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Use and potential of wild and semi-wild food plants in alleviating household poverty and food insecurity:
a case study of Bunyoro-Kitara Kingdom, Uganda

Agea, Jacob

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Use and Potential of Wild and Semi-Wild Food Plants in Alleviating Household Poverty and Food Insecurity: A Case Study of Bunyoro-Kitara Kingdom, Uganda

By

Jacob Godfrey Agea

MSc. and BSc. (Forestry) Makerere University Kampala, Uganda

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PRIFYSGOL
BANGOR
UNIVERSITY

School of Environment, Natural Resources and Geography,
Bangor University, Bangor,
United Kingdom

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DEDICATION

To my family, Mum (Mrs. Phoebe Sarah Opio), Grandmum (Mrs. Consy Ogena), the late Mudukayo Agea and my late Aunt Freda Among

For they should know why?

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ABBREVIATIONS AND ACRONYMS

AI	Availability Index
ANOVA	Analysis of Variance
AOAC	Association of Official Agricultural Chemists
CBOs	Community Based Organisations
CFSI	Cultural Food Significance Index (Indices)
CSOs	Civil Society Organisations
CTAB	Cetyl Trimethyl Ammonium Bromide
DCPIP	The 2,6-dichlorophenolindophenol
DENR-CAR	Department of Environment and Natural Resources- Cordillera Administrative Region
DSOER	District State of Environment Report
FAO	Food and Agricultural Organization of the United Nations
FBOs	Faith Based Organisations
FGD/FGDs	Focus Group Discussions
FMRI	Food-medicinal role index
HDI	Human Development Index
IFTs	Indigenous Fruit Trees
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MDGs	Millennium Development Goals
MFFI	Multi-functional food use index
MoFPED	Ministry of Finance, Planning and Economic Development
NARO	National Agricultural Research Organisation
NGOs	Non Governmental Organisations
NTFPs	Non-Timber Forest Products
NWFPs	Non-Wood Forest Products
PEAP	Poverty Eradication Action Plan
PMA	Plan for modernization of agriculture
PPA	Participatory Poverty Asessment
PPP	Purchasing Power Parity
PUI	Part use index
QI	Quotation Index
RDA	Recommended Daily Allowance
RMS	Rapid Market Survey
SAREC	Sida's Department for Research Cooperation
SIDA	Swedish International Development Cooperation Agency
SWOT	Strength, Weakness, Opportunities and Threats
TCA	Trichloro Acetic Acid
TSAI	Taste score appreciation index
UBOS	Uganda Bureau of Statistics
UDIH,	Uganda Districts Information Handbook
UGX	Uganda Shillings
UNDP	United Nations Development Program
USD	United States Dollars
WHO	World Health Organisation
WSWFPs	Wild and semi-wild food plants

ABSTRACT

Wild and semi-wild food plants (WSWFPs) although widely consumed in many parts of Uganda, suffer from large neglect, disregard, and erosion. Agricultural programmers envision their use as a 'backward' food security practice, devoting very little attention, if any, to them. This little attention and support washes any away practical and inexpensive efforts to improve nutrition and income among the poor households. This study, therefore, explored the use and potential of WSWFPs in alleviating household poverty and food insecurity in Bunyoro-Kitara Kingdom, Uganda. Specifically, it: (1) documented WSWFPs commonly consumed, parts consumed, contribution to the diet, cultural significance and social implications of their consumption by the local people; (2) explored the local methods of harvesting, preparation, and preservation of the commonly consumed WSWFPs; (3) assessed the nutritional values of selected WSWFPs; (4) assessed the market potential of the traded WSWFPs; (5) determined local management practices, selection criteria, constraints, opportunities and strategies to use and management of WSWFPs in the Kingdom. The study employed both qualitative and quantitative designs, using descriptive and exploratory surveys, and laboratory techniques. Household survey using semi-structured questionnaire was used to collect data on the objectives 1 and 5. Focus group discussions (FDGs) were held to seek data on objective 2 and parts of objective 1 and 5. Rapid market surveys (RMS) were conducted to collect data on objective 4. Key informant interviews were used to corroborate household survey and RMS data. Field walks with key informants were conducted to collect samples of selected WSWFPs for laboratory analysis. Selection of WSWFPs for nutrient content analyses were guided by SWOT (strength, weakness, opportunities and threats) analysis in reference to availability of the plant, market value, available information on nutritional composition, and extent of anthropogenic pressure on species. Data from household survey, key informant interviews, FGDs and RMS were analysed using a combination of methods and statistical packages. The laboratory and analytical procedures included determination of moisture, ash, calories, protein, fat, total carbohydrates, dietary fibre, vitamins, essential macro, and micro mineral elements contents using standard procedures.

Sixty (62) WSWFPs belonging to 31 botanical families were reportedly being commonly consumed in the study area. Their consumption comprised a major part (7 to 9 months) of the dietary intake of the poor households. Fresh leaves and shoots, and fruits were the most predominantly consumed plant parts. Mean per capita harvests varied substantially by species, as high as 31.59 g day^{-1} in *Amaranthus dubius* to about 0.04 g day^{-1} as in *Lantana camara*. Like mean per capita harvest, mean per capita consumption also varied from one species to another. Mean per capita consumption of some the plants such as *Hyptis spicigera* (107.02 g day^{-1}) and *Borassus aethiopum* (91.82 g day^{-1}) were higher than the reported vegetable and fruit per capita consumption of 79.45 g day^{-1} in sub Saharan Africa, although much although much lower than the world average of 205.48 g consumed per person per day. Besides, most WSWFPs had moderate (CFSI 20–99) to very high (CFSI $\geq$ 300) cultural food significance indices. Gathering techniques, which were largely dependant on the plant parts harvested, included plucking of edible parts (e.g. leaves and shoots); picking/collecting fruits that have fallen from the tree to the ground; pulling out (uprooting) the whole plant (e.g. Amaranthus) from the soil; cutting off the tender aerial plant parts; digging out the tubers and roots, knocking down ('shooting') fruits from the tree crowns with objects such as stones, and climbing and shaking of tree branches to dislodge the ripe fruits. Preparation procedures for the gathered edible plants also varied from plant to plant. Some procedures such as sorting, wilting, washing, and chopping of the plants into smaller pieces prior to cooking were common among many leafy plants that are normally cooked. Actual cooking procedure such as boiling, stir-frying, steaming, and/or addition to other cooking foods, as well as cooking time, and cooking ingredients were dependant on each species. Most fruits were eaten as snacks without any special preparation procedures. Majority of the gathered plants were preserved by direct sun drying. Shelf lives of freshly harvested plants varied from two to 10 days under special conditions. Preserved food plants had storage shelf life ranging from four to about 12 months depending on the plant species. Trade in these plants was largely undeveloped with very short and simple market chains, and few traders (mainly women) selling WSWFPs in combination with conventional food plants such as tomatoes, okra, and cabbages. Almost all the traders sold WSWFPs in their generic forms without any form of processing or value addition. Those who attempted to process or add value were engaged only in preliminary activities such as sorting bad or old plants away from the batches. There were no definite mechanisms of setting prices of traded WSWFPs; most traders relied on the daily market demand, time and risks involved in gathering process, past seasons' prices, and price information of substitute foods. Average weekly profits yielded from traded WSWFPs were moderate and ranged from UGX 764.5 to 6754.2 (USD 0.38–3.36).

Compared to the conventionally planted cabbage, mangoes and sesame crops, most WSWFPs were generally richer sources of macro and micronutrients, including, vitamin C, beta-carotene, calories, total carbohydrates, dietary fibres, ash, moisture, potassium, phosphorus, magnesium, calcium, sodium to iron, manganese, copper and zinc, and therefore they can help improve household nutrition especially during the months preceding the harvest of cultivated crops and also during periods of social unrests, droughts, famine, and other natural catastrophes. A diet comprising of WSWFPs can definitely assure a relief from some of the major and minor nutrient deficiencies often faced by the poor households. A few (44.4 ± 2.6%) households were involved in the management of the gathered WSWFPs. Common management practices included occasional cultivation, seeds scattering to encourage more availability, and sparing/tolerating some WSWFPs in the gardens. Only 13 of the 62 documented WSWFPs were occasionally cultivated in the area. Their selections for cultivation were based on a number of criteria such as their market demands, tastes, ability to produce harvestable parts in a short time period, cultural and social acceptability, and their ease of management. Main challenges to their use, management, and promotion in the Kingdom included their weak market competitiveness compared to conventional crops, their general weedy characteristics, scarce knowledge on preparation procedures, negative public perceptions, little promotional support from the government, and the increasing inaccessibility of some of the food plants because of habitat loss. On the other hand, the main opportunities to their use, management, and promotion included the increasing awareness of their nutritional values, growing demand, and market value of some WSWFPs in face of local and national food problems, and the fact that most WSWFPs are already an integral part of local cultures and are present in many traditional food preparation systems. Key strategies for promoting their use and management included setting up local community seed centres to maintain and supply planting materials; scaling-up public awareness campaigns on their nutritional benefits; and supporting deliberate cultivation and marketing of these plants by the local people.

Key words: Edible wild plants, ethnobotany, food security, nutrition, poverty alleviation, semi-cultivated plants.

CHAPTER ONE

INTRODUCTION

"As there is a plenty of common and French sorrel; lamb's quarters, and water cresses, growing about camp; and as these vegetables are very conducive to health, and tend to prevent the scurvy and all putrid disorders... the General recommends to the soldiers the constant use of them, as they make an agreeable salad, and have the most salutary effect. The regimental officer of the day [is] to send to gather them every morning, and have them distributed among the men"

George Washington.
General Orders, Headquarters, Middle-Brook. Letter dated June 9th, 1777.

1.1 Background to the study

Wild and semi-wild food plants (WSWFPs) in the context of this study are all are wild or semi-cultivated plants endowed with one or more parts that can be used for food if harvested or gathered at the appropriate stage of growth and properly prepared (Kallas, 1996*ab*). The term 'wild-food plant' can be misleading. At face value this means you can eat the whole plant. However, this interpretation is dangerous. Some edible plants also contain poisonous parts. For example, all but the flowers and the ripe fruit of blue elderberry (*Sambucus canadensis* and *Sambucus cerulean*) is deadly poisonous with cyanide. One key to the successful and safe use of wild plants for food is to focus on the part or parts known to be edible. Some plant parts become poisonous with age or the growth stage of the plant. For example, common milkweed (*Asclepias syriaca*) produces a pod containing seeds. When it is young and tender, before its seeds develop, the pod is an excellent cooked vegetable. Once the seeds reach maturity, the pod is poisonous and that poison cannot be cooked out (Kallas, 1996*ab*).

Many edible wild plant parts do not become truly edible or palatable unless they are properly prepared or processed in some way. Processing could involve, among other things, physically removing certain parts of the plant (like seeds from a fruit or the rind of a root), leaching water-soluble substances out of a plant part, or heating to a certain temperature (Kallas, 1996*ab*; Grivetti and Ogle, 2000). WSWFPs can be weeds growing in urban areas, agricultural landscape, homesteads, and roadsides to native plants growing in deep wilderness (Kallas, 1996*a*). WSWFPs are usually considered as an additional diet to farmers' daily food consumption pattern, generally based on their crop harvest, domestic livestock products and food purchases on local markets (Bell, 1995). Their consumption is more common and widespread in food insecure areas where a wide range of species is consumed (Bukenya-Ziraba, 1996; Pardo-de-Santayana *et al.,* 2007).

It has been well documented that during times of natural and man-made disasters, populations suffering from severe food shortages can become heavily reliant on wild food plants for day-to-day survival (Guinand and Lemessa, 2000; Harris and Mohammed, 2003; Tabuti, 2007). Wild food plants contribute to local household food and livelihood security especially for the economically disadvantaged, the young or the elderly. They are important to local food security because they are free and are easy to access by the local communities (FAO, 1988; Banana and Turiho-Habwe, 1997; Shackleton et al., 1998; Somnasang & Moreno-Black, 2000). In addition, they also contribute to household economies (Ladio, 2001), provide an important source of vitamins and minerals, and act as a coping strategy for those suffering from chronic or episodic food shortages (Harris and Mohammed, 2003). Wild relatives of crop plants are also important to plant breeding because they are a source of genes, which can be used to improve existing crop varieties (Smith *et al.,* 2000).

For many years, however, the importance of WSWFPs in subsistence agriculture in the developing world as a food supplement and as a means of survival during times of drought and famine has been overlooked by operational organisations that consider it a symptom of food insecurity and not a possible solution (Bukenya-Ziraba, 1996). This neglect of wild food plant resources by operational organisations are partly attributed to inadequate information on their nutritional contents, and the subsequent misunderstanding of their potential in the household economy. For people outside rural areas, WSWFPs are usually considered obscure, unpalatable, only eaten by the poor or eaten during times of famine. Moreover, the people who eat these foods do not usually mention them in nutritional surveys (Campbell, 1986). In fact, early anthropologists were surprised that some communities did not show symptoms that would have been apparent from lack of certain foods in their diet. Fruits and nuts eaten as snacks during herding or fruits and tubers used to quench hunger and thirst on the way were not usually revealed for total daily food intake.

Another factor could be that compared to what was accepted elsewhere as food, these foods were inferior and thus not worth mentioning as part of diet (Anthony and Haq, 1995). The use of these foods, however, has served to provide food and maintain general health among populations (World Food Programme Emergency Report, 2005). For instance, the oil (argan oil) pressed out of the seed kernel of Argan tree (*Argania spinosa* (L.) Skeel) is highly valued as an alternative to olive oil, besides claims that it has superior characteristics in terms of health and flavour (Crouzat and Harris, 2008).

In Bunyoro-Kitara Kingdom, Uganda, the consumption of these WSWFPs have been reported (Rubaihayo *et al.,* 2003) to be one of the important local survival strategies against poverty and appears to have intensified due to the repeated climatic shocks hampering agricultural production and leading to food shortages (Grogan, 2004). Over 92% of the entire population are poor with earnings less than half of the national average (Kiiza, 2010). Of the current 256,458 households, 97% of them are rural, 12% live in Huts, 38% stay in dwelling units constructed more than thirty years ago; 22% live in semi-permanent and only 6% live in permanent houses (Kiiza, 2010). Food insecurity, inability to meet basic needs, sale of the few assets owned, intermittent borrowing sometimes without repaying, extensive alcoholism, inability to pay tax, malnutrition, early marriages, school dropouts have always been the signs and effects of poverty in the region (Uganda Bureau of Statistics, 2004; Kiiza, 2010).

Like in other regions of Uganda, the persistent high rates of malnutrition and absolute number of people unable to access recommended calories has been increasing (Masindi DC, 2007, FANTA-2, 2010). This persistent high rates of malnutrition especially in children under 5 are symptomatic of the larger problems of inadequate access to food and inequality in wealth distribution within the Kingdom and Uganda at large. About 38% of the population suffer from chronic malnutrition (stunting), 16% are underweight and 6% suffer from acute malnutrition (FANTA-2, 2010). The Kingdoms's food security is also threatened by high population density, low productivity, and a fragile economy, in which average soil losses are among the highest in within the region (MoFPED, 2007). Yet the mainstay source of livelihoods in the area is agriculture (Uganda Bureau of Statistics, 2002; UDIH, 2005). The variable and inconsistent nature of rainfall in some part of the Kingdom often results into drought and famine.

Besides, most farm households not only suffer from high pest prevalence and attacks on their meagre cultivated crops year round but also still use old and archaic tools (hand hoes) for tilling their land (MoFPED, 2007). In addition, there is high dependency ratio in the Kingdom. Currently the ratio is 1:6 per active person (Kiiza, 2010). The dependency ratio has been made worse by the increasing number of refugees in the Kingdom. Most of the refugees are not engaged in lucrative activities. Their incomes are low and they live in very poor conditions. All of these factors have exacerbated household poverty and food insecurity in the Kingdom. WSWFPs could therefore, play an important role in alleviating household poverty and temporal household food insecurity. Their consumption could help to address both chronic and transitory food security situations. As suggested by Hira and Putu (2007), the local food plants and food systems need to be studied as they might provide some way out to problems faced by poor rural communities. Besides, understanding the use and potential of these plants is essential for informed policy and decision making aimed at promoting their use and management.

1.2 Problem statement

For many years, the importance of WSWFPs in the rural household economy in the developing world as a food supplement, source of cash income and as a means of survival during times hardships such as drought, famine and wars has been and still is being overlooked and underestimated. On a global scale, food security has become increasingly dependent on only a handful of crops that have been domesticated (Diamond, 2002). In fact, over 50% of the global requirement for proteins and calories are met by just three crops (maize, wheat and rice). In addition, only 150 crops are commercialised on a significant global scale yet ethnobotanical surveys indicates that there are over 7000 plant species across the world that are cultivated or harvested from the wild for food (Bioversity International, 2007). Lack of attention on WSWFPs has meant that their potential value is under-estimated and under-exploited. It also places them in danger of continued genetic erosion and disappearance. Their neglect by science and development also threatens the livelihood options for the rural poor.

On a regional scale, and sub-Saharan Africa in particular, there is a dearth of information on WSWFPs, where nutritional data on wild food plants, indigenous and traditional fruits, vegetables, condiments, and spices are few and fragmented (Tabuti *et al.,* 2004). For the case of Uganda, Rubaihayo (1995) notes that a lot of effort has been invested by the Government to produce enough food for local consumption and a surplus for export. He however, opined that the indigenous vegetables, often referred to as traditional vegetables and other uncultivated food plant, have been underrated in favour of introduced exotic vegetables. Hence, the potential of these plants has not been exploited. Modern agricultural and nutritional scientists have hitherto not seriously considered the role of WSWFPs in the diets of rural and peri-urban populations who have been the targets of nutrition intervention programmes in the past several decades. Besides, research, particularly concerning the preparation and consumption patterns, cultural significances, marketing, management, and nutritional aspects of WSWFPs still lacks adequate attention (Padulosi *et al.,* 2002; Tabuti, 2007).

In the case of Uganda, little if anything has been systematically documented on this subject (Tabuti *et al.,* 2004; Tabuti, 2007). This is even of greater concern when looking at the frequency of recent food crisis in most part of Uganda and the extent to which subsistence agriculture is still the norm in the country. There are major gaps in knowledge and capacity to process (prepare), utilize, and improve WSWFPs in Uganda (Bukenya-Ziraba, 1996). Information on marketing and economic potential of the WSWFPs in the country is scarce (Rubaihayo *et al.*, 2003). Little attempt has been made to identify effective marketing and policy frameworks for promoting their use and maximising their market values. This research therefore, was aimed at addressing some of these gaps.

1.3 Theoretical concept

While a small number of plant species provide a large proportion of global food needs, hundreds of other species, including wild species, are utilized at a local level and contribute substantially to household food and livelihood security (Prescott-Allen and Prescott-Allen, 1990; Hawksworth and Kalin-Arroyo, 1995). Knowledge concerning the uses and management of these species is likewise often localized and specialized (Anthony and Haq, 1995). Since many WSWFPs have potential for more widespread use, their consumption could contribute to household food security, household food diversification, and income generation (Vietmeyer, 1986; Anthony and Haq, 1995). However, most of the developments in conventional agricultural and forestry have concentrated on 'major crops and plant species', with little attention to the minor and under-utilized wild plants of economic potential (Bertram, 1993). Yet, some of the WSWFPs could potentially become a future indigenous staple food crop that may ease food insecurity among the poor peri-urban and rural households.

In a review of the scanty published literature, Grivetti and Ogle (2000) reported that uncultivated and wild edible fruits, vegetables and other plants species supplied significant amounts of micronutrients to diets in Gambia, Mali, Niger, Swaziland, Tanzania and Burkina Faso. While Oboh and Akindahunsi (2004), reports significantly high total phenol content and antioxidant activity in commonly consumed leafy vegetable in Nigeria, a large number of indigenous and traditional food plants, particularly non-staples like leafy vegetables, sauce condiments and spices are yet to be correctly identified and analysed for their nutritional and functional properties. These foods that are part of the traditional food systems, though abandoned by some communities (Tabuti *et al.*, 2004), are still being gathered and used in other parts of the sub-continent (Sena *et al.*, 1998; Nordeide *et al.*, 1996). They, therefore, need to be exploited and effectively utilized in strategies developed to tackle the perennial problems of food insecurity, hunger, malnutrition and disease in sub-Saharan Africa.

Resolution 3 of the Nairobi Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity (Fowler, 2000) specifically notes that national action strategies and programmes for sustainable agriculture should include 'promotion of crop diversification in agricultural systems where appropriate, including new plants with potential value as food crops', and 'promotion of utilization of, as well as research on, poorly known but potentially useful plants and crops, where appropriate'. WSWFPs should therefore, be considered as a serious issue when developing strategies to fight rural food insecurity and propose integrated development programmes for chronic food-insecure areas of the world. The option to improve food production through exploiting the potential of WSWFPs is a naturally sustainable, cheap and locally available alternative to resolving at least part of the food shortage problem. At the same time, an emphasis on the development of WSWFPs will help enhance and maintain biodiversity.

The study of this kind is therefore, important at a time when food security and nutritional concerns reign high in most part of Uganda including the poverty-stricken Kingdom of Bunyoro-Kitara. This study therefore, adopted a food-based approach (Clendon, 2001). This approach encompasses amongst others food availability, dependability, food diversity, nutritional and economic values, the cultural importance of food and local knowledge about foods issues (Figure 1.1).

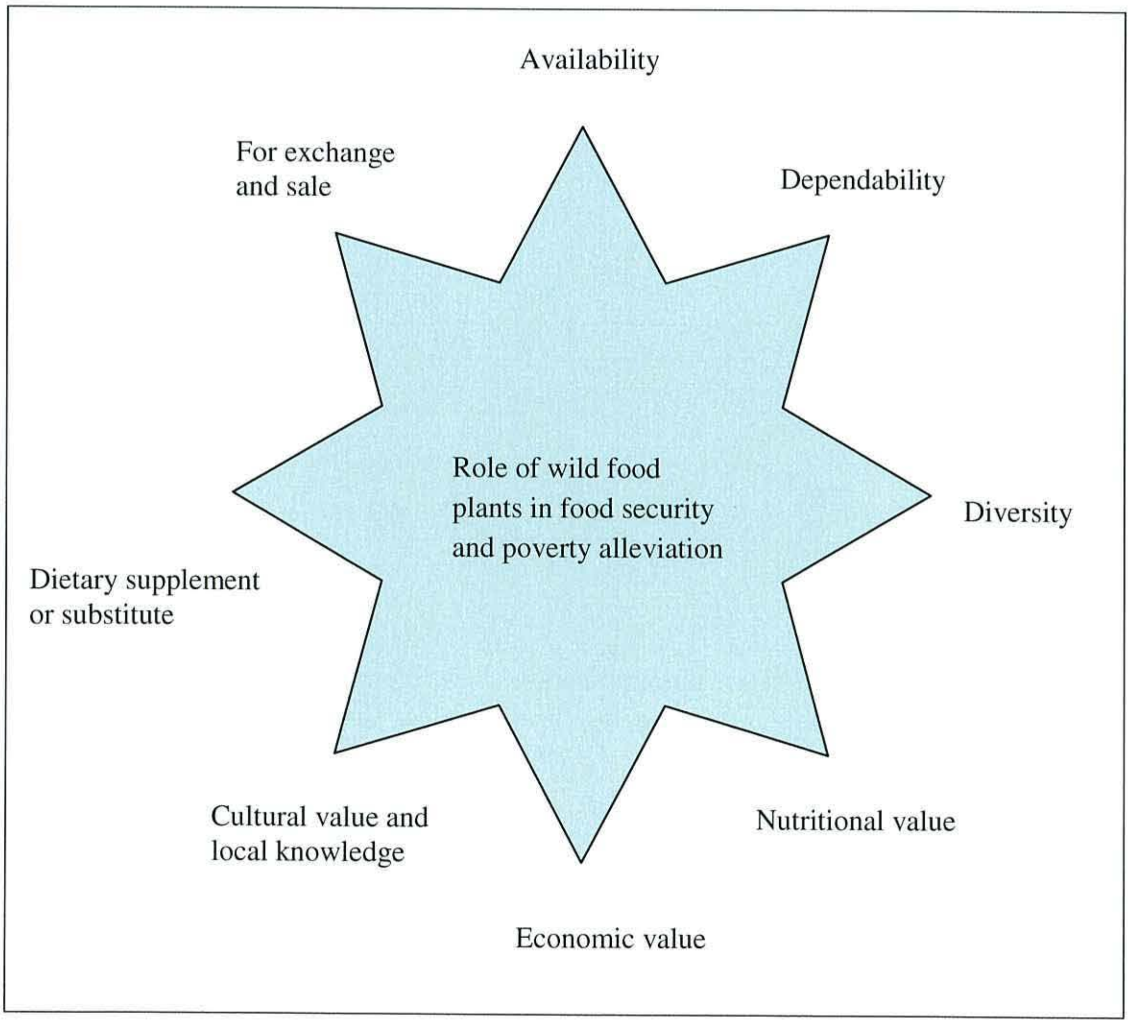


Figure 1.1 Determinants of the roles of WSWFPs in food security and poverty alleviation

1.4 Objectives

1.4.1 Overall objective

The objective of the study was to assess the contribution of WSWFPs in alleviating household poverty and food insecurity in Bunyoro-Kitara Kingdom, Western Uganda.

1.4.2 Specific objectives

The specific objectives were to:

i Document WSWFPs consumed, parts consumed, contribution to the diet, cultural significance and social implications of their consumption by the local people in the Kingdom.

ii Explore the local processes of harvesting, preparation and preservation of commonly consumed WSWFPs in the Kingdom.

iii Assess the market potential of WSWFPs in the Kingdom.

iv Assess the nutritional values of selected WSWFPs consumed by local people in the Kingdom.

v Explore the local management practices, selection criteria, constraints, opportunities and strategies to use and promotion of WSWFPs in the Kingdom.

