-oxidase and or ascorbic acid oxidase activity which could decrease the ascorbic acid content (Hecmmsa, 1981) cited in the ecology of food and nutrition (1986).

The use of local salt and excess water in vegetable preparation, which is a common practice in many African families, could enhance ascorbic acid losses. Imungi and Potter (1983) reported presence of ascorbic acid in drained water from cooked vegetables. Some people also expose vegetables to the sun to eliminate insects that may be present. These traditional practices contribute to the losses observed. Nutrition education should therefore emphasize improved methods of vegetable preparation in the local community.

Beta-carotene:

Vitamin A is essential for the synthesis of epithelial cells (Davidson & Passmore, 1986). Its role in the immune system has also been established (Kielman, 1992). Like Vitamin C, it is also labile. It is reportedly low in dried vegetables (Gomez, 1981).

The fact that Vitamin A deficiency is still a nutritional problem in developing countries is well established (WHO, 1993; UNICEF, 1992). Various survey results from different developing countries indicate low intake of Vitamin A from food especially in pre-school children.

Beta-carotene (a precursor of vitamin A) levels were high in the local vegetables. One hundred grams of most analyzed vegetables can contribute more than 50% of the Recommended Daily Allowance (RDA). High levels of beta-carotene in traditional vegetables have been reported else where (Gomez, 1981; Imungi and Potter, 1983; Mwanjumwa, 1990). Reported values are shown in Appendix 2. It is important to note that traditional vegetables are much higher in beta-carotene content than all the exotic vegetables such as cabbages, cauliflower. Vegetables which were high in Vitamin C, were also high in beta-carotene. This is an important observation, since the Recommended

Daily Intake (RDI) of the two vitamins may be met while consuming the same type of vegetables. This possibility, however, needs to be explored for a range of food plants and experimentation is needed to determine how the body uses these vitamins when they occur together.

Iron, calcium and oxalate contents of the selected vegetables:

Iron

Iron deficiency has been reported to be the most common cause of nutritional anaemia in developing countries (WHO, 1993). Anaemia is reported to affect mostly young children, pregnant women, lactating women and women of reproductive age in general (Oomen and Grubben, 1976).

Iron contents of the selected traditional vegetables were high (4.4 - 15.5 mg/100g of vegetables. These findings compare favourably with the findings reported earlier by several researchers (Oser et al., 1942; Imungi and Potter, 1983; Mwajumwa, 1990), whose findings are recorded in (Appendix 2b). Other researchers, however, have reported a lower range of iron levels in green vegetables (FAO, 1968), than was found in this study, (Appendix 1).

As the vegetables are high in iron content, 100g of green leaves can meet the iron requirement for children while 100-200g of green leafy vegetables can provide the iron requirement for adults especially women at fertile age. If small quantities of vegetables are incorporated into children's diets it may be beneficial since children are much more vulnerable to iron deficiency anaemia. However, it is important to note that absorbability of iron from plant foods is generally low. The importance of preventing Vitamin C losses from vegetables is to be emphasized because this vitamin promotes the absorption of iron.

The elders in their focus discussions mentioned some of the medicinal uses of the indigenous food plants. Their beliefs that some of the indigenous food plants do cure eye problems, anaemia and that eating various leafy vegetables keep people healthy is evident in the laboratory findings of the selected nutrients. The high contents of ascorbic acid, beta-carotene, iron and calcium obtained from the analyses of various local vegetables explains their line of reasoning. Although the elders had no idea about the presence of vitamins and minerals, in the local food plants, they believed that local food plants contributes to better health.

Calcium and oxalate:

Calcium is an important mineral especially for young and rapidly growing children. The main source of calcium is milk, but in the absence of milk vegetables become important source of this nutrient. The high calcium content of green leafy vegetables is well established (Oomen and Grubben, 1978). The calcium content of the vegetables of selected for this study (770-2480) mg/100g are comparable with the (1520-1750 mgs/100), reported by Imungi and Potter (1983) and Mwajumwa (1990).

Although vegetables are very high in calcium, their contribution to this nutrient in the diet can be considerably reduced by oxalate which is reported to decrease absorption due to the formation of calcium-oxalate (Pingle and Ramasastri, 1978; Davidson and Passmore, 1986). Oxalate in vegetables binds calcium thus making it unavailable for absorption.