1.5 Hypothesis

The null hypotheses that were tested in this study are:

H_o: There is no relationship between sex, age of the respondents and knowledge of WSWFPs consumed in Bunyoro-Kitara Kingdom.

H_o: There are no differences in moisture, energy (calories), ash, protein, fat, total carbohydrates, dietary fiber and vitamins- ascorbic acid and β-carotene (provitamin A) contents of some selected WSWFPs consumed by local people in Bunyoro-Kitara Kingdom compared to some well-known cultivated crops.

H_0: There are no differences in the levels of nutritionally essential macro (Ca, K, Mg, Na, P) and micro (Fe, Mn, Cu, Zn) elements in some selected WSWFPs consumed by local people in Bunyoro-Kitara Kingdom compared to some well-known cultivated crops.

1.6 Research questions

The following questions were addressed in the study:

Which are the commonly consumed WSWFPs, and which plant parts are often consumed? What are their consumption patterns? What are their growth forms and collection niches? Who are their main gatherers and consumers in the Kingdom? What are local perceptions about WSWFPs, and what are the social implications of their consumption by the local people? What are the harvest, and consumption rates of WSWFPs by the local people in the Kingdom? What are the cultural significances of WSWFPs consumed in the Kingdom? What are the market potential of WSWFPs popularly consumed by the local people in Kingdom? How are the commonly consumed WSWFPs harvested, and prepared by the local people? How are the gathered WSWFPs preserved by the local people? How long do they preserve the gathered WSWFPs before they start to get bad (shelf-lives)? Are gathered WSWFPs managed? If managed, how are they locally managed within the Kingdom? What criteria do local people use to select occasionally cultivated WSWFPs? What are the limiting factors to the use and promotion of WSWFPs in the Kingdom? What are the opportunities and strategies for enhanced use and promotion of WSWFPs in the Kingdom?

1.7 Expected outputs/implications

A number of research outputs were expected from this study. As far as the knowledge domain is concerned, this study has contributed knowledge on the use and potential of WSWFPs in alleviating household poverty and food insecurity among the poor households. The study has documented commonly consumed WSWFPs, parts consumed, consumption patterns, contribution to the diet, cultural significances and the social implications of their consumption by the local people with a view of promoting their use, cultural values and improving peoples' perception about them. The study has also provided a new insight into the local methods of harvesting, processing, preservation as well as the shelf life of the commonly consumed WSWFPs in the Bunyoro-Kitara Kingdom. It is hoped that these information may be useful in improving their exploitations, uses and values within and outside the Kingdom. It is also hoped that information gathered from market survey of traded WSWFPs may increase the understanding of local incomes derived from these plants. This may in turn enhance their use and management.

More importantly, the results of the nutritional analysis is expected to underscore the nutritional importance of the WSWFPs by local people in Bunyoro-Kitara Kingdom. Understanding of the nutritional values of the WSWFPs by local people could be one of the key strategies for promoting their use, management and/or domestication. In addition, it is anticipated that understanding of the local management practices and selection criteria for the occasionally cultivated WSWFPs may contribute towards better utilisation and their promotion within and outside the Kingdom. Analysis of the constraints, opportunities and strategies to use, management and promotion of WSWFPs in the Kingdom was an important part of the study that is expected to improve understanding and appreciation of challenges in exploiting of the WSWFPs and how poor people might use these challenges to improve the benefits derive from these plants.

In summary, a fuller understanding of the potential of WSWFPs in alleviating household poverty and food insecurity in Bunyoro-Kitara Kingdom is anticipated to be a major step towards formulating policies and programmes that are aimed at increasing their availability, sustainability and/or on-farm cultivation. Currently in Uganda, on-farm cultivation of WSWFPs forms a very small component of farming practices. Yet, the country's Plan for Modernisation of Agriculture (PMA) and Poverty Eradication Action Plan (PEAP) emphasises commercialisation of agriculture and the sustainable use of natural resources for poverty alleviation (Ministry of Agriculture, Animal Industry, and Fisheries, 2000).

1.8 Scope and delimitation

This study was primarily focused on exploring the use and potential of wild and semi-wild food plants (WSWFPs) in alleviating household poverty and food insecurity in Bunyoro-Kitara Kingdom of western Uganda. It did not cover other Kingdoms or regions of Uganda. The study was limited to the documentations of WSWFPs consumed, parts consumed, contribution to the diet, cultural significance and social implications of their consumption in the study area; exploration of local preparation and preservation processes of the commonly consumed WSWFPs; assessment of marketing potential of the traded WSWFPs in the Kingdom; assessment of nutritional values of selected WSWFPs consumed in the area; and lastly exploration of the local management practices, selection criteria, constraints, opportunities and strategies to use and management of WSWFPs in the Kingdom. The study did not cover or made any attempt to investigate in the laboratory, the anti-nutritional factors and toxic compounds that could be present in some of the commonly consumed WSWFPs (e.g. wild yams). In addition, no any attempt whatsoever was made to conduct agronomic farm trials on any of the reported WSWFPs.

1.9 Assumptions

The results presented in this study were collected and analysed with the following assumptions under consideration. Firstly, it was assumed that selections of the samples were unbiased and that the selected samples represent the population of interest. Secondly, it was assumed that the methods, tools, instruments and laboratory techniques used to collect and analysed various data were reliable. In the case of the rapid market survey (RMS), household surveys, key informants interviews and focus group discussions (FGDs), it was assumed that the instruments (questionnaires, interview guides and focus group discussion schedules) that were used to collect the data had validity and that they measured the desired constructs. Lastly, it was assumed that respondents would give their responses or rather answer the surveys truthfully.

1.10 Thesis structure

This thesis is divided into nine chapters (Figure 1.2). Chapter One (Introduction) provides the background information on the study, an overview of the research problem and theoretical concepts upon which the study is anchored. The objectives, hypothesis, research questions, expected outcomes, scope and delimitation, assumptions and thesis structure are also presented in this chapter. Chapter Two provides a general review of a state of knowledge on WSWFPs. Chapter Three present detailed information about the study area (Bunyoro-Kitara Kingdom) and the general methodology used in collection and analysis of data. This includes a description of the survey data collections processes, their purposes, designs, organisation and implementation, and a general discussion of laboratory techniques and statistical procedures subsequently applied in the analysis of the data collected. Specific methodologies are presented in the resulted-related chapters.

The results are presented and systematically discussed in five separate chapters (i.e. Chapter 4, 5, 6, 7 and 8). Chapter Four deals with commonly consumed WSWFPs by local people; Chapter Five is about local process of harvesting, preparation and preservation of commonly consumed WSWFPs in the Kingdom; Chapter Six captures the market potential of WSWFPs; Chapter Seven presents the nutritional values of some selected WSWFPs consumed by local people; while Chapter Eight is about management of WSWFPs by local people. Chapter Nine presents the general synthesis of research findings, conclusions, and recommendations.

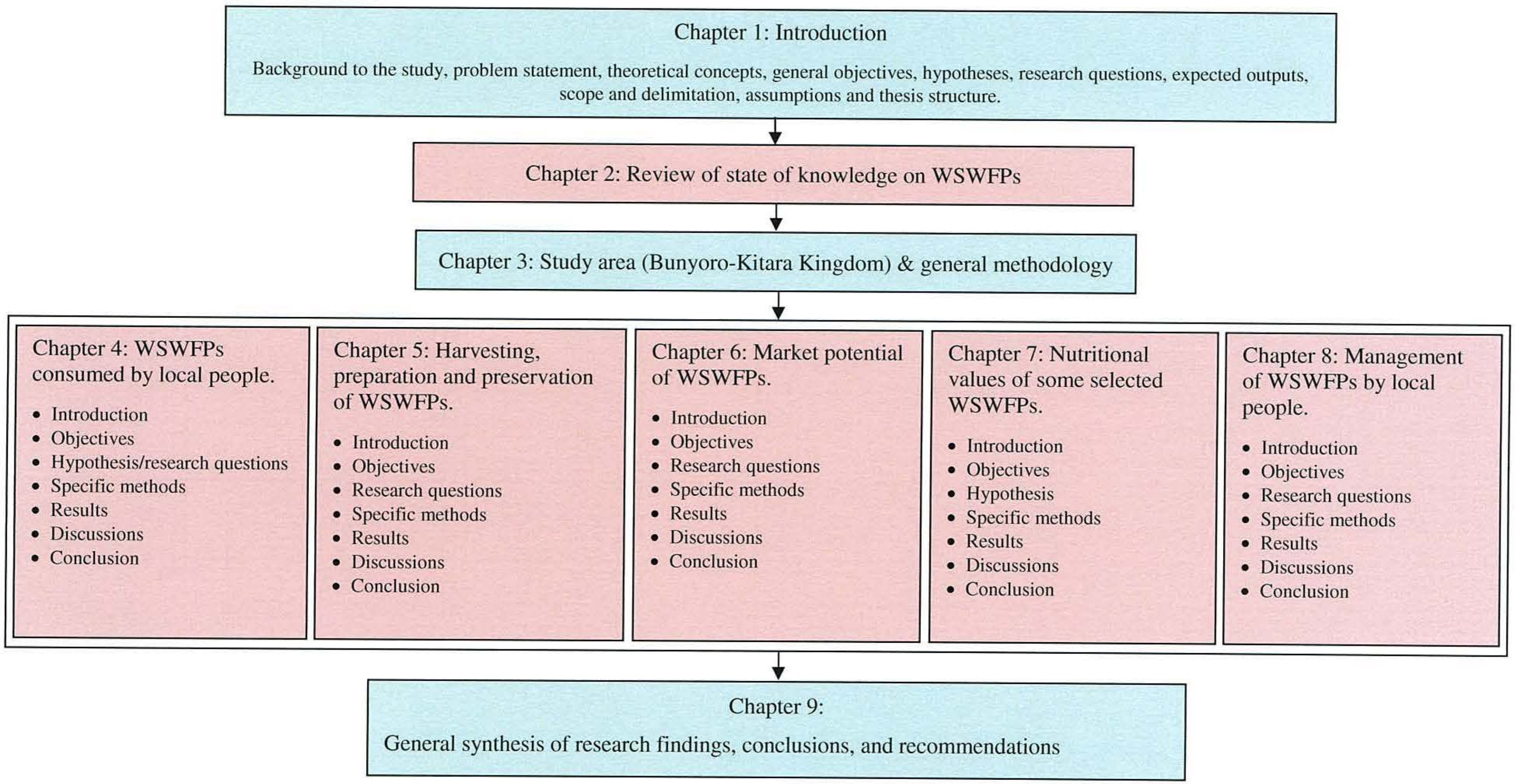


Figure 1.2 Thesis structure of the present study.

CHAPTER TWO

REVIEW OF STATE OF KNOWLEDGE ON WSWFPS

2.1 Introduction

Since time immemorial, WSWFPs have sustained human populations in each of the inhabited continents (Grivetti and Ogle, 2000). The agricultural revolution that began more than 10000 years ago created a dramatic shift in the human food supply (Isaac, 1970; Heiser, 1973; Grivetti, 1980). One result was a significant reduction in dietary diversity. As humans focussed more on domesticated cultivars and gave less attention to wild species, plants that once offered important flavour and texture satisfaction and supplied essential nutrients to the diet declined in popularity. As humans changed, economically and technologically from hunter-gatherer encampments to settlements, and ultimately to urban living, diets changed significantly in two ways. First, human food patterns reflected increasing intake of fewer domesticated plants staples, and second, edible wild species that once sustained health and nutritional status began to reduced, and then eliminated from the diet (Grevetti, 1976, 1978, 1981).

In recent centuries, humans have focussed on relatively few plant species with the result that 80 % of total dietary energy intake, globally, is obtained only from twelve domesticated species: eight cereals (barley, maize, millet, rice, rye, sorghum, sugar cane and wheat) and four tubers (cassava, potato, sweet potato and yam) (Grivetti and Ogle, 2000). This focus on few species poses two significant problems. First, nutritional reliance on few species, paradoxically, places humans at evolutionary risks as seen if a cereal-specific rust or smut evolved that attacked these critical foodstuffs. The result would be global famine of incomprehensible scale and human catastrophe. The second problem is the decline in knowledge. By focussing on domesticated cultivars the collective skills needed to identify and prepare WSWFPs has declined precipitously. Since species that contained energy and micronutrients became peripheral or were abandoned, humans sometimes have starved in the midst of 'wild food plenty' (Grevetti, 1978).

2.2 Problems in WSWFPs research studies

Researchers interested in edible wild plants must address three problems (Scoones *et al.*, 1992). First, how to solve questions of identification and comparison of plant use at global, continental (or regional), and local scales. Given the hundreds of thousands of edible wild species, global compendia, by definition, present data on relatively few species and in limited depth (Hendrick, 1919; Uphof, 1968; Usher, 1974; Tanaka, 1976). However, the continental or regional compendia are still useful starting points when investigating edible species for Africa (Dalziel, 1937; Fox, 1966; Irvine, 1948*ab*, 1952), Asia (Merill & Walker, 1938; Raies, 1980), the Americas (Lundell, 1937; Godshall, 1942; Williams, 1981), or Europe (Couplan, 1983). Other works, in turn, are more narrowly focussed on geographical zones such as the tropics (Anderson, 1993; Duke and Vasquez, 1994), the semi-arid Sahel (von Maydell, 1990), and desert zones (Bhandari, 1978; Nabhan, 1985; Al-Eiswi and Takruri, 1989). Most work, however, has been documented among traditional societies or communities, for example, the baTlokwa of eastern Botswana (Grivetti, 1976), highland and lowland Swazi of Swaziland (Ogle, 1982), or the Seri Indians of Sonora, Mexico (Felger and Moser, 1976).

The second problem is that most research is conducted in professional isolation. Many scientists, whether anthropologists, economists, botanists, geographers or sociologists, have conducted significant research on edible species but few of these studies contain quantifiable data that document dietary intake, energy, micronutrient contributions to the diet (Grivetti and Ogle, 2000). Conversely, publications by biochemists, chemists, food scientists, and nutritionists focus on proximate analysis and micronutrient content, and only infrequently contain cultural-ecological, indigenous knowledge or economic data on important species (Grivetti and Ogle, 2000). A third problem is technical and related inconsistent project designs, diverse methods, and differences related to implementation of field and laboratory studies. The literature on edible wild species is complicated by decisions to use widely different field and laboratory methods that makes study comparisons difficult (Grivetti and Ogle, 2000). Numerous techniques are used to collect, transport and preserve botanical specimens, methods that either preserve or destroy micronutrients.

Further, considerable differences exist in techniques used to gather ethnographic data on use of edible plant species, as well as alternative methods to determine micronutrient composition. Two publications (Blum *et al.,* 1997; Khunlein and Pelto, 1997) have helped to standardized field and laboratory methods. The first describes a step-by-step series of techniques useful to field and laboratory methods, while the second provides five case studies where the techniques have been tested (China, India, Niger, Peru and the Philippines). Although both publications focus on field and laboratory assessment of sources of vitamin A, they contain useful information for a wide application of nutrients and micronutrients as well (Grivetti and Ogle, 2000).

2.3 Historical studies on WSWFPs

Human consumption of WSWFPs has been documented from antiquity into the common era (Grivetti and Ogle, 2000). Dietary use of wild fruits, nuts, seeds and leaves appear in numerous records from ancient Egypt (Darby *et al*., 1977), Greece (Athenaeus, 1927-1942), Rome (Apicius, 1958), India (Caraka, 1981), China (Simoons, 1991), and the medieval era (Arano, 1976). Spanish conquistadors in North, Central, and South America observed use of edible wild plants as food and medicine (Cortez, 1929; Bernal Diaz, 1956; de la Cruz, 1940; Farfan, 1944; Hernandez, 1946). Ingestion of wild plants as food and medicine lies at the foundation of many traditional healing systems, whether expressed as ancient Mediterranean-style prescriptions (Dioscorides, 1959) or as contemporary patterns exhibited by west African Hausa who consider 'medicine as food - food as medicine' (Etkin and Ross, 1982; and Etkin, 1986, 1994).

Whilst thousands of ancient, medieval, and early modern accounts document wild species and their roles in herbal medicine, the systematic study of edible wild plants is relatively recent. Investigations of edible species have been approached by scholars from many disciplines including anthropology, botany, forestry, economics, food science, geography, history, medicines, nutrition, and sociology. This diverse literature encompasses botanical classification and systematic (Merrill and Walker, 1938; Mandiville, 1990; Duke and Vasquez, 1994); ecology and human-plant interactions (Etkin, 1994; Balick and Cox, 1996; Cotton, 1996); plant use by age, gender, and social status (Grivetti, 1978, 1979; Lockett, 1999); and dietary use of wild species during civil unrest, war and drought (Valaoras, 1946; Grevetti, 1976).

2.4 Salvage ethnobotany and famine foods

A large body of literature by botanists, nutritionists, and social scientists recognised that WSWFPs are commonly served as critical foods during periods just before harvest. Widespread use of these so called 'famine foods' during the pre-harvest or 'hungry months has been documented (Miracle, 1961; Brooke, 1967; Hunter, 1967; Annegers, 1973; Ogubu, 1973; Zinyama *et al.*, 1993; Lockett, 1999; Balemie and Kebebew, 2006). As generations passed, the ability to identify 'famine foods' declined precipitously. Once families and societies survived by existing on edible wild plants, but inability to identify sustaining species led to increased malnutrition and famine in certain areas of the world. Attempts to stem this loss have been termed 'salvage ethnobotany' by researchers who attempt to identify famine foods before this critical knowledge is lost (Grivetti, 1976; Ogle, 1982; Humphry *et al.*, 1993; Lockett, 1999; Balemie and Kebebew, 2006). Historically wild foods have been an important component of local coping strategies at times of severe food shortages. Documentation of famine foods in Malawi caused by the rains of 1314-16 that killed 10-15% population was more severe than previous famines because of the reduced availability of wild resources following agriculture expansion (Pretty, 1990). Nevertheless, those resources that did exist were crucial for survival.

In the 1974-5 famine in Bangladesh a range of wild food proved important in people's coping strategies (Rahaman, 1978). In the 1973 famine in Sudan, the Berti of western Sudan collected wild grass seeds and survived off these (Holy, 1980). This pattern was repeated in the 1984-5 famine where grass seeds and the tree fruits (notably *Boscia senegalensis*) were collected in order to survive (APU, 1987; De waal, 1988). A similar pattern was reported in Wollo, Ethiopia where leafy plants, plants with seeds, berries, fruits and roots were incorporated into the diet during the food shortages during the 1980s (Rahmato, 1988). In Senegalese Ferlo, Grewia bicolour, fibre and *Combretum aculeatum* seeds are consumed only in extreme conditions (Cmelik *et al.*, 1976). In extreme cases, wild foods may be the only food available. For instance, 41% of the Karimojong population in Uganda was subsisting off wild weeds and bush fruits and seeds during the famine of 1980 (Beillik and Henderson, 1981).

2.5 WSWFPs as edible weeds of agriculture

Wild foods are part of local and regional agriculture and food procurement systems, and wild species are important genetic resources in global effort to maintain biodiversity (Scoones *et al.*, 1992). Along with the major crops planted by farmers, a range of wild plant material can be found in agricultural fields that represent potential food (Zmarlicki *et al.*, 1984; Grivetti, 1987; Mergen, 1987; Ogle and Grivetti, 1985*abc*; Altieri *et al.*, 1987, Brandoa and Zurlo, 1988). These wild foods (vegetables, tubers and grasses) may be potential competitors with the major crop, but whether they are weeds depends on the observer. To many agronomists anything but the major crop itself is regarded as a weed, and so the monocrop ideal is preached by agricultural extension workers throughout the world. Yet many plants deemed 'weeds' may have a variety of uses to local people.

To a woman attempting to find cheap and nutritious ingredients for relish, the wild food resources found in agriculture lands may be critical (Scoones *et al.*, 1992). Many studies documented the importance of wild vegetables in local diets; many of these are available from farmlands (Scoones *et al.*, 1992). Plants collected from the fields may be managed or simply left to grow (Sharland, 1989). As agroecosystems change, through expansion of cultivated area or changes in cropping patterns, so the availability of wild foods alters. As woodlands are cleared, new edible weeds linked with agriculture land appears as other foods more associated with the woodland ecology disappear (Wilson 1989). The simplification of agroecosystems, such as in the conversion of forest areas to cattle pastures in Brazil and the intensification of small-scale agriculture through Green Revolution technologies worldwide, has the greatest impact on the poor, as key sources of food are lost (Hetch, 1982). Although the greatest diversity of wild foods is found in multi-layered, complex agroforestry systems and homegardens, wild foods are still important in apparently simple, monoculture systems. For instance, canals feeding extensive rice areas are habitats for edible plants associated with excess irrigation water (Grandstaff, 1986; Somnasang *et al.*, 1988).

Wild foods are not only associated with undisturbed systems that replicate the ecological diversity of uncleared forest, they are also found in degraded sites. Sometimes disturbance increases the diversity of wild edible plants (Wanjohi, 1987). For instance, in Kenya, the greatest prevalence of wild vegetables was found in gullies caused by erosion on farmlands (Wanjohi, 1987). Pathways, roadsides, home sites, and field edges are also potential sites for wild products; sites which otherwise might be considered valueless. Areas that are logged within forests may the site for mushroom fruiting (Jackson and Boulanger, 1987). More often, the diversity of wild foods declines during the conversion of complex woodland to simplified cropped land. For instance, in Tanzanian villages there is a correlation between the diversity of edible plants being eaten and the degree of deforestation (Fleuret, 1986). Similar twenty years of agricultural change in Kenya have had a major impact on Mbeere wild food collection and use strategies, causing them to use fewer wild food resources, because of reduced access to bush land because of land privatisation (Brokensha and Riley, 1978, 1986; Riley and Brokensha, 1988). As agricultural systems change there are new pressures on wild food resources. One response is the domestication of the wild foods. Vegetables and fruit trees, formerly harvested in the forest or grazing areas, are increasingly protected or planted. In north-western Uganda, some of the valuable weeds in the diet of farmers are occasionally cultivated within the home compounds (Tallantire and Goode, 1975).
incorporated

2.6 Cultural studies on WSWFPs

Interest in the use of WSWFPs by anthropologists may be traced to the pioneering work of Audrey Richards, considered the founder of the field of nutritional anthropology. Her classic studies among the Bemba of Nothern Rhodesia (now Zambia) documented the important role of wild species in traditional diets (Richards, 1939). A second classic paper, published more than 50 years, ago also challenged prevailing views regarding poverty and food intake, disease and environmental setting, and now an impoverished, traditional society, the Otomi, balanced its diet using edible wild plants (Anderson *et al.*, 1946). At the time of survey (field work was conducted in 1943) the Otomi were an economically deprived indigenous Native American society living in the Mezquital Valley, north of Mexico City. The Otomi diet was characterised by use of numerous edible wild plants, identified by the American and Mexican scientists as 'weeds' (Anderson *et al.*, 1946). Despite poverty and an unsanitary environmental setting, the Otomi were well nourished. The Otomi ate relatively few foods and consumption of meat, dairy products, fruits and vegetables was limited. Still, residents of the Mezquital Valley did not exhibit clinical signs of vitamin A deficiency, pellagra, scurvy or rickets. The research team concluded that: 'Any attempts at dietary change would be a mistake until Otomi economic and social conditions can be improved and something better substituted' (Anderson *et al.*, 1946).

The key to Otomi survival was imbedded in Anderson's text (Anderson *et al.*, 1946): 'Almost every conceivable edible plant, including many of the cacti, is used as food. Many of these grow without cultivation during rainy season, and by most Americans would be considered as weeds'. While maize and beans presented a balanced protein intake through complementary amino acids, pique (a fermented beverage prepared from the root of maguey (*Agave* spp.) provided B-complex vitamins, the Otomi use of chillies and edible wild plants allowed maintenance of quality nutritional status in this semi-arid land (Anderson *et al.*, 1946; Grivetti, 1999). The field of cultural ecology that emerged in the post World War II era attracted numerous researchers, both anthropologists and geographers, to ethnobotany and the role of edible wild plants in traditional diets, as shown by studies on the Tarahumara Indians or northern Mexico (Pennington, 1959), use of domesticated and bush foods by the Bayano Cuna Indians of Panama (Bennett, 1962), wild plants use by Sandawe hunters of eastern Africa (Newman, 1968, 1970, 1975), and subsistence ecology of Miskito Indians of Nicarangua (Nietschmann, 1970).

2.7 Descriptive work and inventory studies on WSWFPs

Species inventories with data on dietary or therapeutic uses and micronutrient composition represent a common type of edible plant research. Such efforts usually draw attention to a vast number of local foods often neglected in agricultural studies or dietary investigations (Grivetti and Ogle, 2000). In many geographical regions of the world, species inventories and documentations are a necessary starting point for more specific dietary and nutritional status research. Some studies of this type provide details on local knowledge and use of WSWFPs, important data for understanding the diversity of foods available in specific ecological setting (Grivetti and Ogle, 2000). An inventory of over 600 edible plant species in Vietnam, for example, contained proximate analysis of and a suite of mineral and vitamin data for sixty of the more prominent species (Duc, 1988). Other examples include an inventory of edible species common to the semi-arid region of Sahel in western Africa, where over 800 edible wild plants were identified that made important, critical contributions to mineral and vitamin intakes (Becker, 1983, 1986). Another inventory, which included micronutrient data on 280 Korean wild herbs and vegetables used as food and medicine, reported significant values for carotenoids, vitamin C, and for Ca (Kim and Oh, 1996), a compilation of 241 edible wild foods in Zambia presented proximate analysis and mineral values for Ca, Fe, and P (Malaisse and Parent, 1985). From the point of micronutrient nutrition, however, the use of inventories is usually limited unless the descriptive, ecological and systematic data are combined with dietary assessment on current consumption, without this linkage, inventories seldom permit an understanding of the role certain wild plant species play in overall micronutrient intake (Grivetti and Ogle, 2000).

2.8 Nutritional and dietary assessment studies on WSWFPs

WSWFPs are part of rural people's diets not only during periods of food shortage, but also on a daily basis (Brinman, 1989; FAO, 1989*a*; Kingamkono and Lindstrom, 1990, Falconer and Koppell, 1990). It is the access to a wide range of products and the resulting dietary diversity that contributes to nutritional well-being (FAO, 1989*b*; Getahun, 1974; Grevetti, 1981; Gura, 1986). Better nutritional status is associated with proximity to forests or the presence of home gardens or orchards (Somnasang *et al.*, 1988; Fleuret, 1979; Immink *et al.*, 1991). An increase in the production of fruits and vegetables in Mexico helped to improve the nutritional status of villages (Hernandez *et al.*, 1974). In a study of two different ecological regions, in southern Zimbabwe, it was found that families in the zone in which diversity was greater had a more balanced diet during the dry season (Wilson, 1990). Dietary diversity is crucial as these various nutrients interact with one another with the body. For example, fats enhance the absorption of Vitamins A, D and E (FAO, 1989*ab*) or oxalic acid found in leafy vegetables may inhibit absorption of calcium (Ogle and

Grivetti, 1985*d*). Non-dietary modifiers and anti-nutritional factors may also affect the nutritional impact of wild foods (Thorn *et al.*, 1983; Holmes, 1984). However, most dietary studies emphasize the value of calorific intake from staples.

The nutritional anthropologist Ann Fleuret conducted fieldwork in Tanzania in the 1970s and stated that 'nutrition studies have not seriously considered the role of wild plants in local diets' (Fleuret, 1979). While her comments still apply today, dietary assessment studies completed since her perceptive comment illustrate that wild edible plants provide important nutrients to infants and children, pregnant and lactating women, the elderly and indigenous societies globally. In study conducted in an isolated Australian Aboriginal community, researchers found extensive use of edible wild foods and essentially no malnutrition (O'Dea *et al.*, 1988). In Bangladesh, dietary patterns of women and young children were balanced using dark green leaves as major sources for pro-vitamin A, and the authors concluded that traditional diets, high in edible plants, should be protected and promoted (Zeitlin *et al.*, 1992). Analysis of national household data in Brazil revealed that wild fruits had high caratenoid and vitamin A values, but were ignored in nutrition education (Shrimption, 1989). Study conducted in Papua New Guinea revealed that edible wild plants were nutritionally significant in the local diet and were important sources for Fe intake (Hongo *et al.*, 1989).

A number of studies of this type have been conducted in Africa. In Gambia, WSWFPs were important during pregnancy and lactation, especially leaf sauces prepared from edible species, and researchers found no evidence of Vitamin A deficiency (Villard and Bates, 1987). In Mali, WSWFPs were critically important to diet in both rural and urban settings (Nordeide *et al.*, 1994, 1996). In eastern Niger, more than eighty WSWFPs were regularly used by 93% of the household and contributed substantial amounts of Cu, Fe, Mg, and Zn to the diet. Furthermore, these plants were frequently sold for extra income (Humphrey *et al.*, 1993). Swaziland has been the focus of research on edible plants for more than 50 years, and edible wild fruits and vegetables are commonly eaten throughout the year and contribute significant amounts of Fe, carotenoids, and vitamin C to the diets of children and adults (Beemer, 1993; Jones, 1963; Ogle and Grivetti, 1985*a,b,c,d*; Huss-Ashmore and Curry, 1991).

2.9 Intervention studies and composition reports on WSWFPs

Several intervention studies that considered WSWFPs have been published. In Gambia, wild mango and palm oil were identified as critical foods in maintaining carotenoid intakes and were used to augment diets during pregnancy and lactation (Bates, 1993). The use of burrito sweets (*Mauritia vinifera*) as part of vitamin A supplements, intervention programme for children was implemented in Brazil (Mariath *et al.*, 1989). In 1997, a health intervention was focussed on traditional foods among the Nuxalk of Canada to improve the diet (Kuhnlein and Burgess, 1997). After a brief review of the prevalence of vitamin A deficiency and the efforts to reduce its incidence in Malawi, Moringa (*Moringa oleifera*) was suggested as a potential solution to the problem. A framework for designing nutrition intervention with Moringa was designed and implemented (Babu, 2000). Composition reports on the micronutrients values of WSWFPs abound in the literature but local knowledge and cultural data on when and how such species are used, as to seasonality or importance during the life cycle, are rarely included (Grivetti and Ogle, 2000). Many studies document high values for minerals and vitamins (Eromosele *et al.*, 1991, 1994; Eromosele and Eromosele, 1993). While most such studies have nutrient composition as their primary, some papers have looked beyond energy and micronutrient composition to understand antioxidant activity as part of broader research design to understand protective components of traditional diets (Pepping *et al.*, 1988; Lagouri *et al.*, 1993; Johansson *et al.*, 1997).

2.10 Market studies on WSWFPs

The sale of wild natural products gathered from forests, grasslands, wetlands, and agricultural landscapes has long offered an important source of cash income for poor rural households (Neumann and Hirsch, 2000; Shackleton and Campbell, 2007). Recent evidence suggests that this trade is expanding, driven by a greater need for cash earnings as households become more integrated into the market economy, and by economic hardship and shock due to, among other factors, poverty, unemployment, job loss, withdrawal of agricultural subsidies, and HIV/AIDS (Campbell *et al.*, 2002; Barany *et al.*, 2005). In sub-Saharan Africa, it is estimated that several million people earn their primary cash income from the sale of wild products (Kaimowitz, 2003; Shackleton and Campbell, 2007).The sale of these products may form part of a livelihood diversification strategy, as households seek ways to supplement other income or smooth their earnings throughout the year.

Marketing of the wild edible resources therefore, plays an important role in the socio-economic development of any area as it helps serve the people (Berry, 1967, Sundriyal and Sundriyal, 2004). Local economic surveys of the biological resources cannot be completed without studying the plant and animal products sold in the local markets (Wells and Brandon, 1992). A large variety of wild edibles, medicinal and ornamental plants, and various ethnobiological utility items are often sold at a much smaller level, probably at the local level only, and very few items flow out of the local regions in most areas (Jana 1997). Access to market places and value of their goods, determined by availability, supply and demand were reported (Martin, 1995) to govern the income of different communities. Thus, local markets play a prominent role in the spatial and regional development of any region, rural areas in particular (Sundriyal and Sundriyal, 2004). In any market system, buyers, sellers, and commodities are three integral components, and total business and prosperity of the market depends on their number and the amount of the commodities available on market day (Jana 1998). The demand of such commodities will also depend on their quality, functionality of the value associated with the product, form in which it is being traded, place where it is being marketed, market channels and intermediaries (middlemen), promotional activities aimed at raising the buyers awareness, as well as the price of the commodity being sold (Le Cup, 1994; ATI, 1995; Lintu, 1995). Besides, effective marketing depend on reliable and up-to-date marketing information (ATI, 1995).

2.11 Local food preparation and preservation of foods

Local food preparation and preservation of foods dates back to the prehistoric age when crude processing including various types of cooking, such as over fire, smoking, steaming, fermenting, sun drying and preserving with salt were in practice (McGee, 1984). It has been a constant chore since the first human beings picked up cutting and mashing stones (McGee, 1984). In return, this effort to make food edible, preserve it, and transform its character has sustained an ever-increasing population

(Symons, 2000). Many techniques of food preparation, including grinding, sifting, drying, salting, sealing, fermenting, and applying heat, are therefore, extremely ancient (McGee, 1984; Symons, 2000). Few fundamentally new techniques have been introduced in the past two centuries, among them microwaving.

Local food preparation techniques are often based on culturally-embedded and socially-constructed knowledge that is locally adapted and innovative (Redclift, 1987; Leach and Mearns, 1988). Such knowledge is increasingly recognized as a dynamic process, generated in and through labour practices (Van der Ploeg, 1993). As such, knowledge is not an abstract conceptual system but is partial and flexible (Hobart, 1993). Richards (1993), for example, suggests that knowledge is a set of 'improvisational capacities' stimulated by the distinctive needs of a specific individual in a unique place and time. He thus makes the analogy of knowledge with performance, being a way of coping, putting mistakes and disasters behind oneself without grinding to a halt. This is an increasingly important ability given the rapidly deteriorating awareness of wild foods and their preparation procedures among many rural African communities.

Recent claims have been made for the usefulness of local/indigenous knowledge in aiding the development process (Soussan *et al.,* 1991). One of the several shortcomings when using the term local/indigenous concerns the suggestion that knowledge is only derived locally. In fact, knowledge and practice are often added to from information generated outside the local area (Madge, 1994). Anderson and Grove (1987) and Garber and Jenden (1993) have stated that the significance of local/indigenous knowledge has not yet markedly filtered to development policies. Research on local/indigenous knowledge has until now concentrated on farming systems (Whyte, 1990; Krings, 1991; Gatter, 1993; Madge, 1994) and forest management (Shepherd, 1992; Wilson, 1989) while little information is available on local/indigenous domestic knowledge. In particular, research is lacking on the indigenous knowledge underlying food preparation practices, which transform crops and forest products into edible meals (Madge, 1994). Although Date-Bah (1985) and Dei (1990) have investigated preservation techniques for cultivated foodstuffs, there is as yet little appreciation of such techniques for collected wild foods although they are an essential element of many African cultures. In particular, it is often assumed that collected wild foodstuffs are consumed only as snacks and eaten soon after collection owing to poor preservation methods (Etkin and Ross, 1982).

2.12 WSWFPs' use patterns, seasonality, regulation, and sustainability

WSWFPs often fit a seasonal niche. They may provide green vegetables early in the rainy season, or can be dried and stored for the dry season. They may also provide counter-seasonal food with fruit bearing in the dry season when little else is available. Wild foods may be particular important in years when the harvest fail (Fleuret, 1986, 1989; Wilson, 1989). Collections and consumption of wild foods is often differentiated between socio-economic groups and gender (Brown *et al.*, 1982). Women and children are primary engaged in WSWFP*s* management and harvesting, particularly the green vegetables (Kingamkono and Linstrom, 1990). Wild foods are also important nutritional supplement for children (Rocheleau, 1991). These may be eaten as snack foods or as main meals. The importance of the WSWFP*s* is greatest among the poorer households, where main field crops are often insufficient to provide food for the family for the whole year. In dry miombo area of Zimbabwe poor households use fruits as the alternatives to grain for a quarter of all dry season meals (Wilson, 1989).

The use of the wild products may be regulated by local rules and institutions (Arnold, 1990; Gupta, 1991). Rights over wild products may change as land is cleared for agriculture. In Zimbabwe, wild fruit trees retained on farm plots effectively become individually owned by farmers during the cropping season, although they may revert to common property in the dry seasons (but still are protected by community rules (Scoones *et al.*, 1992). In other settings, all products are privatised by the process of conversion of land to agriculture, reducing the access of those without control over land. In Malawi, farmers have sold the rights to collection of wild resources to Mozambican refugees (Wilson, 1989). The sustainability of wild food use has received relatively little attention in the literature. Sustainable management and harvesting levels for different plant populations remain largely also unknown (Scoones *et al.*, 1992).

2.13 Conclusion

From the above reviews of literature on the state of knowledge on WSWFPs, it can be deduced that the contribution of WSWFPs to the diet, economy and cultures of local communities is often significant and therefore, focus on these species should remain a priority. Research efforts aimed at exploring their full use and potential in alleviating household poverty and food insecurity for the benefits of poor communities, will not only protect biological diversity but also provide adequate food and contribute to the rural household economy. Over-dependence on a few plant species exacerbates many acute difficulties faced by poor households in the areas of food and income security, nutrition, health, ecosystem sustainability and cultural identity. Therefore, there is a need for more research to increase the evidence base by filling our knowledge gaps with more data on the nutritional composition; market potential; harvesting, preparation, and preservation practices; local management strategies as well as cultural significance and social implications of consumption of these plants. If these studies are undertaken systematically, local and national information systems for food and agriculture can be strengthened and used to form the basis for priority setting and policy-making.

CHAPTER THREE

STUDY AREA AND GENERAL METHODOLOGY

3.1 Study area

3.1.1 Location and size

The study was conducted in Bunyoro-Kitara Kingdom. The Kingdom is located in the western region of Uganda. It lies between 0°36' and 2°20' N, and 30°30' and 32°23' E (UDIH, 2005). The Kingdom covers a total area of 19,621.8 Km^2 (8.12% of total area of Uganda). The case study was carried out in two sub-counties (Mutunda and Kiryandongo) of Kibanda county (Figure 2).

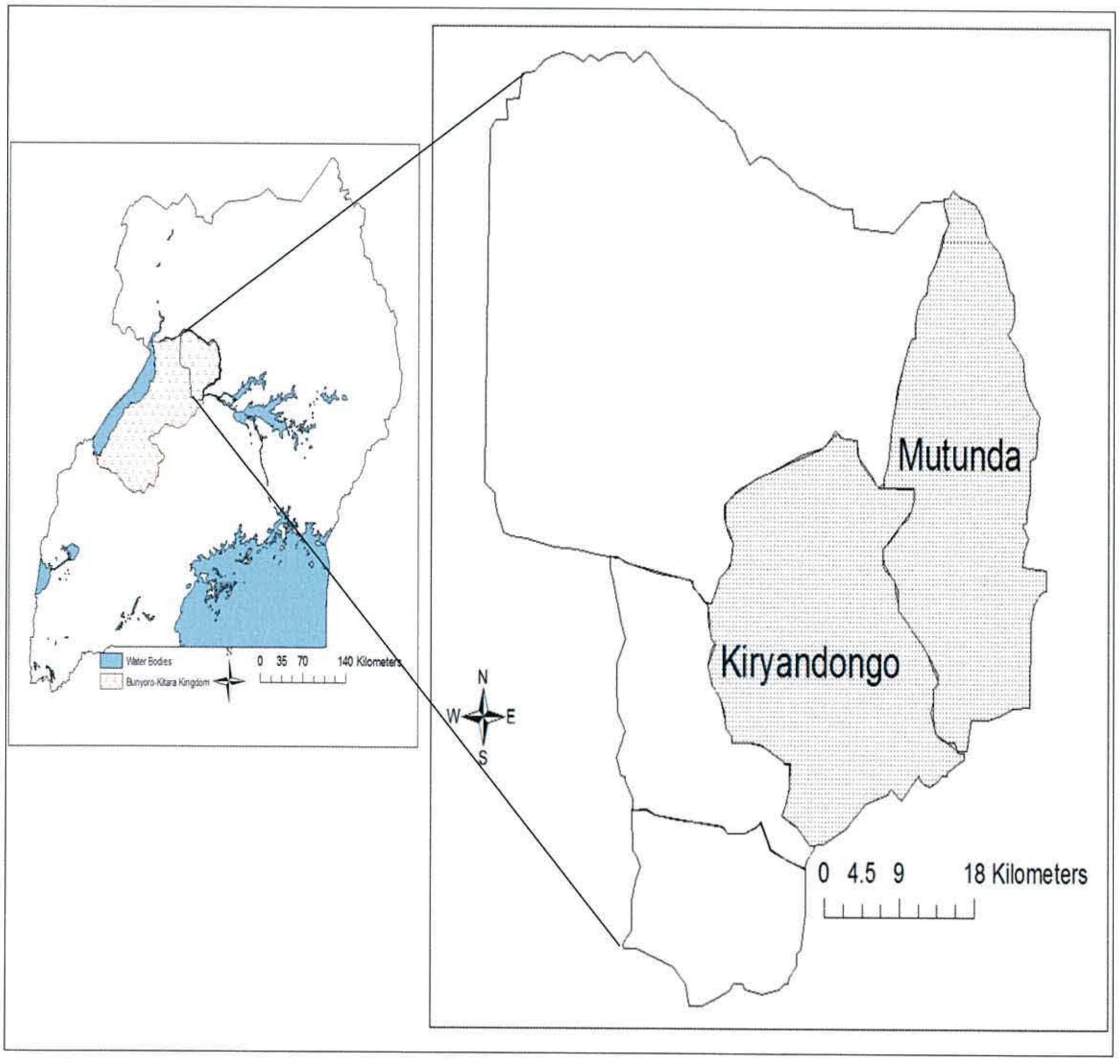


Figure 3.1 Location of Bunyoro-Kitara Kingdom and the study sites.

3.1.2 General background to Bunyoro-Kitara Kingdom

Bunyoro-Kitara Kingdom founded by the Bachwezi is a Kingdom in Uganda that consists of districts of Hoima, Masindi and Kibale. The three districts have a common denominator- poverty, which is threatening to become a trademark of sorts. The Kingdom was created when the ancient Empire of Kitara broke apart during the 16th century (Mwambutsya, 1991). Bunyoro as a Kingdom was initially bigger than the present district of Hoima, Masindi and Kibale. It is said to have been a very big empire comprising the whole of present Uganda, eastern Zaire, western Kenya and parts of northern Tanzania. It is supposed to have collapsed at the advent of the Luo. The Biito Luo are said to have established the Babiito dynasty over some of the remains of the Bachwezi state. The Babiito Kingdom of Bunyoro–Kitara is said to have included present Hoima, Masindi, Mubende, Toro, Busigira, Bwera, Buddu, Buhweju, Kitagwenda and was sovereign over some parts of Busoga. However, over time, the Kingdom of Bunyoro-Kitara started to shrink (Nzita and Mbaga, 1998).

Due to frequent succession disputes, it became weak and it fell prey to the expanding Kingdoms of Buganda and Nkore. Bunyoro-Kitara was the biggest and strongest Kingdom in the interlaucstine region by the beginning of the 18th Century. However, by the end of the 18th century, Bunyoro–Kitara had become weak and started to lose some of her territory. The provinces of Butambala, Gomba, Buddu, and Busoga were lost to Buganda. Some of her parts like Chope, Toro, and Buhweju had earlier broken away and declared their own independence. The Kingdom is home mainly to the Banyoro ethnic group (Nzita and Mbaga, 1998). The native language is Runyoro-Rutooro, a bantu language. Runyoro-Rutooro is also spoken by the people of Toro Kingdom, whose cultural traditions are similar to those of the Banyoro. Inspite of Western cultural imperialism, the Banyoro has maintained their rich cultural heritage. While many Western cultural elements have been assimilated, many Banyoro proudly uphold the ancient traditions of their ancestors (Nzita and Mbaga, 1998).

3.1.3 Climate

Bunyoro-Kitara Kingdom has a favourable climate. The rainfall pattern is generally bimodal. The highest rains are normally received in March-May and August-November. The Kingdom is divided into three major climatic (rainfall) zones: high rainfall (>1000 mm), medium rainfall (800-1000mm) and low rainfall (<800 mm). On average, the Kingdom receives about 1,304 mm of rainfall annually (UDIH, 2005). Mean annual minimum temperature is 16.8°C while the mean annual maximum temperature is 30.1 °C (Uganda Bureau of Statistics, 2004).

3.1.4 Topography

The topography of Bunyoro-Kitara Kingdom is part of the dissected African surface (King 1951). It is characterized by broad, flat-topped ridges of about 1,000 to 1,100 metres in height (UDIH, 2005), whose formation is given tentatively as upper *Cretaceous* (65 - 135 million years ago). These show coincidence in altitude. The surface rises to a plateau, which ranges between 600 - 800 m above sea level. Therefore, this Kingdom can be divided into three main topographic zones;

(a) *Dissected plateau-* This is the dominant landscape in the Kingdom. The topography is either flat topped and capped with lateritic duricrust or rounded and deeply weathered. The hills generally rise 30 to 50 m or more above the valleys. They are remnants of the ancient Buganda surface, which experienced a slow uplift during the mid-Tertiary period and later dissected by a rejuvenated drainage system, resulting in an elevated dissected plateau. There are hill masses capped by remnants of Buganda lower surface (Wayland, 1934). These are conspicuous as flat crests on many hills.

(b) *Escarpment stretch-* This zone covers a watershed running throughout its length Lake Albert. It has been affected by rift valley faulting. The topography is deeply incised by streams and rivers. A typical example is River Wambabya flowing off the escarpment. Steep slopes occur along fault lines. The hills lie along watersheds, which are steep sided with broad coalescing pediments. Hill pediments represent the end-Tertiary surface (Dixey, 1946), which shows up-warped landscape. On either side of the hills, pediments lead onto African surface, which is drawn to the east and actively dissected to the west towards the escarpment.

(c) *The Rift Valley*- The area lying in the rift valley is occupied by Lake Albert. This is represented by early Pleistocene or Acholi surface (Bishop, 1960). It is essentially a flat area of sand beaches with gradients of less than 1%. The plateau suddenly drops off into a rift valley with altitude falling from above sea level to 650 metres. In some places the slope is up to 500 metres long.

3.1.5 Geology

Much of the Bunyoro-Kitara Kingdom is occupied by sedimentary beds of the Bunyoro geological series mainly represented by tillites and phyllites with subsidiary amounts of sandstones and conglomerates as basal members (Bishop, 1965). These rocks are generally classified under Pre-cambrian era, which are part of the dissected African surface. Rift valley and the associated geology occur in areas affected by rift valley faulting. Their distribution follows the weathered detritus that had accumulated prior to faulting which has been removed by post rift valley geological erosion. Therefore the rocks consists of quartzites stones. Other rocks affected by post rift valley erosion include quartzites, granites and schists. Along Lake Albert shores is a broad tract of river and lake alluvium laid down as rift valley floor deposits. At Kaiso in the Albert rift a fossiliferous ferruginised bed occurs in sediments marking a period of recession during interpluvial phase when Lake Albert was formed. In Uganda the oldest deposits are the Kaiso beds (Bishop, 1965).

3.1.6 Geormophology

The geormophology of the Bunyoro-Kitara Kingdom is a typical representation of Waylands peneplain I (Wayland, 1934). It is principally a remnant of lowland erosion surface standing at about 1,300 metres above sea level. This lowland surface is thought to date from early Oligocene era and reached maturity in the Miocene era. This surface is still widespread in the Pre-cambrian terrain and has been deeply incised by rejuvenated rivers. Throughout Africa the land surface has been subjected to base levelling processes over a long time, King (1951). This was during the mid-

Tertiary times when the continent was reduced by sub-aerial denudation to an almost flat plain with no relief. This plain has developed a thick layer of laterite, which can be seen, three kilometres west of Hoima town on a flat ridge crest. During the later part of Tertiary era, the peneplain was followed by a gradual uplift of the land surface. The up-warping is adjacent to the rift in this particular area. The edges for the rift valley in this area are typically marked by scarps that are often faulty and not clearly defined. The axis of the up-warp cuts across the whole Kingdom (Bishop, 1965).

Other areas in the Kingdom are covered with rejuvenated surfaces, which were affected by rift valley faulting. This occurs on a stretch parallel to Lake Albert. The up-warped surfaced and weathered detritus that had accumulated prior to faulting has been removed by post rift valley geological erosion to form sediments on terrace like steps. These can be seen along Lake Albert shores in Kyangwali subcounty. Within the rift valley, the terrain is generally rolling with occasional prominent ridges. The Kingdom is underlain by poorly consolidated alluvial sediments (Bishop, 1965).. These deposits accumulated in the rift valley sediments, which are more than 2,000 m thick. Small areas are covered by infill especially along rivers and streams. The first stages of rivers have been dissected by rejuvenated drainage cutting back from the Rwenzori mountains (main source). However, during the late stages uniform planations have been formed where rivers meander through swamps resulting in areas of infill.

3.1.7 Soils

The soils in the Kingdom are mainly yellowish-red clay loams on sedimentary beds. Highly leached, reddish brown clay loams are also common especially in the extreme eastern part of the Kingdom. These are of low to medium productivity. There are also dark brown, black loams (Bugangari series) found along the axis of the warp and these are mainly of low to medium productivity (Bishop, 1965). The soils of recent origin, which consist of quartzites, are found along the escarpment. Their depth depends on the vegetation cover and land use. They are suitable for coffee and maize. Soils on highland areas developed on pediment fans are lateritized. They are red clay loams (*Kitonya catena*) derived from phyllites. They are of medium to high productivity especially for coffee and maize. On the other hand, greyish-black sands, which are base deficient and acidic in nature generally, occupy rivers and valley floors. These alluvial soils, which are of low productivity includes Wasa complex, Kifu and Bukora series (Bishop, 1965).

3.1.8 Vegetation

The vegetation in Bunyoro-Kitara Kingdom is very varied. It ranges from medium altitude moist forests through forest/savanna mosaic, savanna, swamps to post-cultivation communities (Langdale-Brown *et al.,* 1964).

(a) Forests- A forest is a type of vegetation dominated by trees, many species of which are usually tall at maturity and have straight trunks. Medium altitude moist semi-deciduous forests are found in the south-western part of the Kingdom. It is mapped as *Cynometra - Celtis* forest. This type occurs at altitudes between 690 and 1,350 meters in the western rift. Budongo and Bugoma forest is one of the important forests because it contains growing stock of timber in Uganda much of which is mahogany. In these forests, the purest *Cynometra* stands are usually found on valley bottom soils with impeded drainage. The form of stem with its spreading buttresses suggests that it may be specially adapted to growth on such soils (Osmaston, 1959). It is a mixed forest with different sizes of other species. The only species with uniform size in all types are *Celtis* spp. There are herbaceous climbers and abundant lianas in mixed forests where irregular canopy favours their growth. However, the dense level of *Cynometra* offers few opportunities to them.

(b) Forest/Mosaic Savanna- This is the most widespread type of vegetation in the Kingdom. This is a savanna-like community, which consists of a mixture of forest remnants, incoming savanna trees and a grass layer dominated by *Pennisetum purpureum* (Elephant grass). This is a result of clearing of original forest and the influence of repeated cultivation, cutting and grass fires (Langdale-Brown *et al.,* 1964). Tree heights vary from 6 to 24 meters and the aerial cover of their foliage is generally about 10 per cent. The grass layer varies in height from 1.8 to 3.6 meters or more. A variant dominated by *Phoenix reclinata* and *Acacia polycantha* is found in valleys and contain species of grasses and sedges commonly found under water logged conditions. The other elements of the mosaic are small patches of the original forest dominated by *Imperata cylindrica var. africana, Hyparrhenia rufa* and *Cymbopogon afronardus*. This type of vegetation in which *Pennisetum purpureum* is associated with deciduous trees (*Combretum* spp.) occurs on shallow rocky soils (Langdale-Brown *et al.,* 1964).