Local vegetables are reportedly high in oxalate content. Mwajumwa (1990) reported oxalate levels ranging from 175mg/100g in G. gynandra to as high as 15,766mg/100g) in Amaranthus species. The vegetables studied were notably low in oxalate content (10.8 to 93.3mg/100g on a dry weight basis), compared with the levels
(175 - 15,766 mg/100g per edible portion of vegetables quoted in the literature. Since the vegetables were found to be high in both calcium and iron contents, the oxalate content in the local vegetables should not discourage their utilization in human diets. The amaranthus species which has been reported to have high levels of oxalate was not available for this analysis.

It should also be noted that high levels of oxalate should not be of much concern when the calcium content is reasonably high since deficiency of this nutrient is not likely to occur. According to Pingle and Ramasastri (1978), oxalate levels observed in this study are lower than the 2% critical level. The local vegetables that were studied except for (Amaranthus hibridus), therefore can be consumed without any concern about the oxalate present in them.

6.3 Limitations in promotion of production and consumption of the traditional food plants

The decline in the production and utilization of traditional food plants is associated with certain factors. In the present study, an attempt was made to outline the limitations in both production and marketing of traditional food plants. From this study, it is evident that a few of the population in the study area have ideas as to why the production and consumption of traditional food plants is declining. Some of the people were able to explain the phenomena as they discussed in the focus groups. The constraints to promotion of production and consumption of traditional food plants are discussed below.

6.3.1 Familiarity of the community with the traditional food plants:

Considering the small proportion of the respondents mentioning the various reasons as limitations in the production and consumptions of traditional food plants [Sections 5.10 and 5.11], it is evident that the community is not adequately familiar with the traditional food plants and hence their decline in production. This may be explained by the fact that the proportion of the population in the older age group (over 65 years) is very small. Further, although it was not possible to compare this area with other areas with regard to effect of education and familiarity with traditional food plants, it appears that the relatively high literacy rate would partially account for the unfamiliarity. This has been observed else where (Mascarenhas et al., 1985). Familiarity with these food plants might be increased if they were included in program of the extension service. That extension work on these food has been given little attention and that their promotion has not been emphasized is well established (Mukiibi, 1988). This was also reported by the elders during the focus group discussion.

The community in the study area is only familiar with the few traditional food plants that are cultivated in their area, as is evident from the data on the proportion of persons mentioning various foods. This confirms the fact that as in other parts of the world, people only depend on a few food plants which are widely known (FAO,1985).

6.3.2 Production Constraints:

Availability of seeds and planting materials has been identified as one of the production constraints by the elders. It has been observed that in many countries, it is easier to buy seeds of exotic food crops (FAO, 1985), whereas the distribution of the seeds of local species is almost non-existent. The farmers have to produce their own seeds without any background regarding appropriate methodology/technology for plant improvement which should increase productivity and improve pest resistance (FAO, 1985). The fact that many of the traditional crops are not yet intensively grown on a large scale may partially explain why private seed suppliers have so far neglected this sector.

In Uganda, seed multiplication for local vegetables has been initiated in a few of the research centres, namely; the District Farm Institute (D.F.I) in Mukono District, Kawanda Research Centre (K.R.C) and Serere Research Centre (S.R.C), (GOU,1992). Their work is aimed at promotion of the traditional food plants. This seed multiplication effort is, however, on a small scale.

6.3.3 Marketing constraints:

Marketing constraints are other problems limiting promotion of traditional food plants. Lack of markets has been reported by other workers (FAO, 1985) to be the major constraints in the promotion of traditional food plants markets should grow when both urban and rural populations have increased an familiarity with the traditional food plants.

Poor infrastructure in the study area has also been reported to be a major constraint in marketing traditional food plants. This constraint applies to the other crops as well (GOU, 1992).

A number of additional reasons were given by the elders, these include low seed yield, lack of seed and overemphasis on exotic crops. These constraints have been mentioned in other reports (FAO, 1986). The traditional belief, that root crops should not be fed to babies or that pregnant mothers should not eat certain types of food plants because they could cause abortion may have significantly negative effects in the efforts of promoting the production and consumption of traditional food plants. Judging from the elders' reasons, it appears that they are in a better position to explain the limitations in consumption and production of these crops than the younger generations.

In developing countries, informal education on traditional food practices is no longer given. Western education, urbanization and the change from subsistence to cash economy agriculture play a role in the decreased interest in these food plants.