(c) Moist Combretum savanna- This unit covers a continuous stretch from North to South-western side parallel to Lake Albert. Deciduous broad leaved trees of the *Combretaceae* make up the woody cover, which is characterised in the grass layer by *Hyparrhenia rufa*. Tree cover is light ranging from 3 to 12m high, with abundant *Combretum molle, Terminalia glaucescens* and *Albizia zygia*. It is subjected to effects of annual grass fires, the cutting of wood for fuel and periodic clearing for cultivation (Langdale-Brown *et al.,* 1964). This vegetation type is intermediate between forest and the dry savanna types.

(d) Grass savanna- Grass savannas are derived from forest, wooded savanna and thicket by repeated cultivation, grazing and burning. They fall into two main groups; those dominated by species of *Hyparrhenia* and those of *Themeda*. A *Themeda chloris* grass savanna occupies a stretch next to the moist *combretum* towards Lake Albert shores. This community occurs on sandy loams. There is abundant *Brachiara decumbens, Hyparrhenia filipendula* and *Sporobolus pyramidalis*. The grasses stand at 0.6 to 1.2 m high and there are few scattered trees. Small thicket clumps occur regularly on anthills. Dry *Hyparrhenia* grass savanna is dominated by *Hyparrhenia filipendula* and *Hyparrhenia dissoluta* species (Langdale-Brown *et al.,* 1964). Some of them are associated with *Acacia* spp. while others appear to have been derived from combretaceous savanna woodland. They occur on off-shore tips of Lake Albert. They mostly stand between 600 to 1350 m altitudes on shallow light textured soils.

(e) Dry Combretum savanna- This is a fire climax savanna consisting of broad-leaved deciduous trees (*Combretum molle* and *Terminalia glaucescens*) and perennial grasses. The trees vary from 4.5 to 12 m in height. The grass layer is dominated by *Loudetia arundinacea* and the tussock habit of this grass determines the structure of this layer. This vegetation type occurs on shallow soils under mean annual rainfalls of 571 to 962 mm with a dry season of 3 to 4 months duration (Langdale-Brown *et al.,* 1964).

(f) Post-cultivation communities- Post-cultivation communities cover relatively small area around Kingdom. They change from year to year and are sometimes submerged into more stable climax communities. *Cymbopogon afronardus* occurs abundantly on shallow or stony soils in the forest zone and on deeper soils after prolonged cultivation (Langdale-Brown *et al.,* 1964). Practically all trees and shrubs associated with this community are remnants of previous climaxes (ranging from moist evergreen forest to broadleaved savanna woodland) adapted to poor conditions.

(g) Swamp- Pediplanation and reversed drainage have resulted in swamps forming a major feature in Uganda. Most of them are covered with grasses or sedges. Swamps occur along rivers in the Kingdom such as Nkusi and Wambabya. They are dominated by *Cyperus* papyrus at about 600 up 1950 m altitudes (Langdale-Brown *et al.,* 1964). The common associates include *Cissampelos micronata, Dissotis rotundifolia Dyopteris striata, Leersia lexandia* and *Polygonum salicifolium. Cyperus* papyrus attains a height of 2.4 to 4.5 m. It is cut for thatching and rope making.

3.1.9 Population and the economy

According to Uganda Bureau of Statistics (2002), Bunyoro-Kitara Kingdom has a total population of 1,434,007 people. Of these, 728,672 are female; 705,335 are male; 100,073 are urban dwellers while 1,333,907 are rural dwellers. The average growth rate in the Kingdom is about 3.45% (Uganda Bureau of Statistics, 2002). As in all of Uganda, agriculture is the core economic activity with a bias on food crops such as maize, finger millet, cassava, rice, sorghum, yams, beans, simsim (sesame), peas, groundnuts, irish potatoes, sweet potatoes sunflower, cowpeas, and bananas. Fruits and vegetables (mainly pineapples, onions, tomatoes and cabbages) are also produced. The main cash crops grown include tobacco, coffee, cotton, tea (UDIH, 2005). Although it has ample surface water resources, agriculture production is limited by low rainfall amounts. Majority of the households in the Kingdom also keep various livestock such as cattle, goats, sheep, pigs, chicken, ducks, turkeys, guinea fowls and geese to supplement income and food obtained from crop production (UDIH, 2005). Bee-keeping is also picking up with increasing demand for the products

Being richly endowed with natural water resources, fishing is a major economic activity, particularly on Lake Albert where fishing has greatly influenced the social and economic development of areas around L. Albert. There are a number of wetlands where some fishing is also done, with the prominent ones being Kafu, Wambabya, Waki, and Kibale. Aquaculture is also picking up and, currently there are over 500 constructed fish ponds, of which 93% are stocked with tilapia, mirror carp, and clarias (Uganda Bureau of Statistics, 2004) There are several small-scale industries associated with milling (maize, rice, oil, wood), furniture making, animal feeds, bakery, shoe-making, printing and brick-making, manufacturing of jaggery, processing of hides and skin, pit sawing. There is a large-scale sugar production factory, Kinyara Sugar Works Ltd (UDIH, 2005).

3.2 General methodology

3.2.1 Introduction

In the previous section 1.3, theoretical food-based concept for understanding the role of WSWFPs in food security and poverty alleviation was presented. The objectives, hypothesis, and research questions for this study were developed based on that conceptual approach. These objectives, hypotheses, and research questions formed the basis for the selection of the proposed methods and techniques of data collection and analysis presented herein. This section therefore, gives the general research methodology that was undertaken. Specific methods are concisely presented under each major chapter.

3.2.2 Study design

A design is 'a plan or strategy of shaping the research (Henn *et al.,* 2006), or as Hakim (1987) puts: design deals primarily with aim, purposes, intentions, and plans within the practical constraints of location, time, money and availability of staff. The purpose of the research design is to achieve greater control of variables, thus improving the validity of the study in examination of the research problem. Here a theoretical framework is often developed to guide further the study' (Burns and Grove, 2001). In this study, both qualitative and quantitative designs using descriptive and exploratory surveys, and laboratory techniques were used. The general systematic approach (Figure 3.2) was followed while undertaking this research study. Prior to the main fieldwork, a thorough literature review and consultations were made. This was followed by a general reconnaissance survey of the area. The main field work and analyses were phased into: household survey using semi-questionnaire interviews, key informant interviews, rapid market survey (RMS), focus group discussions (FGDs), field inventory for specimen sample collection and laboratory work for nutritional analysis.

3.2.2.1 Quantitative and qualitative designs

Quantitative research is depicted as the traditional scientific approach to research that has its underpinnings in the philosophical paradigm for human inquiry known as positivism (Polit and Hungler, 1999). Research driven by the positivist tradition is a 'systematic and methodological process' (Koch and Harrington, 1998) that places considerable value on 'rationality, objectivity, prediction, and control' (Streubert and Carpenter, 1999). A distinguishing feature is the collection of numerical data (Jack and Clarke, 1998) that, in turn, can be subjected to statistical analysis (Carter, 2000). Advocates of the quantitative approach are therefore described as objective scientists (Duffy, 1986) committed to the discovery of quantifiable information (Carr, 1994). Parahoo (1997) identifies three levels of quantitative research: descriptive, correlational and causal; causal referring to experiment as a research design. Burns and Grove (1993) define a quantitative design as a systematic process in which numerical data are utilized to obtain information about the phenomenon under study. A quantitative approach facilitates deductive reasoning where the researcher starts with something that is little known about to further explore the topic (Clifford, 1997). Quantitative research design were used in this study because most of the data and or responses that were sought, were to be collected, analysed and presented as mean frequency counts and percentages.

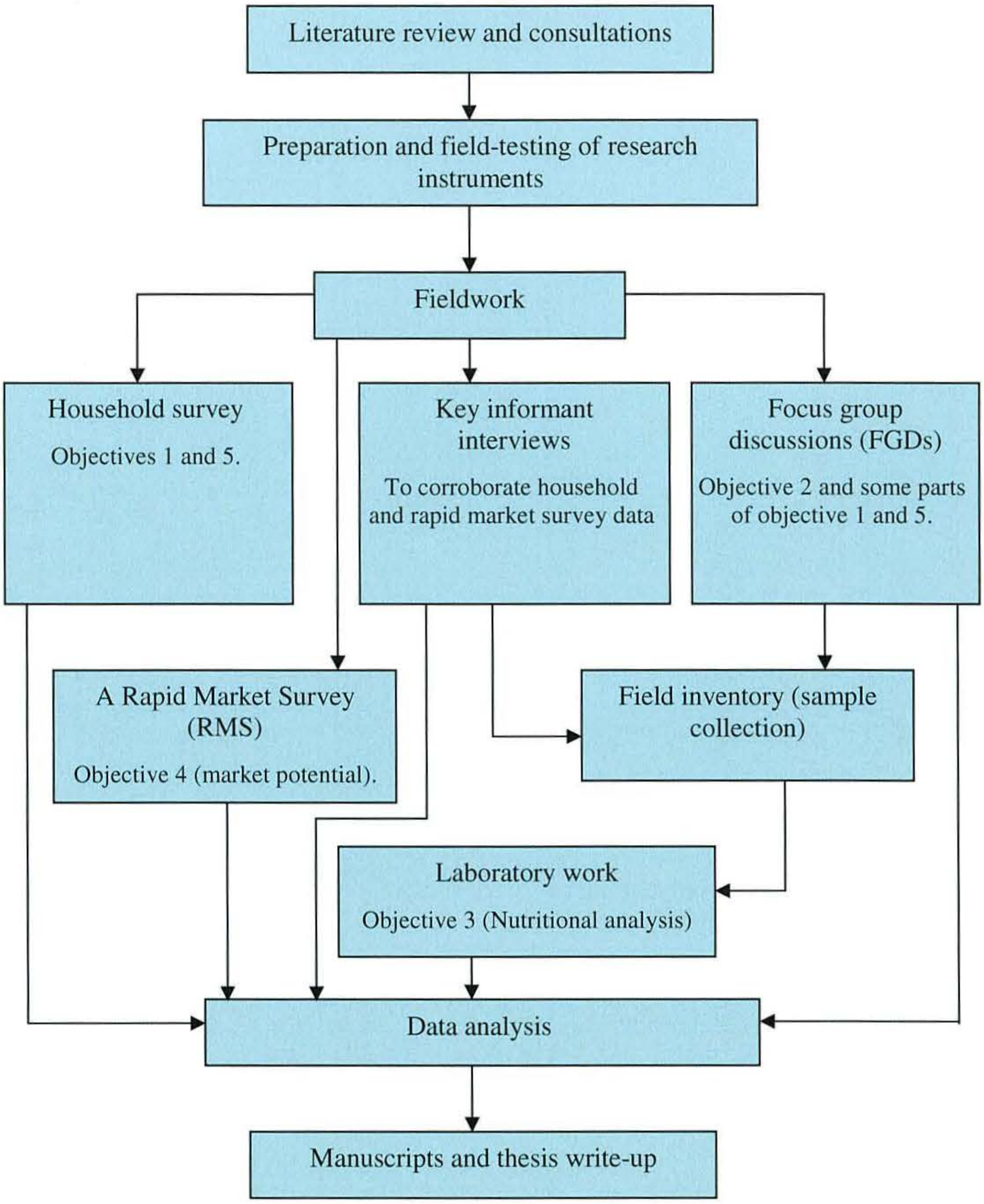


Figure 3.2 General systematic approaches to the study.

Qualitative design is a generic investigative designs described as ethnographic, naturalistic, anthropological, field, or participant observation. It emphasizes the importance of looking at variables in the natural setting in which they are found. Interaction between variables is important. Detailed data are gathered through open-ended questions that provide direct quotations. The interviewer is an integral part of the investigation (Jacob, 1988). This differs from quantitative research, which attempts to gather data by objective methods to provide information about relations, comparisons, and predictions and attempts to remove the investigator from the investigation (Smith, 1983). In this study, focus group discussions and key informant interviews were used to collect qualitative data.

3.2.2.2 Descriptive studies and exploratory surveys

According to Burns and Grove (1993), descriptive studies attempt to describe the phenomenon in detail. Uys and Basson (2000) defined a descriptive study as the collection of accurate data on the phenomenon to be studied. Polit and Hungler (1999) described a descriptive study as concerned with observation, description, and documentation of aspects of a situation rather than relationships among variables. According to Webster (1994), descriptive research provides an accurate portrayal or account of characteristics of a particular individual, event or group in real-life situations, for the purpose of discovering meaning, describing what exists and obtaining information about the current status of the phenomenon. Descriptive studies were used to describe how local people harvest, prepare, and preserve the commonly consumed WSWFPS. Based on the premise that a great deal of information could be obtained from a large sector of population in a fairly economical and accurate manner, exploratory household surveys, rapid market surveys and focus group discussions were conducted. Exploratory surveys were aimed at obtaining information about people's beliefs, attitudes, opinions, interests and aspirations (Abrahamson, 1992).

3.2.3 Reconnaissance survey

Prior to the main fieldwork, a reconnaissance survey was conducted. As with other forms of science, one needs to be able to show that the data collected from research instrument are valid and reliable. Ideally, every research instruments should undergo a formal pilot during which the acceptability, validity, and reliability of the measure is tested (Patten, 2004). The reconnaissance survey in this study therefore, helped to test for the validity and reliability of the research instruments (questionnaires and the checklists). This survey also helped the researcher get acquainted with and gain a general understanding of, the study area as well as introducing the purpose of the research to the local leaders and seeking their consent to conduct the study.

3.2.4 Study population

Population includes all members or units of some clearly defined group of people, objects, or events for inclusion in the study (Burns and Grove, 2001; Brink, 2001; Polit and Hungler, 1999; Uys and Basson, 2000). In this study, household were the target population for household survey and traders dealing in WSWFPs in local markets within Mutunda and Kiryandongo sub-counties of Kibanda county of Bunyoro Kitara Kingdom were targeted. Household list were obtained from sub-county headquarters.

3.2.5 Sample size and sampling procedure

It is very important to select a representative sample size. Incorrect conclusions can be reached when the sample does not represent the underlying population. Gay (1978) stated that the sample's merit determines the generalizability of the results. This study used a combination of two sampling procedures: simple random sampling and purposive sampling. Gay (1987) reports that random sampling is the best single way to obtain a representative sample. No technique, not even random sampling guarantees a representative sample, but the probability is higher for this procedure than for any other (Gay, 1987). In simple random sampling every individual or household have the same probability of being selected and the selection of one individual in no way affects the selection of another individual. In other words, all individuals or households in a defined population have an equal and independent chance of being in the sample. In this study, simple random sampling was used to select households for household survey part of the study.

Purposive sampling is a form of non-probability sampling, which is characterized by the use of judgment and a deliberate effort to obtain representative samples by including typical areas or groups in the sample (Kerlinger, 1986; Polit and Hunglar, 1999). In other words, the researcher attempts to do what proportional clustering with randomization accomplishes by using human judgment and logic. With purposive sampling, the sample, which is believed to be representative to the population of interest, is "hand-picked" for the research (Kerlinger, 1986). The sampling may involve studying the entire population of some limited group for example tradition healers in a certain community. Most focus group research relies on purposive sampling (Miles & Huberman, 1984), with researchers selecting participants based on the potential contributions of participants. This sampling procedure was used to select the key informants and members to be included in the focus group discussions as well as during rapid market survey. Dane (1990) points out that with purposive sampling, the researcher is able to home in on people or events, which have good grounds in what they believe, will be critical for the research. In this sense it might not only be economical but might also be informative in a way that conventional probability sampling cannot be (Descombe, 1998).

A sample is a representative portion of the community's population. Krejcie and Morgan (1970) produced a table for determining sample size (Table 3.1). They did this in response to an article called "Small Sample Techniques" issued by the research division of the National Education Association, Washington D.C. In this article, a formula was provided for this purpose, but, according to Krejcie and Morgan (1970), regrettably an easy reference table had not been provided. Krejcie and Morgan (1970) therefore, produced a table (Table 3.1) based on the formula:

$$Sample\ size = \frac{X^2NP(1-P)}{C^2(N-1)+X^2P(1-P)}).$$

Where, X^2 is a constant value of 3.841 (the square of the Z value of 1.96 for 95% confidence level); N represents the population size; P is the population parameter of 0.5; C is a 95% confidence interval (0.05)- a probability that the samples represent the population. No calculations are required to use the table.

According to Krejcie and Morgan (1970), if one wished to know the sample size required to be representative of the opinions of a population of 9,000 people, then one enters the table at N=9,000. The sample size in this example is 368. The table is applicable to any population of a defined (finite) size. Alternative 'The Survey System Sample Size Calculator' (Creative Research Systems, 2007) which requires one to enter the population size and population parameter (Table 3.2) was used. The calculator is based on Krejcie and Morgan (1970) formula. Using this method, 364 households were chosen for household survey because the documents gathered from sub-counties and county headquarter indicated that Kiryadongo and Mutunda had a total household number of 6788. However, 21 extra households were added to make a total of 385 samples for household survey. Krejcie and Morgan (1970) state that, using this calculation, as the population increases the sample size increases at a diminishing rate (plateau) and remains, eventually constant at slightly more than 380 cases. There is little to be gained to warrant the expense and energy to sample beyond about 380 cases. Alreck and Settle (1995) provide similar evidence.

Table 3.1 Required sample size at the 5% confidence interval, given a finite population (N = Population size and n = Sample size).

N - n	N - n	N - n	N - n	N - n
10 - 10	100 - 80	280 - 162	800 - 260	2800 - 338
15 - 14	110 - 86	290 - 165	850 - 265	3000 - 341
20 - 19	120 - 92	300 - 169	900 - 269	3500 - 346
25 - 24	130 - 97	320 - 175	950 - 274	4000 - 351
30 - 28	140 - 103	340 - 181	1000 - 278	4500 - 354
35 - 32	150 - 108	360 - 186	1100 - 285	5000 - 357
40 - 36	160 - 113	380 - 191	1200 - 291	6000 - 361
45 - 40	170 - 118	400 - 196	1300 - 297	7000 - 364
50 - 44	180 - 123	420 - 201	1400 - 302	8000 - 367
55 - 48	190 - 127	440 - 205	1500 - 306	9000 - 368
60 - 52	200 - 132	460 - 210	1600 - 310	10000 - 370
65 - 56	210 - 136	480 - 241	1700 - 313	15000 - 375
70 - 59	220 - 140	500 - 217	1800 - 317	20000 - 377
75 - 63	230 - 144	550 - 226	1900 - 320	30000 - 379
80 - 66	240 - 148	600 - 234	2000 - 322	40000 - 380
85 - 70	250 - 152	650 - 242	2200 - 327	50000 - 381
90 - 73	260 - 155	700 - 248	2400 - 331	75000 - 382
95 - 76	270 - 159	750 - 254	2600 - 335	100000 -384

(Adapted from Krejcie and Morgan, 1970, p.608).

Table 3.2 The Survey System Sample Size Calculator.

Determine Sample Size	
Confidence Level:	☑ 95% ☐ 99%
Confidence Interval:	
Population:	
Sample size needed:	

(Creative Research Systems, 2007)

3.2.6 Methods for data collection

3.2.6.1 Household survey

The term 'survey' is commonly applied to a research methodology designed to collect data from a specific population, or sample from that population, and typically utilizes a questionnaire or an interview as survey instrument (Robson, 1993). Surveys are used to obtain data from individuals about themselves, their households, or about larger social institutions. Sample surveys are important for collecting and analyzing information from selected individual (Rossi *et al.,* 1983). According to Leary (1995), there are distinct advantages in using a face-to-face questionnaire methodology. It is less expensive and easier to administer and, they allow confidentiality. Jobber (1986) also noted that face-to-face questionnaire makes it possible to handle complex issues. It is useful in enabling you to 'stage manage' the interview so that all the open ended questions are answered fully. For these reasons, in this study, semi-structured questionnaires were administered in face-to-face approach to 385 randomly selected households from Kakwokwo, Diima, Nyamahasa, Kitwara, Kyankende, Kichwabugingo, and Kikube parishes of Kiryandongo and Mutunda sub-counties. Fifty-five (55) households were slected from each parish.

The household survey questionnaires (Appendix I) covered amongst other things: the socio-demographic characteristics of the respondents. Informants were asked to list the WSWFPs commonly consumed in their locality, where they are gathered from; who gathers them, who consumes them, which parts are consumed and how it's consumed (consumption pattern), an estimate of quantity harvested during the previous 12 months, the habitat in which they are gathered, perceived availability, utilization frequency, taste score appreciation and food-medicinal role of the WSWFPs, periodic dependability on WSWFPs, perceptions of about the consumption of WSWFPs and social implications of their consumption. In addition, respondents were asked questions relating to marketing of the WSWFPs; selection criteria, propagation methods and management techniques for the semi-cultivated wild food plants; constraints, opportunities and strategies to utilisation and promotion of WSWFPs.

3.2.6.2 Key informant interviews

Crabtree and Miller (1992) in their handbook of qualitative research, describes the key informant interview as a form of ethnographic method where individuals who possess special knowledge or status, who are willing to share their knowledge and skills with the researcher and who have access to perspectives or observations denied to the researcher (Goetz and Lecompte, 1984) are interviewed. Selection of key informants are therefore, not based on random chance but on the basis of who has access to the data, and who is able and willing to give infomation (Johnson, 1990). The interview with these key informants has to be performed according to specific rules, and might best be described as non-directive or speaker centred. Tremblay (1957) highlights the five characteristics of an ideal key informant: a) *Role in community.* Their formal role should expose them to the kind of information being sought by the researcher. b) *Knowledge.* In addition to having access to the information desired, the informant should have absorbed the information meaningfully. c) *Willingness.* The informant should be willing to communicate their knowledge to the interviewer and to cooperate as fully as possible. d) *Communicability.* They should be able to communicate their knowledge in a manner that is intelligible to the interviewer. e) *Impartiality.* Key informants should be objective and unbiased.

Of these five criteria of eligibility, only the informant's role in the community can be determined with certainty in advance. Once individuals who perform key roles are detected, the other four criteria should be considered in order to ensure that only the most productive informants are interviewed. The extent to which each of the criteria is met is likely to determine the usefulness of the information gained by the interviewer (Howard, 1986; Burgess1984). In this study, key informants were selected for focus group discussions and also during rapid market survey. Some key informants were also selected among the study community to corroborate household survey data.

3.2.6.3 Rapid market survey (RMS)

Rapid Market Survey (RMS) is a procedure for analysing commodity markets using a combination of techniques such as structured and semi-structured questionnaires with key informants, and also using direct observations (Simmons *et al.,* 1994). The method is very useful in trying to identify and understand the current market trends, opportunities and constraints (Simmons *et al.,* 1994). In this study, semi-structured questionnaires (Appendix II) were administered face-to-face to 82 traders that were encountered selling WSWFPs. Data collected in the market survey included list of WSWFPs marketed, estimated quantities traded per week, buying and selling prices, mechanisms of market price determination, pre-sale processing and value addition activities, main customers, promotional arrangements undertaken if any, constraints experienced in marketing the WSWFPs and possible strategies to improve the marketing of WSWFPs.

3.2.6.4 Focus group discussions

Focus group discussions (FGDs) is a form of group interactive interview comprising of 6-12 people that capitalises on communication between research participants in order to generate data (Kitzinger, 1994). It is often used as a quick and convenient way to collect data from several people simultaneously. Instead of the facilator asking each person to respond to a question in turn, people are encouraged to talk to one another: asking questions, exchanging anecdotes and commenting on each other's experiences and points of view (Kitzinger, 1994). The method is particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they think that way. The idea behind the FGDs is that group processes can help people to explore and clarify their views in ways that would be less easily accessible in a one to one interview. Group discussion is particularly appropriate when the interviewer has a series of open ended questions and wishes to encourage research participants to explore the issues of importance to them, in their own vocabulary, generating their own questions and pursuing their own priorities. When group dynamics work well the participants work alongside the researcher, taking the research in new and often unexpected directions (Kitzinger, 1995).

Group work also helps researchers tap into the many different forms of communication that people use in day-to-day interaction, including jokes, anecdotes, teasing, and arguing. Gaining access to such variety of communication is useful because people's knowledge and attitudes are not entirely encapsulated in reasoned responses to direct questions (Kitzinger, 1995). In this study, eight (8) focus group discussions (FGDs) guided by the checklist (Appendix III) was conducted in order to explore the local methods of harvesting, processing and preserving the commonly consumed WSWFPs in the study area. Local knowledge on shelf life of the preserved foods (how long it is stored) was also sought during these discussions. Data on seasonal calendar of the availability of different WSWFPs consumed in the locality were generated during the discussions. The selections of the preferred WSWFPs for nutrient content analysis were also guided by FGDs. The helpful question or phrases (Appendix IV) adapted from Krueger 1994 in Henn *et al.* (2006) were used.

3.2.6 .5 Field inventory

The validity and usefulness of plant nutritional analysis depend largely on obtaining a reliable sample. If the sample taken is not representative of the population from which it was taken, all the careful and costly work put into subsequent analysis would be a wasted effort because the result would be less valid (Temminghoff and Houba, 2004). A minimum of 15-25 plants should be sampled in order to obtain a statistically significant number of plant tissues needed for analysis (A and L Eastern Labs, 2006). In this study, field inventory (field walk) with key informants were undertaken to collect plant samples of 18 selected WSWFPs for laboratory analysis. The selection of these species for nutrient content analysis were undertaken on the basis of SWOT (Strength, Weakness, Opportunities and Threats) analysis considering occurrence of the plant in natural habitats, market value, scanty information available on nutrient content, and finally extent of anthropogenic pressure on species (Appendix V).