The elders were very insightful in suggesting inclusion of education on traditional food crops in the school curriculum.

6.4 The role of traditional food plants in ensuring food security:

6.4.1 Use of traditional foods in famine situations:

Drought and famine have been reported in the drier areas of Uganda, (Mukiibi, 1988). This situation is evident in some places of Northern Uganda and Karamoja District, where in most cases, it results in famine and malnutrition. Food plants used in the community for alleviation of hunger during famine situations are given in [Section 5.10].

It is disturbing that drought resistant cereals such as millet, sorghum and others are so infrequently mentioned. One of the reasons why the drought resistant cereals are not popularly grown in this area could be that the community is not familiar with them and hence does not utilise them. The availability of processed cassava, sweet potatoes and plantains as reported by the community would be attractive for use during famine situations. Maize and beans are reportedly purchased to supplement the food supply.

Cassava and sweet potatoes have high yields and could be promoted to help alleviate hunger and malnutrition and offer food security in times of famine. These tubers would have to be supplemented with legumes and vegetables to enhance dietary quality. The merit of purchased maize and rice for use during famine situations is subject to question since millet and sorghum which are more drought resistant are more suitable in such situations.

6.5 **The potential role of traditional food plants:**

Apart from improving micronutrient intake and alleviating hunger during times of famine, there are other potential benefits which can be derived from the promotion of the traditional food crops which may not be immediately evident from this work. The possibility should, however, be investigated because of the constraints observed.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATION:

Conclusion:

The community in the study area was not very familiar with the majority of the traditional food plants except for the few staple food crops namely; cassava, matooke (plantains) and sweet potatoes, a few legumes mostly cowpeas, beans and some fruits and vegetables which are both exotic and indigenous in origin.

Vegetables and some root crops that were grown/collected in the past are no longer being used by the community, thus indicating a decreased food availability. These foods could supplement the mainly starch-based staples eaten in this rural community.

Elders are aware of the declining production and collection of the traditional food plants, and are concerned that these food plants are becoming extinct.

Constraints in the promotion of production and consumption of the traditional food plants are mainly their unpopularity, difficulty in propagating the traditional food plants, difficulty in collecting the indigenous fruits and vegetables from the forest, a lack of improved seeds, a lack of good marketing and pricing system, a lack of credit facilities, a lack of information on the nutritional values of the traditional food plants, poor infrastructure and transportation system and a lack of informal education on traditional foods and their uses.

The indigenous vegetables were quite high in nutritional value specifically in beta-carotene, ascorbic acid, iron and calcium. Inclusion of vegetables in the diets have the potential for increasing protein supply. The oxalate content of the analyzed vegetables would likely not be a factor affecting the availability of calcium and iron.

The traditional food plants particularly those which were reported to have high yields (cassava, matooke [plantains], sweet potatoes, and yams) as well as some of the lower yielding but widely grown, fruits and vegetables, have great potential in increasing the food supply in Uganda.

Recommendation:

The following are recommendations derived from the study.

1. While acknowledging the economic benefits of commercial horticulture based on export or exotic crops, greater emphasis must be placed upon the particular contribution of the local species in the economy of the home.

2. Horticultural extension programmes should be planned to adequately cover two production sectors, intensively produced exotic species for export and local or native species for domestic use.

3. Before the potential of the traditional food plants in broadening the food base and improving nutrition can be realised, the production and marketing constraints mentioned by both the elders and the community are to be addressed. This requires government commitment and the people of Uganda to mount a nation-wide campaign on the importance of the traditional food plants.

(4) There is a need to popularise the use of more varieties of the traditional food plants, particularly those cultivars and clones found to be high yielding, nutritious and disease, pest and drought resistant.

(5) More research and nutrient analyses should be carried out to provide data on nutrient content, methods of propagation, to improve and promote more varieties of the traditional food plants particularly the indigenous types to increase the food supply in the country.

(6) There is need to develop a better marketing system and a more efficient input purchase and delivery policy. Higher producer prices, better credit opportunities for farmers producing traditional crops are required.

(7) There is a need to initiate research programmes into processing, methods of preservation (e.g drying under controlled conditions) and storage techniques to ensure food availability throughout the year.

(8) Research on the industrial uses of crops such as cassava, matooke (plantains), sweet potatoes, cowpeas, beans, pumpkins and various fruits and vegetables is needed.