In addition to the 18 selected WSWFPs, samples of three (3) conventional food plants namely the common cabbage (*Brassica oleracea var capitata*), sesame (*Sesamum indicum*), and Mangoes (*Mangifera indica*) were also analysed for comparison purposes. Each plant sample for laboratory analysis was taken from a minimum of 15 plants found within a radius of 1 km, with exception of *Hibiscus acetosella* where sample was collected from 13 plants and *Hyptis spicigera* where 1.5 kilograms of seeds was given by one of the key informant. Only the frequently harvested edible plant parts were collected in plastic bags dully labelled with sample numbers, date, code of locations, plant part, and analysis to be conducted (Appendix VI). About 500 – 1000 g of each plant material were collected in order to have an adequate amount of plant material for the analysis.

3.2.6.6 Laboratory and analytical procedures

The laboratory and analytical procedures for nutritional analysis was limited to portion of the plant normally consumed by local communities. The analyses included where appropriate determination of moisture content, energy (calories), ash, protein, fat, total carbohydrates, dietary fiber, ascorbic acid, β-carotene and nutritionally essential macro (Ca, K, Mg, Na, P) and micro (Fe, Mn, Cu, Zn) elements. All plant materials with exception of those used for determination of vitamin C and β-carotene, were dried in an oven with a fan at 100 ^{0}C for 8 hours using the AOAC (1980) air oven method No. 14.003 and then grounded for chemical analysis. Total nitrogen (N) was determined using the micro-Kjeldahl method. P was determined spectrophotometrically (absorbance at a wavelength of 880nm) after plant samples were wet-fired with nitric-perchloric acid using Spectronic 20D+ Spectrophotometer model (USA).

Na and K concentrations were determined using the Flame Photometer (Jenway, model PFP7, UK) while other elements (Ca, Fe, Mg, Mn, Cu and Zn) were determined by Flame Atomic Absorption Spectrometry (Perkin Elmer 2380 AA - auto wavelength scan model, USA and Varian SpectrAA 220 FS- A fully automated double beam system, Australia). Moisture and total ash contents were determined using the AOAC standard methods (1980, 1984). Dietary fibre was determined using the method described by Goering and Van Soest (1970). Total fat content were determined using a Tecator Soxtec System (HT 1043 Extraction Unit, Teccator Co. USA). Protein contents of the plant samples were determined by multiplying N (Nitrogen) contents by a coefficient of 6.25 (Frank, 1975). AOAC (1990) method was adopted for the analysis of total carbohydrate using the Manual Clegg Anthrone Method. Ascorbic acid (Vitamic C) contents of the plant samples were determined according to the procedures given in Kirk and Sawyer (1973) while β-carotene was determined following procedures outlined by De Ritter and Purcell (1981). Total energy (calories) of the plant samples was determined using a Gallenkamp Autobomb calorimeter (SG 96/02/536, UK). All samples were analysed in triplicates.

3.2.7 Data analysis

This section only gives a general overview of data analysis procedures. Details of the specific analysis undertaken are presented under each chapter (specific studies).

3.2.7.1 Household survey data

Household survey data were analysed descriptively and inferentially using Excel spreadsheet and MINITAB statistical package. Mean frequencies of citations of different variables sought were computed. A two-tailed test and a box plot were used to compare variation in the knowledge of WSWFPs between men and women's' respondents. Linear regression analysis was used to show the relationship between the ages of the respondents and local knowledge of WSWFPs (in terms of number known person). Contribution of WSWFPs to household diet was computed using two generic types of measures- mean per capita harvest and mean per capita use (consumption) (Wolfe and Utermohle, 2000). The periodic dependency by households on WSWFPs was computed and presented in a chart form.

3.2.7.2 Data from focus group discussions

Focus group discussions (FDGs) often collect qualitative data. Miles and Huberman (1994) likens qualitative data collected to the legal doctrine of "attractive nuisance", meaning that qualitative researchers should be aware the data is inherently chaotic, and must be prepared to deal with the consequences. Qualitative data tend to overload the researcher at almost every point, the sheer range of phenomena to be observed, discussed, the recorded volume of notes, the time required for write-up, coding and analysis can all become overwhelming (Miles and Huberman, 1994). York (1998) argued that in qualitative data analysis, the structure of data analysis (content analysis, coding or analytic comparison) is mostly determined after data is collected. According to Strauss and Corbin (1990) content analysis can be undertaken with any written form of data, transcripts of interviews and discussions. The basic task of content analysis is to reduce words to themes or concepts that have meaning to the observation of the phenomenon under study. All the information available should be objectively analyzed for relevance, and precautions should be taken to avoid the selective recording of information according to some preconceived hypothesis. Coding is an analysis aimed at reviewing a set of field notes, transcribed or synthesized, and to dissect them meaningfully (Miles and Huberman, 1994).

Coding has three main categories: open, axial, and selective. Open coding is the process of developing categories of concepts, and themes emerging from data collected without making any prior assumptions about what might be discovered. Axial coding facilitates building connections within categories and thus serves to deepen the theoretical framework underpinning the analysis. Selective coding is reflected in the structural relationship between categories- the relationship between a core category and related categories, which are integrated to form the theoretical structure of the analysis (Miles and Huberman, 1994). Analytic comparisons refer to the method of agreement and the method of difference in logical inquiry (Neuman, 1994). The method of agreement draws the researcher's attention to what is common across cases or themes. With the method of difference, the researcher seeks information on cases with a different outcome from initial cases, and different causes.

In this study, content analysis, coding system and analytical comparisons were used to analyse data emanating from FGDs. After each focus group session, recorded notes were reviewed and re-evaluated for their truthfulness and to identify the recurrent ideas that came out during the discussions. Tape recorded sessions of the group discussions were played and listened again. Outcomes of discussions were grouped according to key themes (topics). Key statements and ideas expressed for each topic explored in the discussion were identified and different positions that emerged under each key theme were summarised. A systematic comparison was made on the emerging themes and positions (Neuman, 1994) to identify the common ideas. Verbatim phrases that represent each position/theme were pulled out. A full report of the discussion which reflected the outcome of the discussions as completely as possible were later prepared, using the participants' own words. Where there were scoring exercises, mean scores were computed.

3.2.7.3 Rapid market survey (RMS) data

In order to describe the market potential for WSWFPs; data from RMS which included market characteristics, market conduct and performance, market opportunities, constraints and strategies were analysed using simple descriptive statistics in Excel spreadsheet and MINITAB statistical package. Data were coded to obtain a limited set of attributes for a variable (Babbie and Mouton, 2001), cleaned (checked) for mistakes and entered into the computer. As a coding process, lists of responses were made for variables, groups identified and numbers assigned to these groups. However, some data were not coded but used descriptively. Market prices and weekly volumes of traded WSWFPs were compared to some of the selected conventional food plants (e.g. *Abelmoschus esculentus, Brassica oleracea var capitat, Mangifera indica* and *Sesamum indicum*) traded in the same locality. Weekly volumes of traded WSWFPs based on the usual units of the measurement (including bundles and heaps) within the markets were estimated per species sold. The profit margin, which is the dollar value difference in the selling price and total cost of production (Holland, 1998), was computed per traded species. Gross margin percent, which is calculated as the profit margin (difference in the selling price and the total cost) divided by the selling price (Holland, 1998), was also computed. Transport expenses were excluded in the cost computation because only 4% of the traders incurred transport expenses in form of hired bicycles.

3.2.7.4 Laboratory and analytical data

Nutritional contents of the analysed WSWFPs were compared to those of the three (3) conventional food plants namely the common cabbage (*Brassica oleracea var capitata*), sesame (*Sesamum indicum*), and mangoes (*Mangifera indica*) using ANOVA (Steel and Torrie, 1980) at 5% level of significance in MINITAB statistical software.

3.2.8 Validity and reliability

Talbot (1996) defines validity as the degree to which an instrument measures what it is intended to measure. An instrument is valid if it measures what it is intended to measure and accurately achieves the purpose for which it was designed (Wallen and Fraenkel, 2001). According to Patten (2004), no test instrument is perfectly valid. The researcher therefore, needs some kind of assurance that the instrument being used will result in accurate conclusions (Wallen and Fraenkel, 2001). According to Patten (2004), content validity is determined by judgments on the appropriateness of the instrument's content. Patten (2004) identifies three principles to improve content validity- using a broad sample of content rather than a narrow one; emphasizing important material, and writing questions to measure the appropriate skill. In this study, these three principles were addressed while developing the survey items. In addition, the research instruments were given to three (3) experts of ethnobotanical surveys to check for content clarity and relevancy. Reliability is the degree of consistency or dependability with which an instrument measures the attributes it is designed to measure (Uys and Basson, 2000; Wallen and Fraenkel, 2001). According to Patten (2004), 'validity is more important than reliability'. However, reliability does need to be addressed. In this study therefore, the research instruments were pre-tested for their reliability. Ten (10) traders selling amongst other things WSWFPs and 20 households from the target population were administered with questionnaires for RMS and household survey respectively to test the clarity of contents. Their responses were used to improve the reliability of the final sets of questionnaires.

3.2.9 Ethical considerations

Ethics is concerned with what is wrong or right in the conduct of research (Mouton, 2001). McNamara (1999) identifies five ethical concerns to be considered when conducting survey research. First, researchers need to make sure that participation is voluntary. In this study, the respondents' rights were protected, they were informed that participation in the study was voluntary and that they could withdraw at any time should they so wish with no consequences. McNamara's (1999) second ethical guideline is to avoid possible harm to respondents. This could include embarrassment or feeling uncomfortable about questions. In this study, sensitive questions that could cause embarrassment or uncomfortable feelings among the respondents were avoided. A third ethical guideline is to protect a respondent's identity. This can be accomplished by exercising anonymity and confidentiality. A survey is anonymous when a respondent cannot be identified based on a response. A survey is confidential when a response can be identified with a subject, but the researcher promises not to disclose the individual's identity (McNamara, 1999). In this study, respondents' privacy and anonymity were ensured. Respondents' names were not indicated in the questionnaires. No individual's identity could be traced to a questionnaire or any other instrument and information given. The respondents were assured that the information they give would be treated with utmost confidentiality.

McNamara's (1999) fourth ethical concern is to let all prospective respondents know the purpose of the survey and the organization that is sponsoring it. In this study, the purpose of the study was discussed verbatim with the prospective respondents. At a national, Uganda National Council of Science and Technology granted the permission to conduct this study after a written permission accompanied with the research proposal. The permission was also sought from the county (Kibanda) and sub-counties (Mutunda and Kiryandongo) chiefs. The fifth ethical issue as described by McNamara (1999), is to accurately report, both the methods and results of the surveys. Because advancements in academic fields come through honesty and openness, findings that emanated from this study were reported in as unbiased manner as possible.

CHAPTER 4

WILD AND SEMI-WILD FOOD PLANTS CONSUMED BY LOCAL PEOPLE IN BUNYORO-KITARA KINGDOM, UGANDA

4.1 Introduction

There has been renewed interest towards consumption of wild and semi-wild food plants (WSWFPs) (Delang, 2006; Johns and Eyzaguirre, 2006). Despite agricultural societies' primary reliance on conventional crop plants, the tradition of eating WSWFPs has not completely disappeared, their nutritional roles and health benefits are being reported in many surveys worldwide (Balemie and Kebebew, 2006; Lockett *et al.,* 2000). The important contribution that these plants can make to poverty reduction through enhancing household food security and incomes has been recognised (Garrity 2004; Russell and Franzel, 2004). Wild gathered food plants have been part of human diet since time immemorial and it is argued that past societies made more use of the wild flora to overcome hunger than is done today (King, 1994; Diamond, 2002; Leonti, 2006).

Although currently eradicating extreme poverty and hunger (Objective one of the Millennium Development Goal) is the main focus of many international development agenda where wild food resources could help; even in biodiversity-rich countries wild food resources still get little attention. Lack of clear examination of the links between poverty and the use of the wild food resources means that policy recommendations are rarely based on hard evidence (Bird and Dickson, 2005). Numerous publications provide detailed knowledge of edible wild plants in specific locations in Africa (Campbell, 1986; FAO, 2004*a*; Tabuti *et al.,* 2004; Balemie and Kebebew, 2006; Tabuti, 2007). These studies reveal that wild plants are essential components of many Africans' diets, especially in periods of seasonal food shortage.

A study conducted in Zimbabwe revealed that some poor households rely on wild fruits as an alternative to cultivated food for a quarter of all dry season's meals (Wilson, 1990). Similarly, in Northern Nigeria, leafy vegetables and other bush foods are collected as daily supplements to relishes and soups (Loghurst, 1986). In

Swaziland, wild plants are still of great importance and contribute a greater share to the annual diet than domesticated crops (Ogle and Grivetti, 1985). Still many more wild species are believed to be edible and undocumented yet. The contribution that these wild food plants make to many poor peoples' livelihoods (Bukenya-Ziraba, 1996; Poulton and Poole, 2001) is however, often not acknowledged in many national statistical reporting.

This is a reflection of the general lack of official and scientific interest in these wild resources by policy makers (Leakey and Newton, 1994; Tchiegang-Megueni *et al.*, 2001). Where such national level information is available, it is restricted mainly to a narrow range of exotic food plants such as mango, avocado and citrus that have sufficiently large and often international markets. This study makes the case that, in addition to these conventional food plants, more attention should be paid to WSWFPs. Documentation of the WSWFPs, parts consumed, their contribution to the diet as well as the social implications of their consumption by local people in the Bunyoro-Kitara Kingdom of Uganda will therefore, be a major milestone in the development of cultural information that will provide an authoritative look at many neglected WSWFPs which can contribute to poverty alleviation, food security, agricultural diversification and income generation. It is hoped that the information documented will increase understanding of the importance of WSWFPs in rural livelihoods.

4.2 Objectives

4.2.1 Overall objective

To contribute towards a greater understanding of the use of the wild and semi-wild food plants among nutritionally vulnerable rural communities in Bunyoro-Kitara Kingdom, Uganda.

4.2.2 Specific objectives

i. To document the edible WSWFPs, the parts consumed, consumption pattern, main gatherers, main consumers, cultural significance, local perceptions, and social implications of their consumption in the Kingdom.

ii. To characterize the commonly consumed wild WSWFPs in terms of growth forms (tree, shrub, herb, climber, graminoid) and the collection niches.

iii. To assess the contribution of the WSWFPs to overall household diet in the Kingdom.

4.3 Research questions

Which are the commonly consumed WSWFPs and which plant parts are most often consumed? What are their consumption patterns? What are their growth forms and collection niches? Who are their main gatherers and consumers in the Kingdom? What are the local perceptions about WSWFPs and what are the social implications of their consumption by the local people? What are the harvest and consumption rates of WSWFPs by the local people in the Kingdom? What are the cultural significances of WSWFPs consumed in the Kingdom?

4.4 Methods of data collection and analysis

4.4.1 Data collection

The study was conducted in Mutunda and Kiryandongo sub-counties of Kibanda County in Bunyoro-Kitara Kingdom. Data were collected using a combination of methods namely: semi-structured questionnaires, focus group discussions, and key informant interviews. A total of 385 households from the two sub-counties (Kiryandongo and Mutunda) were chosen for household survey following the method described by Krejcie and Morgan (1970). Fifty-five (55) households each from the three (3) parishes (Kakwokwo, Diima and Nyamahasa) of Mutunda sub-county and from four (4) parishes (Kitwara, Kyankende, Kichwabugingo and Kikube) of Kiryandongo sub-county were then randomly selected. According to Krejcie and Morgan (1970), if one wished to know a representative sample size of a population of 9,000 people, then one looks in to the table at level N = 9,000 (see Chapter 3). The sample size in this example is 368. The table, which is applicable to any population of a defined (finite) size is based on a formula:

$$\textit{Sample size} = \frac{X^2NP(1-P)}{C^2(N-1)+X^2P(1-P)}).$$

Where, X^2 is a constant value of 3.841 (the square of the Z value of 1.96 for 95% confidence level); N represents the population size; P is the population parameter of 0.5; C is a 95% confidence interval (0.05)- a probability that the samples represent the population. No calculations are required to use the table.

Using this method, 364 households were chosen for household survey because the documents gathered from sub-counties and county headquarter indicated that Kiryadongo and Mutunda had a total household number of 6788. However, 21 extra households were added to make a total of 385 samples for household survey. Krejcie and Morgan (1970) state that, using this calculation, as the population increases the sample size increases at a diminishing rate (plateau) and remains, eventually constant at slightly more than 380 cases. There is little to be gained to warrant the expense and energy to sample beyond about 380 cases. Alreck and Settle (1995) provide similar evidence.

The selected households were administered with semi-structured questionnaire (Appendix I). Respondents were asked to name the wild food plants they gather, the parts consumed, the quantity extracted during the previous 12 months, the habitat in which the wild food plants are gathered, perceptions about the wild food plants and social implications of their consumption. This information together with perception of their availability, the frequency of species use, the taste appreciation and the medicinal purpose attributed to its ingestion were used to evaluate the cultural significance of individual WSWFPs consumed in the Kingdom. An approach similar to that followed by Padoch (1988) and Hedge *et al.* (1996) was adopted during interviews about WSWFPs gathered. Each informant was asked to list the preferred WSWFPs consumed in the area. Focus group discussions were held to construct seasonal calendar on availability of different WSWFPs consumed in the area and to characterize the commonly consumed WSWFPs in terms of growth form (trees, shrubs, herbs, climbers, graminoids), and collection niches.

To assess the contribution of WSWFPs to overall household diet, each informant was asked to estimate the amount of WSWFPs harvested by members of his or her household in the previous 12-month period. In addition, they were asked to report whether or not WSWFPs were used by members of the household during the previous 12-month period. Informants were also asked to report whether or not the WSWFPs was given away and/or received by members of the household during the previous 12-month period. By asking about resources received, households who consumed but did not harvest a resource can be identified (Wolfe and Utermohle, 2000). Informants were also asked to estimate how long in a year their household members often depend on WSWFPs. This estimate was gathered in form of frequency (1-3 months, 3-6 months, 7-9 months and 10-12 months). Key informants were selected among the study community to corroborate household survey data.

4.4.2 Data analysis

Household questionnaire responses were analysed descriptively, and inferentially using Excel spread sheets and MINITAB statistical package. Mean frequency of citation of the consumption patterns, main consumers, main gatherers, plant parts consumed, and the collection niches were computed. A two-tailed test was used to compare the knowledge of WSWFPs between male and female respondents. A box plot was also used to show the variation in number of WSWFPs reported by men and women. Linear regression analysis was employed to show the relationship between the ages of the respondents and local knowledge of WSWFPs. Perceptions of respondents towards WSWFPs and the social implications of the consumption of WSWFPs were also analysed descriptively. Mean frequencies of the perceived responses and social implications were computed. Key informant interviews were summarised and presented in boxes that condenses information (Binnendijk, 1996).

Contribution of WSWFPs to household diet was computed using two generic types of measures- mean per capita harvest and mean per capita use (consumption) (Wolfe and Utermohle, 2000). Mean per capita harvest is a statistical measure of the amounts of WSWFPs harvested annually by households for subsistence use, expressed on a per person basis (g/day). It is calculated by dividing the total harvest of a resource category by the total number of people in the surveyed households within the community. Mean per capita harvest, assumes that wild resource harvests are equally distributed for consumption among all community residents (Wolfe and Utermohle, 2000). An average family size of seven people was used in determining the total number of people in the surveyed households of the studied community.

Mean per capita use is a statistical measure of the amounts of wild foods used annually within households that reported using wild foods, expressed on a per person basis (g/day). It is calculated by dividing the entire community's mean per capita harvest of a resource category by the proportion or the percent proportion of households using the resource (Wolfe and Utermohle, 2000). Mean per capita use assumes that only persons living in households that reported using the wild food consume the wild food harvest in a community. It assumes that there is no consumption of a wild food by members of households that reported not using the wild food (Wolfe and Utermohle, 2000). The duration in terms of months upon which households depend on WSWFPs was computed into percentages and presented in a chart.

Cultural food significance indices (CFSI) (Pieroni, 2001) were calculated in order to evaluate the cultural significance of WSWFPs commonly consumed by the local people. The index is calculated as: CFSI = QI x AI x FUI x PUI x MFFI x TSAI x FMRI x 10^{-2}. The formula takes in account seven indices which express the; frequency of quotation (QI), availability (AI), frequency of Utilization (FUI), plant parts use (PUI), multifunctional food use (MFFI), taste score appreciation (TSAI), and food-medicinal role (FMRI). The quotation index (QI) (Appendix VII) expresses the number of all the positive responses given by the informants about a particular plant while listing the plants that they gather and consume.

The availability index (AI) expresses the availability of the species, perceived by the local people and corrected by the factor that considers if the use of the plant is ubiquitous or localized within the study area (Table 4.1). In the last case AI is diminished by half or a whole unit. In this way, AI does not represent a 'determined' availability index as in the work of Leposky *et al* (1985), but rather a 'perceived' availability index (Pieroni, 2001). In cultural significance evaluation studies, ecological factors such as relative abundance in the natural milieu cannot be directly considered as criteria because they are not culturally dependent (Pieroni, 2001).

On the contrary, perception of a given species, which only indirectly expresses its availability in the natural context, also represents a factor, which influences the cultural meanings of the species within a given group and a natural context.

Frequency of use index (FUI) represents the frequency of utilization of each plant as stated by informants (Table 4.1). Food-medicinal role index (FMRI) reflects the perceived properties as food-medicine for the wild food plants commonly consumed by the local people. Supposed ritual or magical 'health' as related to the ingestion of some plants (Pieroni, 2001) is considered in the evaluation of these values. Higher values are attributed in cases of well-defined medicinal properties ascribed to the ingested plants. For more general assessment of the plant as 'healthy', without any specifications, minor FMRI values are assigned (Table 4.2). Taste score appreciation index (TSAI) represents the score by which local people express the taste appreciation for each plant (Table 4.2). Scores are based on a possible range of values between 4 and 10 (4: lowest, terrible taste; 10: highest, best taste) (Pieroni, 2001). Kuhnlein *et al* (1982) used similar scale (1: very poor; 2: poor; 3: fair; 4: good; 5: very good) to taste the acceptability of roots used by the native people on the coasts of British Columbia.

Plant parts use index (PUI) expresses the multiple uses of diverse parts of the same plant. It takes into account whether multiple morphological plant parts are collected and eaten instead of single parts (Table 4.3). The contemporary use of the multiple plant parts for different food aims is evaluated higher than the use of young tissues of the whole plant (Pieroni, 2001). Multifunctional food use index (MFFI) considers the possible food uses of each plant. Values are assigned to traditional food preparations, excluding the new 'imported' or 'creative' utilisation. In species which are boiled and then further processed (stewed, stuffing for diverse preparations), the value attributed to the boiling process is increased by a half unit. If the plant is generally used in a mixture of more than three species, the index value is diminished by a half a unit (Table 4.3).

Table 4.1 The availability index (AI) and the utilization frequency index (FUI) categories.

Availability	*Index value*	*Utilisation frequency*	*Index value*
Very common	3.0	More than once/week	5.0
Common	2.0	Once/week	4.0
Rare	1.0	Once/month	3.0
Localisation of use	Index	More than once/year but less than twelve's times	2.0
Ubiquitary	=	Once/year	1.0
Localised	-0.5		
Very localised	-1.0		

Table 4.2 Taste score appreciation index (TSAI) and Food-medicinal role index (FMRI) categories.

Taste appreciation	*Index value*	*Role as food-medicine*	*Index value*
Best/excellent	10	Very high ('that food is a medicine')	5.0
Very good	9	High ('that food is quite a medicine', with clear specification of the treated affection)	4.0
Good	7.5	Middle-high ('that food is very healthy')	3.0
Fair	6.5	Middle-low ('that food is healthy', no specification of a particular therapeutic action)	2.0
Poor	5.5	Not recognised	1.0
Terrible/bad	4		

Table 4.3 Part use index (PUI) and Multi-functional food use index (MFFI) categories.

Part use for food	*Index value*	*Usage*	*Index value*
Bark	1.0	Raw, as snack	0.5
Roots or rootstocks	1.5	Raw, in salads	1.5
Roots, only young plant parts	1.0	Fried	1.0
Bulbs	1.5	Boiled	1.0
Stems	1.0	Boiled- then stewed, fried or pasted with groundnut/sesame	1.5
Leaves	1.5	Soups (mixtures)	0.75
Leaves stalks	1.0	Stewed	1.0
Young whorls of leaves	1.0	Roasted/steamed	1.0
Leaves with a few stems	2.0	Condiments/spices	1.0
Shoots	1.25	Juices/wine/beverages	1.0
Shoots, only young parts	0.75	Syrups	1.0
Buds	0.75	Potash	0.5
Flowers	0.75	Bread/porridge component	0.75
Receptacles	0.75	Relishes	1.0
Fruits	1.5	Paste	1.5
Seeds	1.0		
Whole aerial parts	3.0		

4.5 Results

4.5.1 Household profile

The household profiles of the respondents are given in Table 4.4. Many (59%) respondents were female. Sex segregation is heavily skewed towards women, essentially because some of the male household heads preferred that the questionnaire be administered to their wives (spouses) than themselves. While it may be argued that this skewness might have influenced the outcome of the findings in this study, it should be understood that the households interviewed were selected randomly. Respondents' ages ranged from 16 to 68 years, although many (54.5%) respondents were above 36 years old.

Most (68.3%) respondents were married. About 51.4% and 31.7% of the respondents had reached primary and secondary education levels, respectively. Most (63.6%) surveyed households had more than six members and the average family size was seven (7) people. The majority (84.4%) of respondents were subsistence farmers growing mainly food crops such as maize, cassava, groundnuts, finger millet, sorghum, beans, simsim (sesame), peas, groundnuts, sweet potatoes, cowpeas, and bananas. Most (81.9%) did not have sufficient year-round food for their household members. Although the majority (81%) of the respondents owned land, the size of the land holding was generally small.