(9) Improvement of the infrastructure, storage and transportation system would greatly encourage the production of the traditional food crops.

(10) There is a need to educate the community on improved methods of vegetable preparation, as some nutrients e.g ascorbic acid is labile and great losses are observed during traditional methods of vegetable preparation.

Appendix 1

Comparison of selected nutrients in 100g of indigenous and exotic vegetables on a fresh weight basis:

Vegetables	Protein g	Fat g	Fibre g	Ash g	Calcium mg	Iron mg	B-c mg	Asco. acid mg
(Local)								
Cowpea leaves	6.0	1.4	2.4	2.3	68.2	12.3	2.4	98
African spiderherb	3.4	0.5	1.6	2.3	39.7	9.4	2.1	92
Cassava leaves (w)	7.7	1.9	3.5	1.4	131.9	6.8	2.2	255
Bitter berries	1.5	0.5	2.0	0.7	10.5	0.4	0.3	20
Cocoyam leaves	13.2	1.7	3.3	2.0	79.0	2.8	2.5	60
Cassava leaves (r)	8.5	1.8	3.4	1.7	131.1	7.6	7.3	169
Amaranthus dubius	3.1	1.0	1.7	2.6	38.4	7.6	5.7	**
Amaranthus lividus	4.9	0.9	1.8	3.2	156.6	12.3	6.5	**
Lima beans leaves	4.2	1.1	2.4	1.3	71.3	9.3	0.8	210
Vergans	5.0	0.8	1.9	2.4	56.7	5.1	0.8	89
Rossele	4.7	0.7	2.5	1.9	175.6	8.5	0.9	56
Black nightshade	5.7	1.1	1.4	2.4	94.1	15.5	1.7	30
Amaranthus hibridus	14.7	1.3	2.6	4.4	393.7	6.6	11.0	138

Data from the analyzed vegetables

(Exotic)	g	g	g	g	mg	mg	mg	mg
Cabbage (B.pekinensis)	1.3	.2	.9	1.7	35	.5	-	-
Chinese cabbage (B.sinensis)	2.0	.3	1.4	1.8	58	0	2.3	-
Common cabbage (B.oleracea)	1.7	.1	3.8	1.5	367	.5	0.1	60
Carrot (D.carota)	.9	.1	1.4	0.8	35	.7	5.9	8
Cauliflower (B.oleracea)	2.0	.1	1.2	.9	35	1.2	0.02	96
Celery (A.graveolens)	1.1	.1	1.0	1.6	87	.9	-	17

Figures are calculated on fresh weight basis, B-c = beta-carotene, Asco = ascorbic. Source: (FAO, 1968).

Appendix 2

The Recommended Daily Intakes of Certain Nutrients:

	Calories No.	Proteins gms	Cal. mg	Iron mg	Vit.A I.U	Vit.C mg
Man	2200-3000	65-70	0.5	12-16	4000	25
Woman	1800-2500	55-65	0.5	14-18	4000	25
During Preg.	2200-2900	85	1.2	20	5500	35
During Lact.	2700-3400	95	1.4	20	7000	45
Children 1-6	1000-1400	40-55	.5-.6	8-11	2000-2500	15-20
6-11	1400-2200	55-65	.6-.8	11-14	2500-3500	20-25
11-18	1900-3000	65-80	0.8	14-19	3500-4000	25-30

Source: "Human Nutrition in Tropical Africa" by Michael Latham, F.A.O., 1965. It is desirable that 20 percent of the protein be of animal origin, but failing this, the protein should be derived from a variety of foods.

Appendix 2b

Nutrient values of various vegetables in 100g of edible portion as reported by other researchers:

Vegetable	Protein g	Fat g	Fibre g	Ash g	Calcium mg	Iron mg	B-c mg	Asco. acid mg	Source
Green vegetables	30-40		20-30						Srinkantia (1973)
Dark green vegetable	20-40								Jellife & Jellife (1973)
Cassava leaves	30-40								Jellife & Jellife (1973)
<u>Amaranthus</u> <u>hybridus</u>						0.9		53	Oyejola & Bashir (1974)
<u>G</u>. <u>gynandra</u>							8900	78	Sreeramulu et al.(1983) Gomez,(1983)
Pumpkin leaves							9000		Gomez,(1983)
Solanum <u>nigrum</u>							7700		Gomez,(1983)
Cocoyam leaves							9952		Gomez,(1983)
Cowpea leaves	33-34		2-2.6	13-15	1520-1750	28.6-38.8	57	410	Imungi & Potter (1983)
Cabbage raw	1.3	0.2					150	25	Brouk,(1975)
Celery raw	0.9	0.1					240	9	Brouk,(1975)
Water cress raw	2.2	0.3					4900	79	Brouk,(1975)

Note: B-c = beta-carotene, asco acid = ascorbic acid.

Appendix 3

The different food groups and proportion of persons mentioning:

Food groups	Scientific name	Proportion of persons mentioning them:
1. Cereal grains		
1. Maize	Zea mays	73.5
2. Millet	Elusine corocana	21.4
3. Sorghum	Sorghum bicolor	6.1
2 Root crops		
1. Cassava	Manihot esculenta	100.0
2. Sweet Potatoes	Ipomea batatas	91.8
3. Mayoni (Yams)	Colocusia esculenta	66.3
4. Balugu (Yams)	Dioscorea sp.	24.5
5. Endagu (Yams)	Dioscorea sp.	20.4
6. Kayinja (Yams)	Dioscorea sp.	10.2
7. Ebisebe (Yams)	Dioscorea alata	9.2
8. Nandigoya (Yams)	Dioscorea sp.	8.2
9. Kaama (Yams)	Dioscorea oderassim	4.1
10. Bikongo (Yams)	Dioscorea sp.	1.0
3. Plantains		
1. Matooke	Musa spp.	92.9
2. Ndiizi	Musa sapietum	18.4
3. Gonja	Musa sp.	17.3
4. Bogoya	Musa sp.	12.2
5. Bananas (brewing)	Musa sp.	6.1
4. Legumes/pulses		
1. Beans	Phaseolus vulgaris	77.6
2. Soy beans	Glycine max	54.1
3. Epand	Vaandzeia sulterranea	13.2
4. Cowpeas	Vigna unguiculata	12.2
5. Ebigaaga	Phaseolus lunatus	6.1
6. Enkolimbo	Cajanas cajan	3.1
5. Oil Seeds		
1. Groundnuts	Arachis hypogea	58.2
2. Simsim	Sesanum indica	14.3

Table continues

6. **Fruits**

Fruits	Scientific name	Proportion of persons mentioning them:
1. Jack Fruit	Artocarpus integer	50.0
2. Passion Fruits	Passiflora edulis	40.8
3. Mangoes	Mangifera indica	34.7
4. Avocado	Persea americana	34.7
5. Pawpaws	Carica papaya	30.6
6. Pineapple	Ananas comosus	24.5
7. Ntutunu	Physalis peruviana	8.2
8. Mpafu	Canarium schweiznfurthii	6.1
9. Jambula	Syzigium jambulana	4.1
10. Local berries	Fragaria ananassa	1.0

7. **Vegetables**

1. Doodo	Amarãnthus lividus	40.8
2. Ensuju (Pumpkins)	Cucurbita maxima	32.6
3. Ebuga	Amaranthus dubius	32.7
4. Nakati	Solanum nigrum	28.6
5. Tomatoes	Typersicon typersicum	24.5
6. Cabbages	Brassica oleracea	23.5
7. Ntula	Solanum gilo	15.3
8. Irish Potatoes	Solanum tuberosum	13.2
9. Ejjobyo	Gynandropsis gynandra	11.2
10. Onions	Allium cepa	8.2
11. Tomatoes	L. lycopersicum	7.1
12. Egg plants	Solanum melongena	7.1
13. Eggobe	Vigna unguiculata	5.1
14. Katunkuma	Solanum indicum	4.1
15. Matungulu	Afranum sangaineum	4.1
16. Mushrooms	-	2.0
17. Omujaja	Osmum suave	2.0
18. Ttimpa	Colocasia antguonum	2.0
19. Ebisoboza dried	Vigna unguiculata	2.0
20. Enkenene	Morus alba	2.0
21. Enderema	Basella alba	2.0
22. Ensuga	Solanum nigrum	1.0
23. Gudu	-	1.0
24. Field peas	-	1.0