Most (60.3%) families had only 0.81 to 1.62 ha (2 – 4 acres) of land. More than a half (53.2%) of respondents had annual cash income ranging from UGX 200,000 to 400,000 (≈USD 100 to 200). Only 34% of the respondents had annual cash income greater than UGX 400,000 (USD 200). The majority (86.5%) of respondents derived their cash income from on-farm activities. The rest (13.5%) ventured mainly into off-farm activities such as gathering WSWFPs, sale of charcoal and firewood. All respondents reported that their households do eat WSWFPs.

Table 4.4 Household profiles of the respondents.

Variable	% response
Sex	
Male	41.0
Female	59.0
Age	
<18	6.8
18 -36	38.7
>36	54.5
Marital status	
Single	12.5
Married	68.3
Divorced/separated	5.5
Widow/widower	14.0
Education level	
No formal education	9.4
Primary	51.4
Secondary	31.7
Tertiary	7.5
Major occupation	
Subsistence farming	84.4
Civil work (councillors, teachers, midwives)	6.8
'Boda-boda'cyclists	3.6
Student (vocational, college and secondary school)	2.9
Others (Housewives, market vendor, firewood and charcoal trade)	2.3
Land ownership	
Own land	81.0
Does not own land	19.0
If own land, size of the land owned in acres (hectares- ha)	
<2 acres (0.81 ha)	10.9
2-4 acres (0.81-1.62 ha)	60.3
>4 acres (1.62 ha)	28.8
Family size	
<3 people	13.0
3-6 people	23.4
>6 people	63.6
Food sufficiency in the household	
Sufficient	10.9
Not sufficient	89.1
*Annual cash income (UGX)**	
<200.000 (≈USD 100)	12.7
200,000 – 400,000 (≈USD 100 – 200)	53.2
>400,000 (≈USD 200)	34.0
Main sources of cash incomes	
On-farm	86.5
Off-farm	13.5
Household ever eaten WSWFPs	
Yes	100.0
No	0

* USD1 = 2010 Uganda shilling (UGX).

4.5.2 Commonly consumed WSWFPS in the kingdom

Sixty two (62) WSWFPs belonging to 31 botanical families were reported as being consumed (Table 4.5). The most frequently mentioned were *Amaranthus dubius* (73.8%), *Amaranthus spinosus* (71.4%), *Tamarindus indica* (69.1%), *Hibiscus sabdariffa* (51.9%), *Vitex doniana* (50.1%), *Solanum nigrum* (49.1%), *Crotalaria ochroleuca* (47.8%), *Cleome gynandra* (45.2%), *Hibiscus acetosella* (44.7%), *Senna obtusifolia* (43.9%), *Aframomum angustifolium* (43.6%), *Vernonia amygdalina* (40.3%) and *Asystasia gangetica* (39.2%).

In terms of botanical families, members of Solanaceae family (9.7%), Fabaceae (9.7%), Amaranthaceace (8.1%), Malvaceae (8.1%), Asteraceae (6.5%) and Brassicaceae (4.8%) were the most commonly consumed (Figure 4.1). Plate 4.1 4.2 and 4.3 depict some of the WSWFPs reportedly consumed by the local people in the Kingdom.

Plate 4.1 *Vitex doniana* Sweet (Muhomozi, Owelo).

Table 4.5 Commonly consumed WSWFPs, parts consumed and consumption pattern in the study area.

WSWFPs	Botanical family	Local names	FPM (%)	Parts consumed	Consumption pattern
Amaranthus dubius Mart. *ex* Thell.	Amaranthaceace	Doodo	73.8	YLS	As main sauce or side-dish after cooking (boiled, stewed, fried or pasted with groundnut/sesame), as potash salt in other foods.
Amaranthus spinosus L.	Amaranthaceace	Doodo y'amahwa	71.4	YLS	As main sauce or side-dish after cooking (boiled, stewed, fried or pasted with groundnut/sesame), as potash salt in other foods.
Tamarindus indica L.	Fabaceae	Mukoge	69.1	RF, URF	Raw as a snack, as refreshing juices, local wine, porridge and bread component.
Hibiscus sabdariffa L.	Malvaceae	Bamya, Ekikenke	51.9	YLS, SD	Leaves as main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame), leaves added to boiling beans as condiments to make the sauce thicker, seeds as condiments, paste and relishes.
Vitex doniana Sweet	Verbenaceae	Muhomozi, Owelo	50.1	RF	Raw as snacks.
Solanum nigrum L.	Solanaceae	Enswiga	49.1	YLS, RF	Leaves and shoots as main sauce or side dish after cooking (boiled, fried or steamed). Ripe fruits raw as a snack.
Crotalaria ochroleuca G.Don	Fabaceae	Kumuro, Alaju	47.8	YL, F	As main sauce or side-dish after cooking (boiled, stewed, or pasted with groundnut/sesame).
Cleome gynandra L.	Brassicaceae	Eyobyo	45.2	YLS, F, TS, LS, B	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame or fried mixed with amaranthus spp.). Crushed dried leaves use as a relish with porridge.
Hibiscus acetosella Welw. *ex* Hiern	Malvaceae	Makawang kulo, Gwanya	44.7	YLS, SD	Leaves as main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame, stew), leaves added to boiling beans as condiments to make the sauce thicker, seeds as condiments.
Senna obtusifolia (L.) Irwin & Barneby	Fabaceae	Oyado, Luge	43.9	YL	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Aframomum angustifolium (Sonnerat) K.Schum.	Zingiberaceae	Amatehe, Kongo amor	43.6	RF	Raw as a snack, as juice, wine and porridge component, as condiments/ spices for local breads.
Vernonia amygdalina Del.	Asteraceae	Kibirizi	40.3	YLS	As side dish after cooking (boiled and pasted with groundnut/sesame). Boiled leaves as medicinal beverages.
Asystasia gangetica (L.) T.Anders.	Acanthaceae	Temba, Odipa ikong	39.2	YLS, TS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Capsicum frutescens L.	Solanaceae	Kamulari, Alyera	38.4	RF, URF, YL	Fruits as spices/condiments/appetizers, leaves as main sauce or side-dish after cooking (fried or boiled and pasted).
Asystasia mysorensis (Roth)	Acanthaceae	Nyante,	37.1	RF, URF,	As main sauce or side-dish after cooking (boiled and pasted with

T.Anders.		Acwewanggweno		YL	groundnut/sesame).
Acalypha bipartita Müll. Arg.	Euphorbiaceae	Egoza, Ayuu	36.6	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Corchorus tridens L.	Malvaceae	Eteke	36.6	YL	As stew in other foods, as condiments.
Bidens pilosa L.	Asteraceae	Obukurra	35.1	YLS, F	As main sauce or side-dish after cooking (boiled andpasted with groundnut/sesame, stewed or fried), as a refreshing beverage.
Vigna unguiculata (L.) Walp.	Fabaceae	Mugobiswa	35.1	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Physalis peruviana L.	Solanaceae	Ntuutu	34.8	RF	Raw as a snack and as part of salad. As juice and porridge component
Sonchus oleraceus L.	Asteraceae	Kizimyamucho, Apuruku	34.3	YL	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Corchorus trilocularis L.	Malvaceae	Otigo lum	34.0	YL	As stew in other foods, as condiments.
Basella alba L.	Basellaceae	Enderema	33.8	YL	As main sauce or side-dish after cooking (boiled, stewed or fried), added to other cooking food as condiments.
Aframomum alboviolaceum (Ridley) K.Schum	Zingiberaceae	Amasaasi, Ocao	31.4	RF	Raw as a snack, as juice, wine and porridge component, as condiments/ spices for local breads.
Cleome hirta (Klotzsch) Oliv.	Brassicaceae	Akayobyo akasajja	31.2	YLS, F, TS, LS, B	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame or fried mixed with amaranthus spp.). Crushed dried leaves use as a relish with porridge.
Borassus aethiopum Mart.	Arecaceae	Ekituugu, Tugo	30.6	RF	As a snack, juice/beverage, wine and porridge component
Ficus sur Forssk.	Moraceae	Kabalira, Oduru	28.3	RF	Raw as a snack.
Canarium schweinfurthii Engl.	Burseraceae	Empafu	24.7	RF, SD	Raw as snacks or after parboiling with salted water.
Oxygonum sinuatum (Hochst. & Steud. *ex* Meisn.) Dammer	Polygonaceae	Kacumita bagenge, Cuguru	21.8	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame or fried).
Dioscorea minutiflora Engl.	Dioscoreaceae	Kaama/Ekihama	20.5	T	As part of the main meal/sauce after boiling.
Amaranthus graecizans L.	Amaranthaceace	Nyabutongo, Ocoboro	20.3	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame, steamed or fried), as potash salt in other foods.
Sida alba L.	Malvaceae	Orucuhya	18.7	YL	As main sauce or side-dish after cooking (boiled, stewed or fried).
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	Amaranthaceace	Omujuiga	18.4	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame, steamed or fried).
Solanum lycopersicum L.	Solanaceae	Bunyanya bunyoro	16.6	RF, URF	Raw as salad, as main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame or fried), as condiments.
Annona senegalensis Pers.	Annonaceae	Mubengeya, Obwolo	16.4	RF	Raw as a snack.

Amaranthus lividus L.	Amaranthaceace	Bwora, Mboog'ennene	16.1	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame, steamed or fried).
Carissa edulis (Forssk.) Vahl	Apocynaceae	Omuyonza, Acuga	16.1	RF	Raw as a snack or as juices/beverage and wine.
Ocimum gratissimum L.	Lamiaceae	Mujaja	15.6	YL	As condiments/spices and refreshing tea-like beverages.
Garcinia buchananii Bak.	Clusiaceae	Museka	15.1	RF, SD	Fruits raw as snack, baked seeds eaten as snacks.
Phaseolus lunatus L.	Fabaceae	Amaijalero, Okuku	14.3	SD, YL, F	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame, stewed or fried).
Ximenia americana L.	Olacaceae	Enseka, Olimo	13.8	RF	Raws as snacks.
Mondia whitei (Hook.f.) Skeels	Apocynaceae	Omurondwa	13.5	R	Chewed raw as a snack, as condiments/spices and wine.
Solanum anguivi Lam.	Solanaceae	Obuhuruhuru, Katukuma	13.0	URF	As main sauce or side-dish after cooking (boiled, stewed, fried or pasted with groundnut/sesame).
Solanum macrocarpon L.	Solanaceae	Bugorra	11.9	YL, URF	As main sauce or side-dish after cooking (boiled, stewed, fried or pasted with groundnut/sesame).
Hyptis spicigera Lam.	Lamiaceae	Amola, Lamola	11.7	SD, YL, F	Seeds as condiments/paste for sauces and relishes. Leaves and flowers as main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Ipomoea eriocarpa R.Br.	Convolvulaceae	Acatolao, Podowia kuri	11.4	YLS	As main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Ampelocissus africana (Lour.) Merr.	Vitaceae	Anunu, Olok	10.4	RF, YL	Ripe fruit(s) raw as snacks, leaves as main sauce or side-dish after cooking (boiled and pasted with groundnut/sesame).
Rhus pyroides var. pyroides Burch.	Anacardiaceae	Obukanjakanja, Awaca	9.4	RF, URF	Raw as snacks and as porridge component.
Sesamum calycinum Welw.	Pedaliaceae	Amacande ga kanyamunya	9.4	YL	Leaves as main sauce or side-dish after cooking (boiled, stewed or pasted with groundnut/sesame), leaves condiments in other foods.
Oxalis corniculata L.	Oxalidaceae	Kanyunywa mbuzi	8.8	YL	Chewed raw as snacks
Erucastrum arabicum Fisch. & C.A.Mey.	Brassicaceae	Oburobwenaku	8.6	YL	Leaves as main sauce or side-dish after cooking (boiled or fried).
Phoenix reclinata Jacq.	Arecaceae	Omukindo	8.3	RF, SD	Fruits raw as snack, boiled seed kernels as snacks.
Oxalis latifolia Kunth	Oxalidaceae	Kanyeebwa	8.1	YL	Chewed raw as snacks.
Crassocephalum crepidioides (Benth.) S.Moore	Asteraceae	Ekinami	7.8	YL	Main sauce after cooking in mixture (stew) of other foods.
Cymbopogon citratus (DC.) Stapf	Poaceae	Lemon grass	7.0	AP	As condiments/spices/flavouring or tea-like beverages.
Tristemma mauritianum J.F.Gmel.	Melastomataceae	Oburo bw'enkombe	6.8	S, RF	Raw as a snack.
Abrus precatorius L.	Fabaceae	Akarunga	6.0	YL	Leaves are chewed raw as a snack.

Vangueria apiculata K.Schum.	Rubiaceae	Matungunda	5.5	RF	Raw as a snack.
Rubus pinnatus Willd.	Rosaceae	Amakerre	3.4	RF	Raw as a snack and as salad components.
Urtica massaica Mildbr.	Urticaceae	Orugenyi, Ekicuraganyi	2.9	YL	As main sauce or side-dish after cooking (boiled and pasted with groundnut/ sesame or fried).
Lantana camara L.	Verbenaceae	Jerenga, Abelwinyo	1.6	RF	Raw as a snack.
Imperata cylindrica (L.) Raeuschel	Poaceae	Rusojo	1.3	RZ, S, F	Rhizomes chewed raw as a snack to satiate thirst, inflorescence, and young shoots cooked and eaten (boiled and pasted).

FPM = Frequency of plant mention, YLS = Young (tender) leaves and shoots, YL = Young (tender) leaves only, S = shoots only, SD = Seeds, F= Flowers/inflorescence, RF = Ripe fruits, URF = Unripe fruit, RZ = Rhizomes, AP = Aerial parts, TS = Tender stems, LS = Leaves stalks, B = Buds, T = Tubers, R = Roots

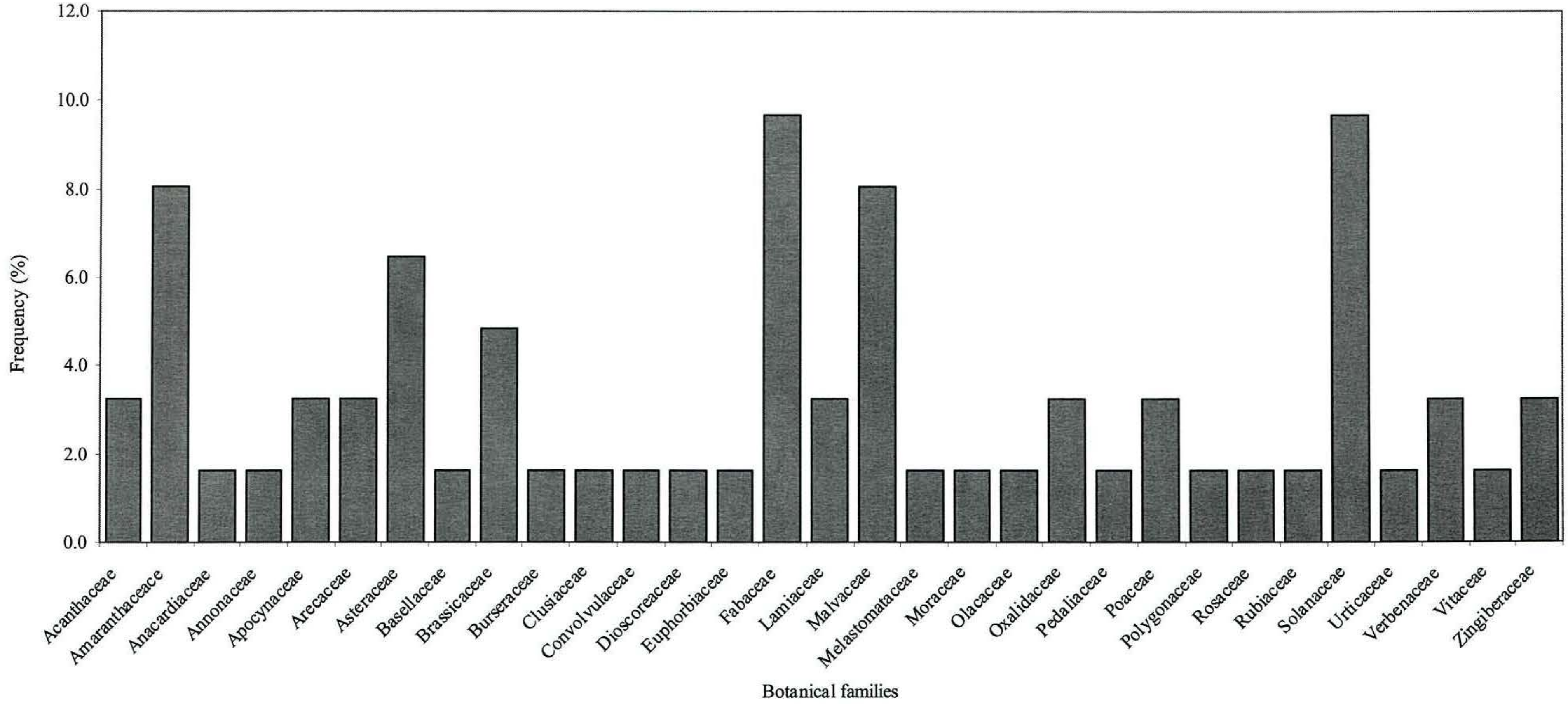


Figure 4.1 Botanical families of the 62 WSWFPs reported.

Amaranthus dubius Mart. *ex* Thell.

Aframomum angustifolium (Sonnerat) K.Schum.

Tamarindus indica L.

Hibiscus acetosella Welw. *ex* Hiern

Basella alba L.

Physalis peruviana L.

Borassus aethiopum Mart.

Ipomoea eriocarpa R.Br.

Plate 4.2 Some of the WSWFPs consumed by local people in the Kingdom.

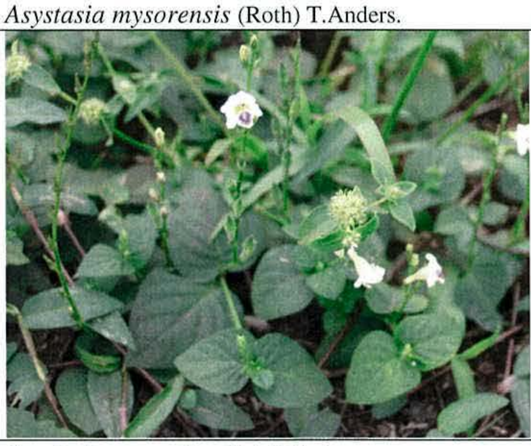
Senna obtusifolia (L.) Irwin & Barneby

Phoenix reclinata Jacq.

Vigna unguiculata (L.) Walp.

Asystasia mysorensis (Roth) T.Anders.

Ximenia Americana L.



Asystasia gangetica (L.) T.Anders.

Vernonia amygdalina Del.

Crotalaria ochroleuca G.Don

Plate 4.3 Some of the WSWFPs consumed by local people in the Kingdom.

4.5.3 Main parts of WSWFPs consumed and consumption patterns

Main parts of WSWFPs commonly consumed in Bunyoro-Kitara Kingdom are presented in Figure 4.2. Most people predominantly consumed fresh leaves and shoots (97.1 ± 1.2%) followed by the fruits (74.3 ± 1.1%). Other important plant parts that were reported by respondents as being eaten included leaves with leaf stalks (31.1 ± 4.4%), roots/tubers or rhizomes (25.5 ± 2.1%), and leaves with a few stems (19.3 ± 3.4%). Seeds, leaves with flowers, and the whole aerial plant parts though reported eaten, were not consumed much. WSWFPs were largely consumed as the main sauce after cooking (86.4 ± 2.8%), raw as snacks (79.1 ± 3.9%) and as side dishes after cooking (63.3 ± 3.9%). Other people however, reportedly consumed them as condiments/spices or appetisers, wine and porridge component, juice/beverages, raw in salads, potash salt in other foods, and as relishes (Table 4.6).

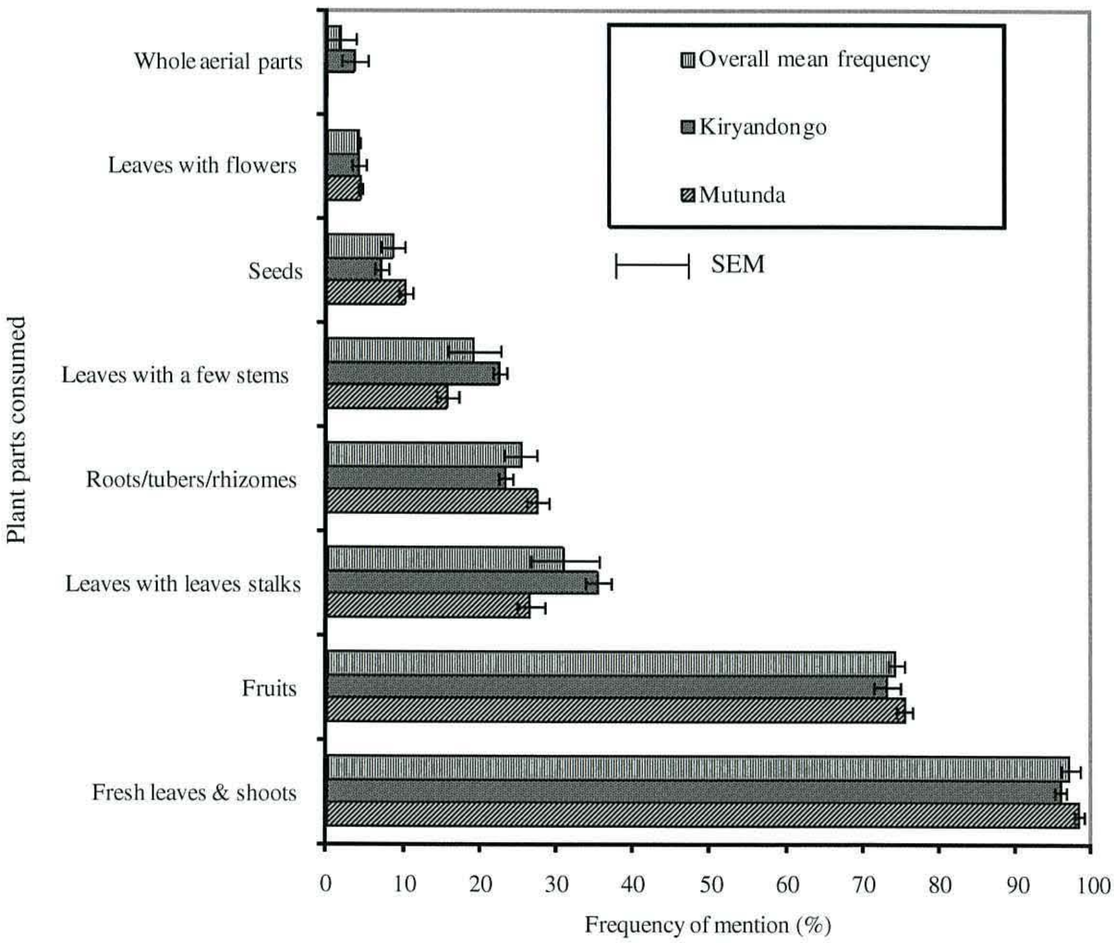


Figure 4.2 Parts of WSWFPs commonly consumed in Bunyoro-Kitara Kingdom.

Table 4.6 Frequency of citation of WSWFPs consumption patterns in the Kingdom.

Consumption patterns	Frequency of mention (%)		
	Mutunda (±SEM)	Kiryandongo (±SEM)	Mean (±SEM)
As main sauce after cooking	89.2 (6.3)	83.6 (3.4)	86.4 (2.8)
Raw as snacks	83.0 (4.8)	75.2 (2.9)	79.1 (3.9)
As side dish after cooking	58.2 (4.2)	68.4 (3.5)	63.3 (3.9)
As condiments/spices/appetizers	51.9 (2.5)	42.1 (5.4)	47.0 (4.9)
Wine and porridge component	32.6 (1.8)	12.8 (3.5)	22.7 (9.9)
As juice/beverages	25.7 (2.3)	16.1 (1.9)	20.9 (4.8)
Raw in salads	4.2 (3.7)	10.8 (2.1)	7.5 (3.3)
As potash salt in other foods	6.0 (1.5)	5.6 (2.1)	5.8 (0.2)
As relishes	4.0 (2.0)	0.0	2.0 (2.0)

4.5.4 Main consumers and gatherers of WSWFPs

The majority (77.0 ± 1.2%) reported that WSWFPs are consumed by all household members (Table 4.7). Other respondents who differed from those who said that WSWFPs are consumed by the entire household, indicated that women (22.7 ± 1.1%), elderly people (old aged) (15.4 ± 0.6%) and children (13.7 ± 1.2%) were the main consumers as opposed to men (6.6 ± 0.4%). Women (85.7 ± 2.7%) and children (75.1±1.6%) constituted the main gatherers (Table 4.7). Plate 4.3 shows two children who were found gathering Amaranthus and Cleome species around their grand parents' abandoned homestead in Diima parish, Mutunda sub-county.

Table 4.7 Frequency of mention of the main consumers and gatherers of WSWFPs in the Kingdom.

Variable	Frequency of mention (%)		
	Mutunda (±SEM)	Kiryandongo (±SEM)	Overall mean (±SEM)
Main consumers			
All household members	78.2 (2.8)	75.8 (2.5)	77.0 (1.2)
Women	23.8 (2.0)	21.6 (2.7)	22.7 (1.1)
Elderly people (old aged)	16.0 (2.0)	14.8 (1.3)	15.4 (0.6)
Children	12.5 (1.7)	14.8 (2.2)	13.7 (1.2)
Men	7.0 (1.8)	6.2 (2.1)	6.6 (0.4)
Main gatherers			
Women	88.4 (4.9)	83.0 (3.8)	85.7 (2.7)
Children	73.5 (4.1)	76.7 (2.4)	75.1 (1.6)
Any household member	14.9 (2.7)	10.1 (2.3)	12.5 (2.4)
Men	12.5 (2.5)	8.3 (2.5)	10.4 (2.1)

Plate 4.4 Children gathering Amaranthus and Cleome species around abandoned homestead.

4.5.5 Relationship between sex, age and knowledge of WSWFPs

A two-tailed test comparison of the knowledge of WSWFPs between men and womens' respondents showed a significant variation (T = 8.15, $P < 0.001$). This variation was also apparent from Figure 4.3, which shows that the mean number of WSWFPs mentioned by women (16 ± 1.79) was relatively higher that those mentioned by men (14 ± 2.14). Linear regression of the respondents' ages with knowledge of WSWFPs (number known per person) was found to be significant (T = 17.04, $P < 0.001$, $R^2 = 0.431$) (Table 4.8). The variation was more apparent when the ages of women (T = 19.39, $P < 0.001$, $R^2 = 0.626$) and men (T = 10.63, $P < 0.001$, $R^2 = 0.42$) were regressed separately with knowledge of WSWFPs (Figure 4.4). Besides, there was a high positive correlation between the knowledge of WSWFPs and the ages of the women (r =0.791, $P < 0.001$, n =227) than in the case for men (r = 0.648, $P < 0.001$, n =158).

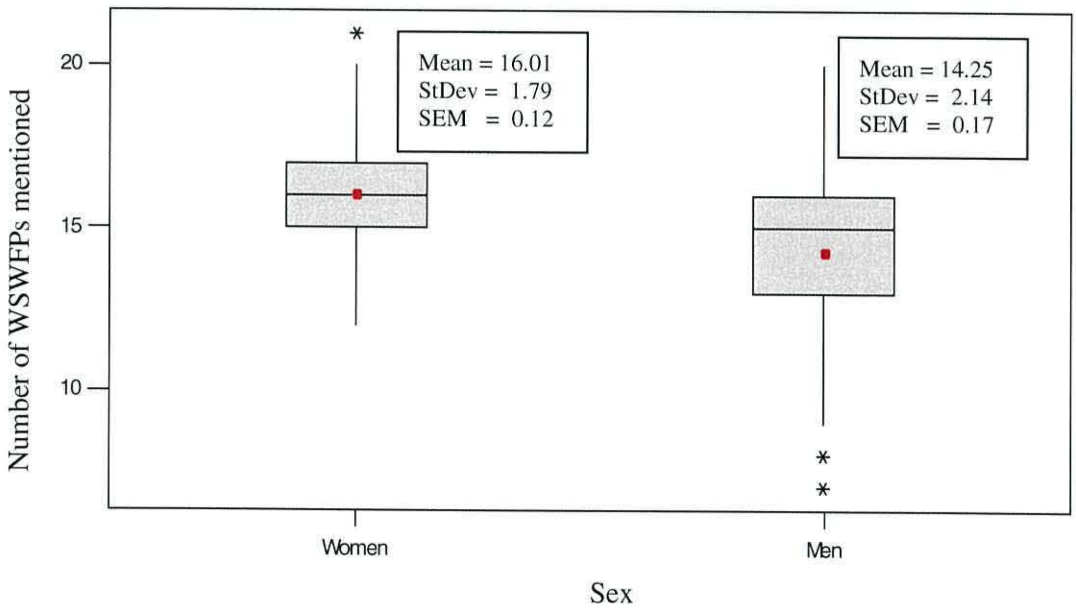


Figure 4.3 Box plots showing the variation in number of WSWFPs mentioned by men and women.

Note: Means are indicated by solid red squares.

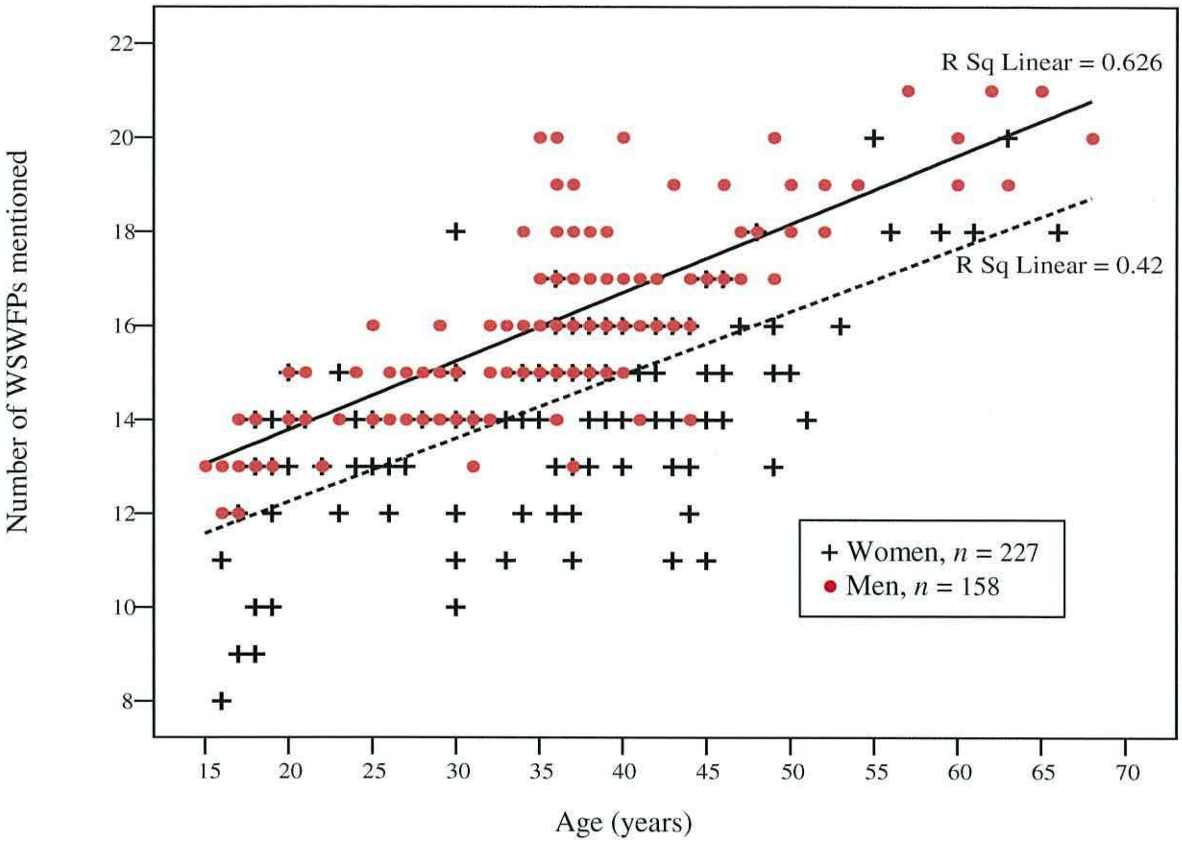


Figure 4.4 Linear regression of sex and age versus knowledge of WSWFPs commonly consumed in Bunyoro-Kitara Kingdom.

Table 4.8 Simple linear regressions of the knowledge of WSWFPs with the age of respondents.

Combined ages				
Predictor	Coef	StDev	T	P
Constant	10.4659	0.2977	35.16	0.001
Combined ages (x)	0.137449	0.008066	17.04	0.001
	S = 1.585	R-Sq = 43.1%	R-Sq(adj) = 43.0%	
The regression equation is knowledge of WSWFPs (y) = 10.5 + 0.137 x				
Men only				
Predictor	Coef	StDev	T	P
Constant	9.5574	0.4748	20.13	0.001
Age of men (m)	0.13482	0.01268	10.63	0.001
	S = 1.616	R-Sq = 42.0%	R-Sq(adj) = 41.7%	
The regression equation is knowledge of WSWFPs (y) = 9.56 + 0.135 m				
Women only				
Predictor	Coef	StDev	T	P
Constant	10.8717	0.2745	39.60	0.001
Age of women (w)	0.145774	0.007517	19.39	0.001
	S = 1.122	R-Sq = 62.6%	R-Sq(adj) = 62.4%	
The regression equation is knowledge of WSWFPs (y) = 10.9 + 0.146 w				

4.5.6 Growth forms and collection niches of the commonly consumed WSWFPs

The growth forms and the collection niches of all WSWFPs reported in this study are presented in Table 4.9. Overall, out of the 62 documented WSWFPs, herbs (51.6%) and shrubs (24.2%) constituted the highest numbers (Figure 4.5). Trees, vines/climbers, and graminoid were few. Collection niches varied greatly depending on the species; from forest habitats to around animal enclosures (kraals)/cattle corridors. Forested areas which included forest gaps and margins (77.8±6.9%), bushlands/woodlands (65.7±2.3%), cultivated farmlands (63.2±2.8%) and grasslands (59.8±4.1%), homegardens/homesteads (55.3±1.2%), and swampy areas/wetlands (50.1±1.3%) were the predominant collection sites for most WSWFPs reported (Table 4.10). Other collection niches included abandoned homesteads and farmlands, wastelands, farm borders, roadsides or along footpaths, as well as areas around animal enclosures (kraals)/cattle corridors.

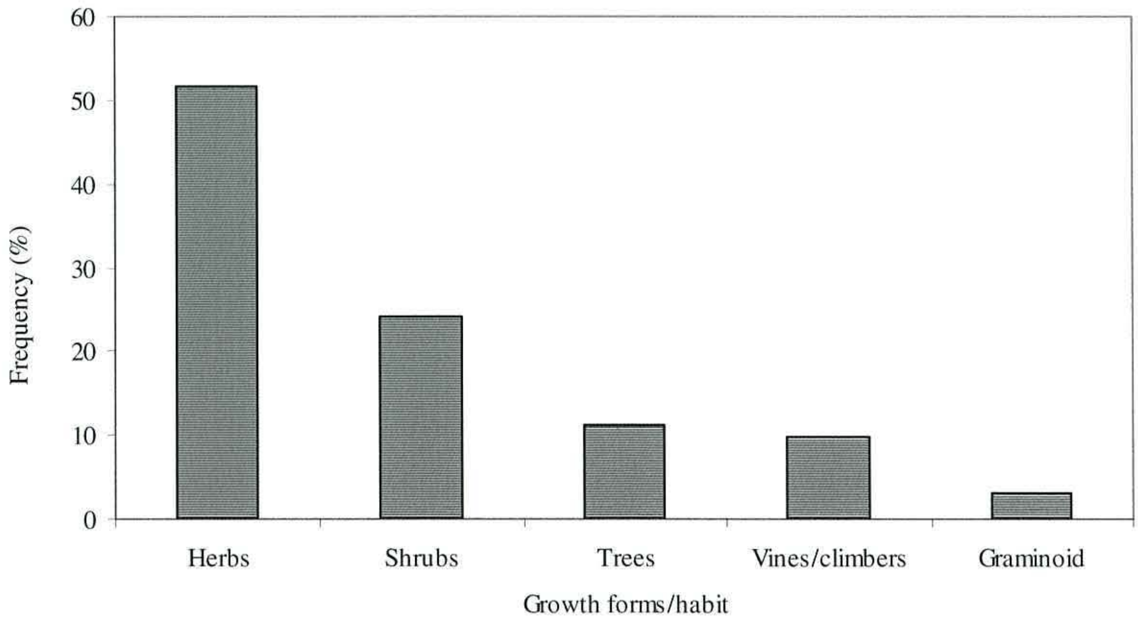


Figure 4.5 Growth forms of WSWFPs commonly consumed in the Kingdom expressed as a percentage of 62 WSWFPs reported in the survey.

Table 4.9 Growth forms and collection niches of the commonly consumed WSWFPs in the Bunyoro-Kitara kingdom.

WSWFPs	Growth forms	Life cycle	Collection niches
Abrus precatorius L.	CL/VI	P	AF, WB, G
Acalypha bipartita Müll. Arg.	SH	P	F, WB, G
Aframomum alboviolaceum (Ridley) K.Schum	HB	P	G, WB
Aframomum angustifolium(Sonnerat) K.Schum.	HB	P	F, SW
Amaranthus dubius Mart. *ex* Thell.	HB	A	WL, AF, AH, CC, RF
Amaranthus graecizans L.	HB	A	CF, WL, AF, AH, RF
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	HB	A	HG, CF, AF, AH
Amaranthus lividus L.	HB	A	CF, WL, AF, AH, F
Amaranthus spinosus L.	HB	A	CF, WL, AF, AH, AE, CC
Ampelocissus africana (Lour.) Merr.	VI/CL	P	WB, G
Annona senegalensis Pers.	SH	P	WB, G
Asystasia gangetica (L.) T.Anders.	HB	P	CF, F, AF, AH
Asystasia mysorensis (Roth) T.Anders.	HB	A	CF, F, AF, AH
Basella alba L.	VI/CL	P	F, SW, FB, WB
Bidens pilosa L.	HB	A	RF, AF, AH, HG, CF
Borassus aethiopum Mart.	TR	P	WB
Canarium schweinfurthii Engl.	TR	P	F, WB, CF
Capsicum frutescens L.	SH	P	AF, AH, CF, F, FB
Carissa edulis (Forssk.) Vahl	SH	P	WB, AE
Cleome gynandra L.	HB	A	RF, AH, AF, HG
Cleome hirta (Klotzsch) Oliv.	HB	A/P	G, WB, RF, AE, HG
Corchorus tridens L.	HB	A	F, HG, CF, WB
Corchorus trilocularis L.	HB	A	F, HG, CF, WB
Crassocephalum crepidioides (Benth.) S.Moore	HB	A	AF, AH, CF, WL
Crotalaria ochroleuca G.Don	HB	A/P	AF, AH, CF, WL, G
Cymbopogon citratus (DC.) Stapf	GR	P	HG
Dioscorea minutiflora Engl.	CL/VI	P	F, WB
Erucastrum arabicum Fisch. & C.A.Mey.	HB	A	AF, AH
Ficus sur Forssk.	TR	P	F, WB
Garcinia buchananii Bak.	TR	P	WB, F, CF
Hibiscus acetosella Welw. *ex* Hiern	SH	P	G, CC, CF, FB
Hibiscus sabdariffa L.	HB	A	HG, CF
Hyptis spicigera Lam.	HB	A	AF, G
Imperata cylindrica (L.) Raeuschel	GR	P	G, FB
Ipomoea eriocarpa R.Br.	HB	A	WB, RF, AF
Lantana camara L.	SH	P	WL, CC, RF, AF
Mondia whitei (Hook.f.) Skeels	VI/CL	P	F, WB

Ocimum gratissimum L.	SH	P	F, WB, HG
Oxalis corniculata L.	HB	P	CF, AF, AH, RF
Oxalis latifolia Kunth	HB	P	CF, AF, AH, RF
Oxygonum sinuatum (Hochst. & Steud. *ex* Meisn.) Dammer	HB	A	AF, AH, CF
Phaseolus lunatus L.	VI/CL	A/P	HG, AF, AF, WB
Phoenix reclinata Jacq.	TR	P	SW
Physalis peruviana L.	SH	P	G, AF, HG, FB
Rhus pyroides var. pyroides Burch.	SH	P	WB, G, FB
Rubus pinnatus Willd.	SH	P	WB, F
Senna obtusifolia (L.) Irwin & Barneby	HB	A/P	CF, WL, AF, RF, G, CC
Sesamum calycinum Welw.	HB	A/P	CF, WL, AF, RF, G
Sida alba L.	HB	A/P	AF, WB, RF
Solanum anguivi Lam.	SH	A/P	F, AF, HG
Solanum lycopersicum L.	HB	A/P	WL, AF, AH, HG
Solanum macrocarpon L.	HB	A/P	WL, AF, HG, FB
Solanum nigrum L.	HB	A/P	F, WB, HG, FB
Sonchus oleraceus L.	HB	A/P	AF, AH, HG, FB
Tamarindus indica L.	TR	P	WB, HG
Tristemma mauritianum J.F.Gmel.	HB	P	SW, WB
Urtica massaica Mildbr.	HB	P	F, AF, AE, CC
Vangueria apiculata K.Schum.	SB	P	WB
Vernonia amygdalina Del.	SB	P	WB, F, FB, AF
Vigna unguiculata (L.) Walp.	VI/CL	A/P	WB, F, G, FB
Vitex doniana Sweet	TR	P	WB
Ximenia americana L.	SH	P	WB

Growth forms: SH = Shrub, TR = Tree, VI = Vine, CL = Climber, GR = Graminoid, HB = Herb. *Life cycles*: A = Annual, P = Perennial, A/P = Annual or short-lived perennial. *Collection niches*: F = Forests/forest gaps/forests margins, WB = Woodlands/Bushlands, G = Grasslands, SW = Swampy areas/wetlands, RF = Roadsides/footpaths, AE = Around animal enclosures (kraals), CC = Cattle corridors, CF = Cultivated farmlands, HG = Homegardens/homesteads, AH = Abandoned homesteads, AF = Abandoned farmlands, WL = Wastelands, FB = Farm borders.

Table 4.10 Frequency of citation of collection niches of the commonly consumed WSWFPs in Bunyoro-Kitara kingdom.

Collection niches	Frequency of citation (%)		
	Mutunda (±SEM)	Kiryandongo (±SEM)	Mean (±SEM)
Forests/forest gaps/forests margins	84.7 (2.0)	70.9 (4.5)	77.8 (6.9)
Bushlands/woodlands	63.5 (4.0)	67.9 (2.1)	65.7 (2.3)
Cultivated farmlands	60.4 (1.5)	66.0 (3.0)	63.2 (2.8)
Grasslands	55.7 (1.4)	63.9 (2.2)	59.8 (4.1)
Homegardens/homesteads	56.5 (3.0)	54.1 (1.8)	55.3 (1.2)
Swampy areas/wetlands	48.8 (2.4)	51.4 (2.5)	50.1 (1.3)
Abandoned homesteads/abandoned farmlands	38.5 (1.1)	54.7 (2.5)	46.6 (8.1)
Wastelands	43.2 (2.0)	36.6 (3.0)	39.9 (3.3)
Farm borders	29.0 (4.8)	26.6 (3.0)	27.8 (1.2)
Roadsides/footpaths	22.3 (1.4)	24.9 (2.0)	23.6 (1.3)
Around animal enclosures (kraals)/cattle corridors	7.3 (1.5)	14.5 (1.9)	10.9 (3.6)

4.5.7 Contribution of the WSWFPs to household diet in the Kingdom

The contribution of the WSWFPs to household diet in the kingdom, were expressed in terms of mean per capita harvest (g day^{-1}), mean per capita use (consumption) and monthly dependencies.

4.5.7.1 Mean per capita harvest of WSWFPs

Mean per capita harvest of WSWFPs varied widely among the species harvested. However, *Amaranthus dubius* (31.59 g day^{-1}), *Borassus aethiopum* (28.14 g day^{-1}), *Amaranthus spinosus* (27.23 g day^{-1}), *Dioscorea minutiflora* (16.06g/day), *Cleome gynandra* (14.74 g day^{-1}), *Acalypha bipartite* (14.07 g day^{-1}), *Hibiscus sabdariffa* (13.79g/day), *Hyptis spicigera* (12.51 g day^{-1}) and *Asystasia gangetica* (11.69 g day^{-1}) had the highest percent contribution to total mean per capita harvest (Table 4.11). Species such as *Lantana camara*, *Vangueria apiculata*, *Imperata cylindrica*, *Rhus pyroides* var. *pyroides*, *Oxalis latifolia*, *Rubus pinnatus* and *Oxalis corniculata*, had the least percent (0.01% – 0.12%) contribution to the total mean per capita harvest.

Most of the households shared (gave out or received) part of their harvests with others. In total, 88.7% of the households gave part of their harvest to others while 90.3% received some WSWFPs from other households who harvested the plants. *Amaranthus spinosus*, *Tamarindus indica*, *Amaranthus dubius*, *Hibiscus sabdariffa*, *Crotalaria ochroleuca*, *Aframomum angustifolium*, *Vitex doniana*, *Solanum nigrum*, *Hibiscus acetosella*, *Asystasia gangetica*, *Acalypha bipartite* and *Cleome gynandra* were the most commonly received resources whereas *Amaranthus dubius*, *Amaranthus spinosus*, *Hibiscus sabdariffa*, *Cleome gynandra*, *Tamarindus indica*, *Solanum nigrum*, *Aframomum angustifolium*, *Crotalaria ochroleuca*, *Corchorus tridens*, *Hibiscus acetosella* were the WSWFPs given out by the greatest number of the households (Table 4.11).

4.5.7.2 Mean per capita use (consumption) of WSWFPs

All households interviewed reported using WSWFPs in the last twelve months. Like in mean per capita harvest, mean per capital consumption also varied from one species to another. *Hyptis spicigera* (107.02 g day^{-1}) (Plate 4.4a), *Borassus aethiopum* (91.82 g day^{-1}), *Dioscorea minutiflora* (78.27 g day^{-1}), *Amaranthus dubius* (42.83 g day^{-1}), *Amaranthus lividus* (42.12 g day^{-1}) (Plate 4.4b), *Acalypha bipartite* (38.16 g day^{-1}), *Amaranthus spinosus* (38.13 g day^{-1}), *Amaranthus hybridus* subsp. *cruentus* (35.50 g day^{-1}), *Abrus precatorius* (35.49g/day), *Amaranthus graecizans* (34.93 g day^{-1}) and *Solanum lycopersicum* (33.79 g day^{-1}) had the highest mean per capital use (Table 4.11). Whereas plants like *Oxalis corniculata*, *Ximenia Americana*, *Oxalis latifolia*, *Rhus pyroides* var. *pyroides*, *Lantana camara*, *Capsicum frutescens* and *Vangueria apiculata*, had the lowest mean per capital use ranging from 5.28 g day^{-1} to 1.80 g day^{-1} (Table 4.11).

Plate 4.5 (a) *Hyptis spicigera* Lam (the plant and its seeds) and (b) *Amaranthus lividus* L.

Table 4.11 Mean per capita harvest and mean per capita use of WSWFPs in Bunyoro-Kitara Kingdom (Wet weight).

WSWFPs	Percentage of households				Mean per capita harvest (g day^{-1})	%[a]	Mean per capita use (g day^{-1})
	Harvesting	Using	Giving	Receiving			
All resources (WSWFPs)	-	-	88.7	90.3	402.90	100.00	1471.88
Hyptis spicigera Lam.	6.2	11.7	6.2	6.2	12.51	3.10	107.02
Borassus aethiopum Mart.	24.9	30.6	23.9	28.8	28.14	6.98	91.82
Dioscorea minutiflora Engl.	13.0	20.5	12.7	10.6	16.06	3.99	78.27
Amaranthus dubius Mart. *ex* Thell.	73.5	73.8	61.0	48.8	31.59	7.84	42.83
Amaranthus lividus L.	15.3	16.1	10.6	12.5	6.78	1.68	42.12
Acalypha bipartite Müll. Arg.	33.2	36.9	28.1	34.0	14.07	3.49	38.16
Amaranthus spinosus L.	71.4	71.4	58.2	57.1	27.23	6.76	38.13
Amaranthus hybridus subsp. *cruentus* (L.) Thell.	17.4	18.4	14.5	17.1	6.55	1.62	35.50
Abrus precatorius L.	5.2	6.0	3.9	5.2	2.12	0.53	35.49
Amaranthus graecizans L.	19.2	20.3	18.2	13.8	7.08	1.76	34.93
Solanum lycopersicum L.	13.2	16.6	12.5	13.5	5.62	1.39	33.79
Aframomum alboviolaceum (Ridley) K.Schum	27.5	31.4	26.8	29.4	10.44	2.59	33.22
Cleome gynandra L.	43.9	45.2	40.8	33.0	14.74	3.66	32.60
Basella alba L.	29.6	33.8	26.5	29.1	10.89	2.70	32.26
Canarium schweinfurthii Engl.	22.3	24.7	22.1	22.6	7.95	1.97	32.22
Asystasia gangetica (L.) T.Anders.	33.5	39.2	24.9	35.8	11.69	2.90	29.80
Asystasia mysorensis (Roth) T.Anders.	33.5	37.1	26.8	31.2	11.05	2.74	29.75
Erucastrum arabicum Fisch. & C.A.Mey.	7.5	8.6	3.9	1.8	2.49	0.62	29.07

Phaseolus lunatus L.	12.2	14.3	11.2	5.7	4.03	1.00	28.20
Urtica massaica Mildbr.	2.3	2.9	2.3	2.1	0.80	0.20	27.83
Hibiscus sabdariffa L.	45.7	51.9	43.9	43.1	13.79	3.42	26.55
Aframomum angustifolium (Sonnerat) K.Schum.	39.0	43.6	36.9	38.2	11.58	2.87	26.54
Crassocephalum crepidioides (Benth.) S.Moore	7.8	7.8	0.0	1.6	1.99	0.49	25.51
Oxygonum sinuatum (Hochst. & Steud. *ex* Meisn.) Dammer	19.0	21.8	17.4	13.0	5.54	1.37	25.39
Crotalaria ochroleuca G.Don	39.7	47.8	36.1	42.3	10.71	2.66	22.40
Hibiscus acetosella Welw. *ex* Hiern	36.1	44.7	31.7	35.8	9.91	2.46	22.19
Cleome hirta (Klotzsch) Oliv.	27.8	31.2	23.4	23.9	6.89	1.71	22.11
Corchorus tridens L.	35.1	36.6	32.2	29.6	7.89	1.96	21.56
Corchorus trilocularis L.	30.4	34.0	28.6	31.4	6.82	1.69	20.06
Sonchus oleraceus L.	27.5	34.3	22.6	16.4	6.81	1.69	19.87
Sesamum calycinum Welw.	9.6	9.4	4.4	2.6	1.80	0.45	19.27
Senna obtusifolia (L.) Irwin & Barneby	35.1	43.9	17.1	11.9	8.43	2.09	19.20
Solanum anguivi Lam.	12.2	13.0	7.3	3.4	2.48	0.62	19.08
Vigna unguiculata (L.) Walp.	26.8	35.1	23.4	26.0	6.39	1.59	18.23
Phoenix reclinata Jacq.	7.0	8.3	5.7	4.2	1.51	0.37	18.18
Solanum nigrum L.	40.3	49.1	37.1	36.1	8.83	2.19	17.98
Physalis peruviana L.	27.8	34.8	26.8	26.8	6.21	1.54	17.86
Sida alba L.	16.6	18.7	11.7	7.3	3.31	0.82	17.72
Garcinia buchananii Bak.	12.2	15.1	11.2	7.8	2.62	0.65	17.42
Solanum macrocarpon L.	10.6	11.9	6.5	3.9	2.01	0.50	16.86

Vernonia amygdalina Del.	29.6	40.3	21.6	25.5	6.78	1.68	16.85
Bidens pilosa L.	31.9	35.1	9.9	13.0	5.91	1.47	16.85
Ficus sur Forssk.	22.9	28.3	19.7	15.3	4.48	1.11	15.82
Tamarindus indica L.	42.1	69.1	39.7	56.6	9.34	2.32	13.52
Ipomoea eriocarpa R.Br.	8.8	11.4	2.1	3.4	1.54	0.38	13.45
Annona senegalensis Pers.	13.8	16.4	12.2	14.5	2.20	0.55	13.44
Rubus pinnatus Willd.	3.1	3.4	2.1	1.0	0.44	0.11	13.03
Ampelocissus africana (Lour.) Merr.	8.6	10.4	1.3	5.7	1.30	0.32	12.50
Carissa edulis (Forssk.) Vahl	12.5	16.1	8.6	14.5	1.86	0.46	11.52
Mondia whitei (Hook.f.) Skeels	9.4	13.5	9.1	13.0	1.55	0.38	11.48
Vitex doniana Sweet	31.9	50.1	28.8	37.4	4.81	1.19	9.59
Tristemma mauritianum J.F.Gmel.	6.8	6.8	0.0	0.0	0.58	0.14	8.55
Imperata cylindrica (L.) Raeuschel	1.3	1.3	0.0	0.0	0.11	0.03	8.16
Ocimum gratissimum L.	13.2	15.6	10.1	2.9	1.25	0.31	8.01
Cymbopogon citrates (DC.) Stapf	7.0	7.0	2.6	0.0	0.56	0.14	7.94
Oxalis corniculata L.	8.8	8.8	0.0	0.0	0.47	0.12	5.28
Ximenia Americana L.	8.6	13.8	7.5	7.5	0.68	0.17	4.95
Oxalis latifolia Kunth	8.1	8.1	0.0	0.0	0.36	0.09	4.48
Rhus pyroides var. *pyroides* Burch.	8.1	9.4	0.0	1.3	0.27	0.07	2.83
Lantana camara L.	1.6	1.6	0.0	0.0	0.04	0.01	2.72
Capsicum frutescens L.	36.1	38.4	3.6	4.4	0.87	0.22	2.28
Vangueria apiculata K.Schum.	2.1	5.5	1.3	4.7	0.10	0.02	1.80

%[a] = contribution to total per capita harvest.