8. **Beverages**

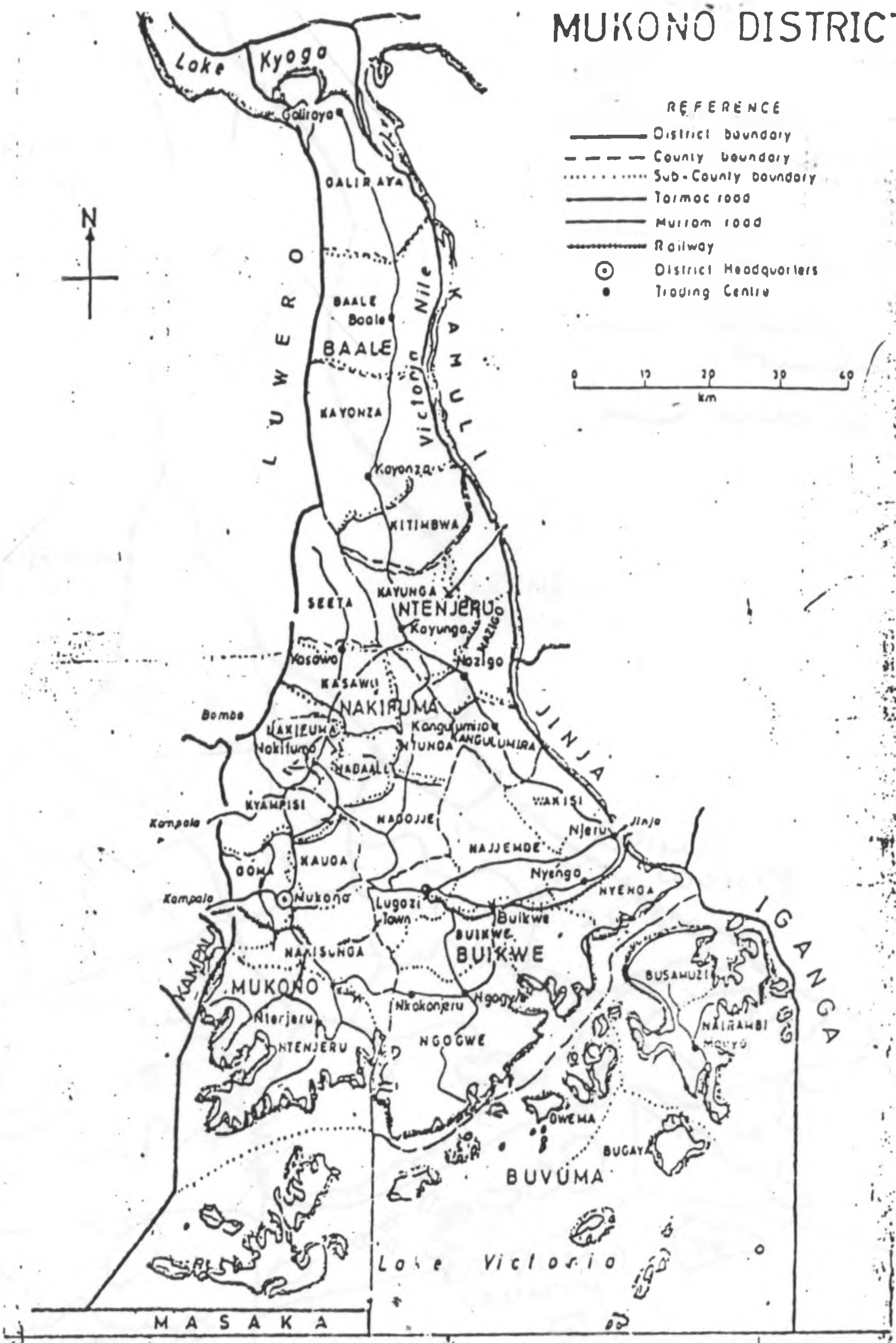
1. Sugar Cane	Saccharum officinarum	24.5
2. Vanilla	vanilla planifolia	12.2
3. Cocoa	-	8.2
4. Coffee	Coffea arabica	6.1
5. Tea	-	2.0

Appendix 4

Map of the Republic of Uganda.

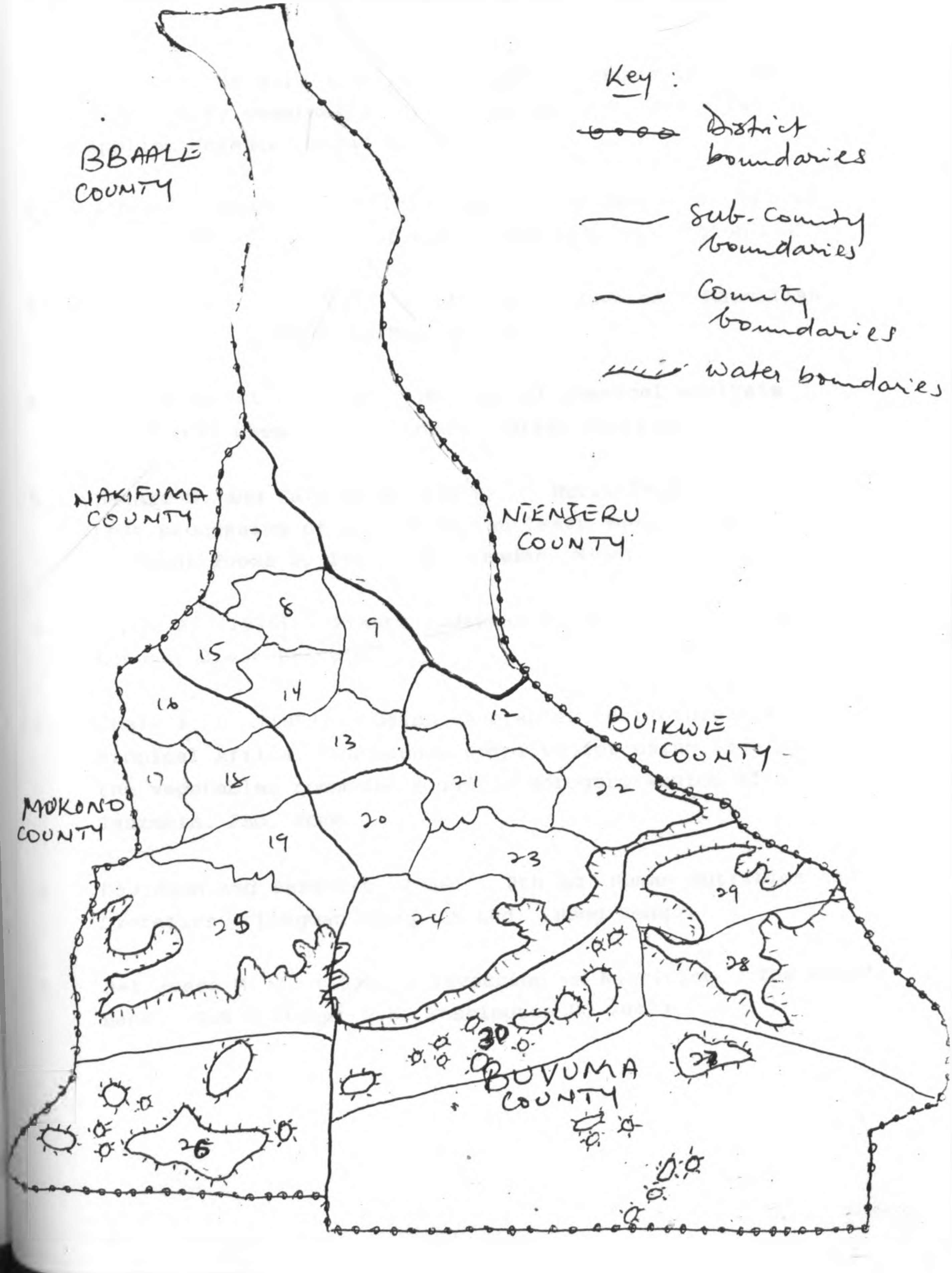
Appendix 4a

Map of Mukono District.



Appendix 4b

Map of Mukono District showing the study Area.



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Appendix 6

QUESTIONNAIRE

UNIVERSITY OF NAIROBI

UNIT OF APPLIED HUMAN NUTRITION

1992

QUESTIONNAIRE

ON

TRADITIONAL FOOD PLANTS

QUESTIONS SHOULD BE DIRECTED TO THE HEAD OF HOUSEHOLD.

The study village..........Location.............

HH No....Interviewer...........Date..../.../....

Name of head of Household......................

Name of Respondent..............................

[List the names of all the household members starting with the oldest in the family, and record the information requested in the table below using the codes provided in the bottom]

NAME	Sex	Age in Yrs and months.	Rel. to HH	Marit. status	Educ lev.	Occ
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
O						

codes: sex : 1 = Male 2 = Female.

(i) Reln. to HH. 1 = Self 2 = wife. 3 = daughter
4 = son 5 = others specify.............

(ii) Marit. status: 1 = married. 2 = single.
3 = divorced 4 = separated
5 = widow/widower.

(iii) Educ.level. o = no educ. 1 = primary educ.
2 = higher educ. 3 = professional training
4 = Children at pre-school age.

Fill the information requested in the table below:

1. What are the main sources of food in this household? Please state the amount produced/purchased, amount consumed, amount sold, seasonal availability and the uses.

use codes below.

Sources of food.	Amt.in sacs.	Amt.con sumed.	Amt. sold.	Ssonal avail.	Uses.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

codes.

1 = Own production. 2 = Purchased.

3 = collected. 4 = others

specify...........................

Fill the information in the table below, use codes provided.

2. What are the most widely available crops in this area?
   (i) Which food plants are cultivated?
   (ii) Mention the food plants which are collected.
   (iii) [If collected], in which season are the available?
   (iv) Mention the uses.

Type of food crops	Culti vated	Collected	seasonal availability	Food uses
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Codes

[1 -collected] [2 - cultivated]

[F = Food crop] [C = cash crop]

Seasonal availability:

1 - rainy season. 2 - dry season. 3 - seasons

Uses: 1 - for consumption, 2 - for sale
3 - Others specify......................

Write the information in the table below. Use codes.

3. What were the most widely grown food plants by your grandparents in the past?

(a) Are they still being grown?
Check [v] 1- Yes [ ]. 2 - No [ ].

(b) [If not], ask why?

Name of food plants	Still being grown.	Not being grown.	Reason for not growing	Uses.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Codes:

1 - still being grown 2 - Not being

Reasons for not growing.

1- Require intensive labour. 2 - No much yield.
3 - associated with low status 4 - Not available.
5. - Others specify.............................

4. Fill the table below with the right information

Use the codes provided.

(i) Mention any food plant collected in the past.

(ii) Are they still being collected? [1 = Yes, 2 = No]

(iii) [If not] ask why?

(iv) Mention their uses.

Name of food plant	Stil being collected	Not being collected	Reasons for not collecting	Uses
1				
2				
3				
4				
5				
6				
8				
9				
10				

Codes.

Reasons for not collecting.

1 - Not available

2 - No longer being eaten

3 - Associated with low status

4 - Others specify................................

USES: 1 - consumption 2 - medicinal

3 - Others specify...........................

....

....

....

....

....

....

Check the list of plants given below:

4. Do you remember these food crops [mention name of plants]

Circle one or two.

1 - Yes 2 - No. If yes ask questions 5, 6, 7 & 8.

Recode the information in the table below, use codes.

5. Are they cultivated or collected ?

[1- cultivated 2 - collected].

6. What are the uses of the plants mentioned above?

....

....

....

....

7. During which season are they available?

....

....

....

....

Table for the questions 5, 6, 7, & 8.

List of food plants.	Culti vated.	Collec ted.	Ssonal aval.	Uses	Conditns used in.
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

codes. Uses:

1 = medicinal 2 = others specify........................

Seasonal availability:

1 = Rainy 2 = Dry 3 = Both

8. Under what circumstances are they used?
   [1 - Normal] [2 - Famine] [3 - Others specify.
   ....
   ....
   ....
   ....
   ....
   ....
   ....
   ....
   ....

MARKET INFORMATION

Write the answers to questions 10 & 11 in the table below.

9. Are there any limitations in the sale of traditional food plants crops?. Yes [ ] No [ ].

[If yes] What are the limitations?

1..
2..
3..
4..
5..
6..
7..
8..
9..
10...

12. What are the food plants used during farmine situation.

1..
2..
3..
4..
5..
6..
7..
8..
9..
10...

FOCUS GROUP DISCUSSION

INTRODUCTION.

Topic for discussion: Traditional food plants.

Check list for focus group discussions:

1. What were the commonest food plants available in the past.
2. Were they cultivated or collected from the wild
3. If they were collected, are they still being collected?
4. Are our traditional food plants still available and used as before? If not why?
5. What are the coping strategies in this area?
6. What are the types of food used during famine situation.
7. What type of food plants grow best in this area?
8. Do you remember any of these plants in this list?
9. What were their uses in the past ? how about now?

Thank you.