4.5.7.3 Availability calendar and dependency on WSWFPs

In terms of monthly dependency, most of the households were found to rely on WSWFPs for most of the year to meet or supplement their household food requirements (Figure 4.6). About 46.8 ± 4.4% households depend on WSWFPs for seven (7) to nine (9) months while 35.1 ± 4.6% depend on WSWFPs for about ten (10) to twelve (12) months, which is nearly the whole year round. Very few households reportedly used WSWFPs for less than 7 months as part of their diet.

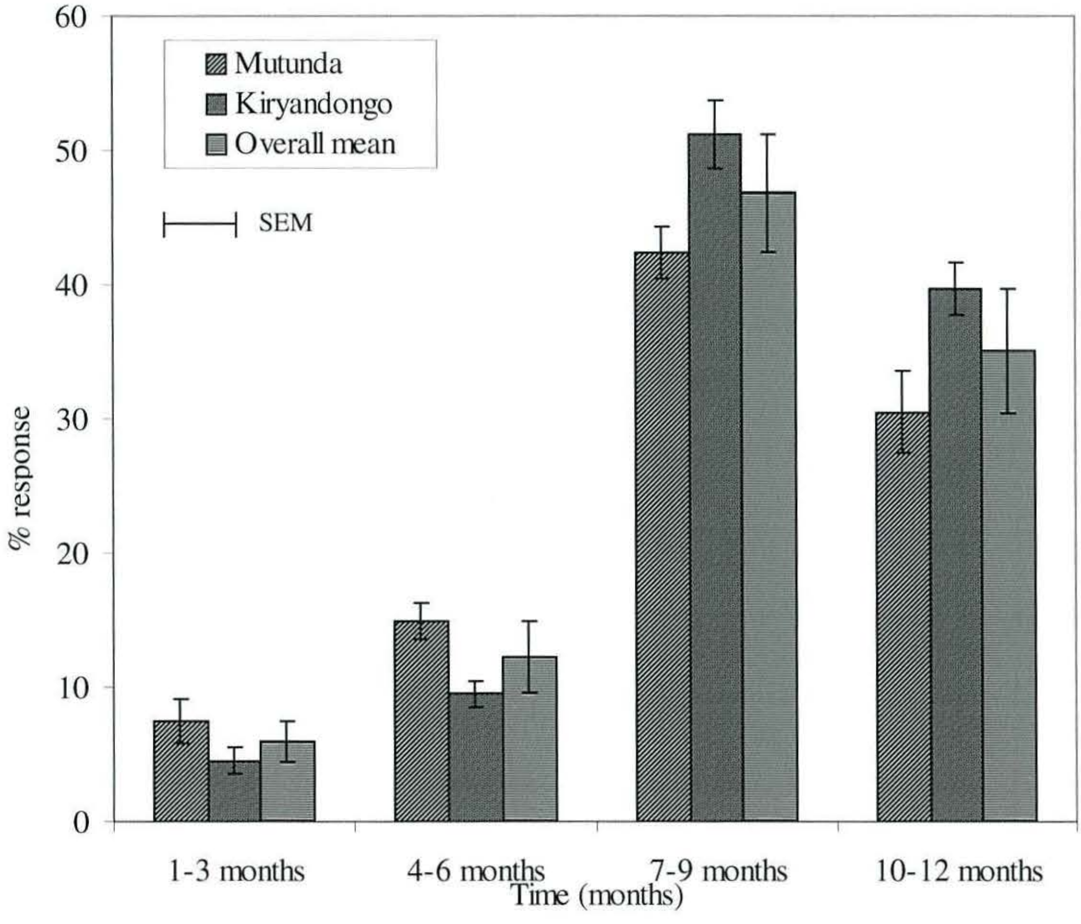


Figure 4.6 Household dependence (months per year) on WSWFPs in the Kingdom.

During the focus group discussions (FGDs), it was noted that most of WSWFPs were available for harvests and consumption nearly throughout the year. Table 4.12 depicts the seasonal calendar of availability of different WSWFPs commonly consumed in this locality. Most WSWFPs such as *Aframomum angustifolium*, *Cymbopogon citrates*, *Imperata cylindrica*, *Mondia whitei* (Plate4.5) and *Vernonia* *amygdalina*, were reported to occur year round (January to December) and can be harvested any time.

Others such as *Acalypha bipartite*, *Amaranthus dubius*, *Ampelocissus africana*, *Basella alba*, *Bidens pilosa*, *Capsicum frutescens*, *Cleome gynandra*, *Cleome hirta*, *Ocimum gratissimum*, *Phaseolus lunatus*, *Rubus pinnatus*, *Sida alba*, *Solanum macrocarpon* and *Tristemma mauritianum*, though available all year round, had main (peak) seasons and occasional periods of availability (Table 4.12).

Plate 4.6 *Mondia whitei* (Hook.f.) Skeels- a wild edible plant that is available year round in the study area.

Table 4.12 Seasonal calendar of availability of different WSWFPs in relation to the cropping cycle of conventional food crops in Bunyoro-Kitara kingdom.

Cropping cycle of conventional food crops		**Dry season**		**1st rainy season**			**Dry season**			**2nd rainy season**			
		2nd season harvests	**Land preparation, crop planting, weeding and crop maturity**				**1st season harvests**			**Land preparation, crop planting, weeding and crop maturity**			**2nd season harvests**
WSWFPs	**Local names**	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Abrus precatorius L.	Akarunga												
Acalypha bipartite Müll. Arg.	Egoza, Ayuu												
Aframomum alboviolaceum (Ridley) K.Schum	Amasaasi, Ocao												
Aframomum angustifolium (Sonnerat) K.Schum.	Amatehe, Kongo amor												
Amaranthus dubius Mart. *ex* Thell.	Doodo												
Amaranthus graecizans L.	Nyabutongo, Ocoboro												
Amaranthus hybridus subsp. *cruentus* (L.) Thell.	Omujuiga												
Amaranthus lividus L.	Bwora, Mboog'ennene												
Amaranthus spinosus L.	Doodo y'amahwa												
Ampelocissus africana (Lour.) Merr.	Anunu, Olok												
Annona senegalensis Pers.	Mubengeya, Obwolo												
Asystasia gangetica (L.) T.Anders.	Temba, Odipa ikong												
Asystasia mysorensis (Roth) T.Anders.	Nyante, Acwewanggweno												
Basella alba L.	Enderema												
Bidens pilosa L.	Obukurra												
Borassus aethiopum Mart.	Ekituugu, Tugo												

Canarium schweinfurthii Engl.	Empafu												
Capsicum frutescens L.	Kamulari, Alyera												
Carissa edulis (Forssk.) Vahl	Omuyonza, Acuga												
Cleome gynandra L.	Eyobyo												
Cleome hirta (Klotzsch) Oliv.	Akayobyo akasajja												
Corchorus tridens L.	Eteke												
Corchorus trilocularis L.	Otigo lum												
Crassocephalum crepidioides (Benth.) S.Moore	Ekinami												
Crotalaria ochroleuca G.Don	Kumuro, Alaju												
Cymbopogon citrates (DC.) Stapf	Lemon grass												
Dioscorea minutiflora Engl.	Kaama/Ekihama												
Erucastrum arabicum Fisch. & C.A.Mey.	Oburobwenaku												
Ficus sur Forssk.	Kabalira, Oduru												
Garcinia buchananii Bak.	Museka												
Hibiscus acetosella Welw. *ex* Hiern	Makawang kulo, Gwanya												
Hibiscus sabdariffa L.	Bamya, Ekikenke												
Hyptis spicigera Lam.	Amola, Lamola	*										*	*
Imperata cylindrica (L.) Raeuschel	Rusojo												
Ipomoea eriocarpa R.Br.	Acatolao, Podowia kuri												
Lantana camara L.	Jerenga, Abelwinyo												
Mondia whitei (Hook.f.) Skeels	Omurondwa												
Ocimum gratissimum L.	Mujaja												
Oxalis corniculata L.	Kanyunywa mbuzi												
Oxalis latifolia Kunth	Kanyeebwa												
Oxygonum sinuatum (Hochst.	Kacumita bagenge,												

& Steud. *ex* Meisn.) Dammer	Cuguru			░	■	■	░		░	■	■	░	
Phaseolus lunatus L.	Amaijalero, Okuku	░	░	■	■	■	■	░	░	■	■	■	░
Phoenix reclinata Jacq.	Omukindo					■	■	░				░	░
Physalis peruviana L.	Ntuutu	░				■	■	░	░			░	■
Rhus pyroides var. *pyroides* Burch.	Obukanjakanja, Awaca					░	■	■				░	■
Rubus pinnatus Willd.	Amakerre	░	░	░	░	■	■	■	■	■	░	░	░
Senna obtusifolia (L.) Irwin & Barneby	Oyado, Luge			░	■	■	░		░	░	░	░	
Sesamum calycinum Welw.	Amacande ga kanyamunya				■	■	░			■	■	░	
Sida alba L.	Orucuhya	░	░	■	■	■	░	░	░	■	■	■	░
Solanum anguivi Lam.	Obuhuruhuru, Katukuma	░				■	■	░			░	■	■
Solanum lycopersicum L.	Bunyanya bunyoro	░				■	■	░				■	■
Solanum macrocarpon L.	Bugorra	░	░	■	■	■	░	░	■	■	■	░	░
Solanum nigrum L.	Enswiga			░	■	■	░		░	■	■	░	
Sonchus oleraceus L.	Kizimyamucho, Apuruku			■	■	■	░		░	■	■	░	
Tamarindus indica L.	Mukoge	■	░								░	■	■
Tristemma mauritianum J.F.Gmel.	Oburo bw'enkombe	░	░	■	■	■	░	░	■	■	■	■	░
Urtica massaica Mildbr.	Orugenyi, Ekicuraganyi			■	■	░			░	■	■	■	
Vangueria apiculata K.Schum.	Matungunda				░	■	■	░					
Vernonia amygdalina Del.	Kibirizi	■	■	■	■	■	■	■	■	■	■	■	■
Vigna unguiculata (L.) Walp.	Mugobiswa			░	■	■	░		░	■	■	░	
Vitex doniana Sweet	Muhomozi, Owelo			░	■	■	■						
Ximenia Americana L.	Enseka, Olimo	░										░	■

■ Main periods of availability ░ Occasional periods of availability * Periods in which edible seeds are harvested.

4.5.8 Cultural significance of commonly consumed WSWFPs in Bunyoro-Kitara Kingdom

Cultural food significance index (CFSI) values of WSWFP commonly consumed in the Kingdom are presented in Table 4.13. CFSI values varied between 410.4 and 0.6. Based on the CFSI values, the documented WSWFPs were classified into six (6) groups: species with very high significance (CFSI ≥ 300), with high significance (CFSI ranging from 100 to 299), moderate significance (CFSI ranging from 20 to 99), low significance (CFSI varying from 5 to 19), very low significance (CFSI from 1 to 4) and negligible significance (ICS< 1).

The group of WSWFPs with very high significance values (CFSI ≥ 300) consisted of *Bidens pilosa* (410.4), *Capsicum frutescens* (375.7) and *Amaranthus spinosus* (366.0). These three plants had generally high quotation indices (QI), availability indices (AI), multifunctional food use indices (MFFI) and food-medicinal role indices (FMRI). *Capsicum frutescens* and *Amaranthus spinosus* had also high frequency of utilization indices (FUI). WSWFPs with high cultural significance values comprised of *Cleome gynandra, Imperata cylindrica, Solanum lycopersicum, Amaranthus dubius, Cymbopogon citrates, Vernonia amygdalina, Cleome hirta* and *Ocimum gratissimum*. With exception of *Cleome gynandra* and *Cleome*, these plants had also high QI. Similarly, with exception of *Imperata cylindrica* and *Vernonia amygdalina*, this group had very high taste score appreciation indices (TSAI). *Imperata cylindrica, Vernonia amygdalina* and *Cymbopogon citrates*, however, had very high FMRI.

Group with moderate cultural significance values consisted of the majority of WSWFPs reported in the study. Key among them included *Solanum macrocarpon, Hibiscus sabdariffa, Amaranthus graecizans, Amaranthus lividus, Asystasia gangetica, Oxygonum sinuatum, Physalis peruviana, Hibiscus acetosella, Phaseolus lunatus* and *Basella alba*. With exception of some few species such as *Asystasia gangetica, Lantana camara, Senna obtusifolia* and *Borassus aethiopum*, this group had generally low QI. Group with low cultural significance values included amongst others *Corchorus tridens, Carissa edulis, Phoenix reclinata, Hyptis spicigera, Crassocephalum crepidioides, Rhus pyroides* var. *pyroides, Solanum anguivi*, *Sonchus oleraceus* and *Acalypha bipartite*. With exception of *Carissa edulis*, *Rhus pyroides* var. *pyroides* and *Vitex doniana*, this group had generally low QI, PUI and MFFI. WSWFPs with very low cultural significance values had generally very low QI, AI, FUI, PUI (plant parts use indices) and MFFI, although most of them had a very high TSAI. A group with negligible cultural significance values consisted of two members namely: *Dioscorea minutiflora* and *Ficus sur*. Plate 4.6 and 4.7 depicts some of WSWFPs with moderate to very high CFSI values.

Bidens pilosa L. (CFSI = 410.4)

Capsicum frutescens L. (CFSI = 375.7)

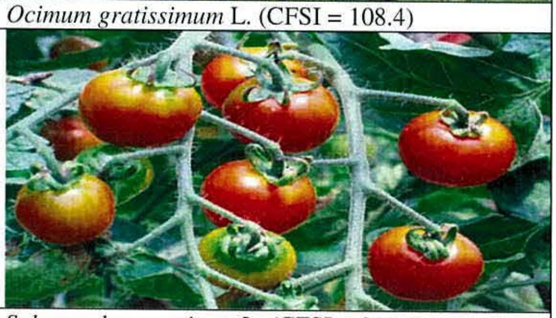
Solanum nigrum L. (CFSI = 289.8)

Cleome gynandra L. (CFSI = 227.3)

Cymbopogon citrates (DC.) Stapf (CFSI = 144.2)

Ocimum gratissimum L. (CFSI = 108.4)

Amaranthus dubius Mart. *ex* Thell. (CFSI = 176.5)



Solanum lycopersicum L. (CFSI = 211.4)

Plate 4.7 Some of the WSWFPs with moderate to very high CFSI values.

Table 4.13 Cultural significances of WSWFPs commonly consumed in Bunyoro-Kitara Kingdom.

WSWFPs	Botanical family	Local names	QI	AI	FUI	PUI	MFFI	TSAI	FMRI	CFSI
Bidens pilosa L.	Compositae	Obukurra	10	2.70	2.91	3.50	4.50	7.30	4.54	410.4
Capsicum frutescens L.	Solanaceae	Kamulari, Alyera	7	2.71	5.01	3.00	3.50	7.71	4.90	375.7
Amaranthus spinosus L.	Amaranthaceace	Doodo y'amahwa	10	2.40	4.39	2.75	4.50	8.69	3.23	366.0
Solanum nigrum L.	Solanaceae	Enswiga	6	2.26	4.61	3.75	3.50	8.94	3.95	289.8
Cleome gynandra L.	Capparaceae/ Cleomaceae	Eyobyo	3	2.47	4.52	6.25	3.50	8.64	3.59	227.3
Imperata cylindrica (L.) Raeuschel	Gramineae	Rusojo	12	2.90	2.40	3.50	2.00	7.29	5.00	212.5
Solanum lycopersicum L.	Solanaceae	Bunyanya bunyoro	9	2.19	4.77	1.50	5.00	9.34	3.21	211.4
Amaranthus dubius Mart. *ex* Thell.	Amaranthaceace	Doodo	5	2.73	4.62	2.75	4.50	9.13	2.47	176.5
Cymbopogon citrates (DC.) Stapf	Poaceae	Lemon grass	5	2.56	5.01	3.00	2.00	9.35	4.01	144.2
Vernonia amygdalina Del.	Compositae	Kibirizi	7	2.22	3.75	2.75	2.50	7.60	4.69	143.0
Cleome hirta (Klotzsch) Oliv.	Capparaceae/ Cleomaceae	Akayobyo akasajja	3	1.69	4.44	4.50	3.50	8.36	3.95	117.4
Ocimum gratissimum L.	Labiatae	Mujaja	8	2.21	4.66	1.50	2.00	9.59	4.56	108.4
Solanum macrocarpon L.	Solanaceae	Bugorra	5	1.62	4.30	3.00	3.50	8.20	2.90	86.8
Hibiscus sabdariffa L.	Malvaceae	Bamya, Ekikenke	2	2.12	4.52	3.75	3.50	9.19	3.42	78.9
Amaranthus graecizans L.	Amaranthaceace	Nyabutongo, Ocoboro	4	1.80	4.21	2.75	4.00	8.67	2.65	76.4
Amaranthus lividus L.	Amaranthaceace	Bwora, Mboog'ennene	5	1.77	3.79	2.75	3.50	7.75	2.97	74.5
Asystasia gangetica (L.) T.Anders.	Acanthaceae	Temba, Odipa ikong	10	1.60	3.37	3.75	1.50	8.03	2.86	69.3
Oxygonum sinuatum (Hochst. & Steud. *ex* Meisn.) Dammer	Polygonaceae	Kacumita bagenge, Cuguru	4	2.16	4.27	2.75	2.50	8.17	3.25	67.3
Physalis peruviana L.	Solanaceae	Ntuutu	5	1.79	3.71	1.50	3.75	8.75	3.93	64.3
Hibiscus acetosella Welw. *ex* Hiern	Malvaceae	Makawang kulo, Gwanya	4	1.00	3.41	3.75	3.50	7.82	3.84	53.7

Phaseolus lunatus L.	Fabaceae	Amaijalero, Okuku	2	2.22	4.20	3.25	3.50	8.20	3.02	52.3
Basella alba L.	Baselllaceae	Enderema	4	1.61	3.91	1.50	4.00	8.48	3.50	44.7
Amaranthus hybridus subsp. *cruentus* (L.) Thell.	Amaranthaceace	Omujuiga	3	1.36	4.69	2.75	3.50	8.65	2.46	39.1
Lantana camara L.	Verbenaceae	Jerenga, Abelwinyo	10	2.92	4.87	1.50	0.50	8.28	4.38	38.7
Mondia whitei (Hook.f.) Skeels	Asclepiadaceae	Omurondwa	5	1.40	3.42	1.50	2.50	9.22	4.33	36.0
Sesamum calycinum Welw.	Pedaliaceae	Amacande ga kanyamunya	4	1.69	4.09	1.50	3.50	7.88	3.15	35.9
Borassus aethiopum Mart.	Palmae/Arecaceae	Ekituugu, Tugo	6	2.31	2.69	1.50	2.25	9.41	2.53	29.9
Senna obtusifolia (L.) Irwin & Barneby	Caesalpiniaceae	Oyado, Luge	7	2.00	3.40	1.50	1.50	7.76	3.53	29.3
Corchorus trilocularis L.	Tiliaceae	Otigo lum	4	2.21	4.68	1.50	2.00	7.87	2.95	28.8
Urtica massaica Mildbr.	Urticaceae	Orugenyi	4	1.75	4.30	1.50	2.50	8.64	2.78	27.0
Asystasia mysorensis (Roth) T.Anders.	Acanthaceae	Nyante, Acwewanggweno	3	1.66	4.27	3.00	1.50	7.59	3.33	24.3
Tamarindus indica L.	Caesalpiniaceae	Mukoge	3	2.30	3.69	1.50	2.25	8.47	3.26	23.6
Corchorus tridens L.	Tiliaceae	Eteke	2	2.22	4.61	1.50	2.00	9.13	3.24	18.2
Carissa edulis (Forssk.) Vahl	Apocynaceae	Omuyonza, Acuga	7	1.61	2.55	1.50	1.50	9.28	2.76	16.6
Phoenix reclinata Jacq.	Palmae	Omukindo	3	2.10	3.25	2.50	1.50	8.54	2.53	16.6
Hyptis spicigera Lam.	Labiatae	Amola, Lamola	3	0.43	2.64	3.25	4.00	9.05	3.97	16.0
Crassocephalum crepidioides (Benth.) S.Moore	Compositae	Ekinami	5	1.75	2.93	1.50	1.50	7.46	3.66	15.7
Rhus pyroides var. *pyroides* Burch.	Anacardiaceae	Obukanjakanja, Awaca	6	1.80	2.79	1.50	1.50	8.08	2.82	15.4
Solanum anguivi Lam.	Solanaceae	Obuhuruhuru, Katukuma	1	1.80	4.60	1.50	3.50	8.07	4.40	15.4
Sonchus oleraceus L.	Compositae	Kizimyamucho, Apuruku	3	2.17	4.10	1.50	1.50	7.68	3.19	14.7
Acalypha bipartite Müll. Arg.	Euphorbiaceae	Egoza, Ayuu	3	1.44	3.96	2.75	1.50	8.27	2.33	13.6
Vitex doniana Sweet	Verbenaceae	Muhomozi, Owelo	15	1.39	3.47	1.50	0.50	8.56	2.81	13.1

Vigna unguiculata (L.) Walp.	Papilionaceae	Mugobiswa	2	1.99	3.64	2.75	1.50	7.14	2.60	11.1
Ipomoea eriocarpa R.Br.	Convolvulaceae	Acatolao, Podowia kuri	5	0.73	2.62	2.75	1.50	7.63	3.17	9.5
Crotalaria ochroleuca G.Don	Papilionaceae	Kumuro, Alaju	3	1.20	3.42	2.25	1.50	7.41	3.03	9.3
Ampelocissus africana (Lour.) Merr.	Vitaceae	Anunu, Olok	2	1.15	2.57	3.00	2.00	7.57	3.15	8.4
Aframomum alboviolaceum (Ridley) K.Schum	Euphorbiaceae	Amasaasi, Ocao	2	1.44	2.28	1.50	2.25	9.10	3.86	7.8
Sida alba L.	Malvaceae	Orucuhya	2	0.88	3.58	1.50	3.00	7.47	3.56	7.5
Garcinia buchananii Bak.	Guttiferae	Museka	2	1.31	3.03	2.50	1.50	7.91	3.13	7.4
Canarium schweinfurthii Engl.	Burseraceae	Empafu	2	1.71	2.89	2.50	1.00	8.52	2.68	5.6
Oxalis corniculata L.	Oxalidaceae	Kanyunywa mbuzi	3	2.24	4.46	1.50	0.50	7.17	2.80	4.5
Oxalis latifolia Kunth	Oxalidaceae	Kanyeebwa	3	2.50	3.59	1.50	0.50	7.78	2.76	4.3
Abrus precatorius L.	Papilionaceae	Akarunga	4	1.34	3.77	1.50	0.50	7.81	3.46	4.1
Aframomum angustifolium (Sonnerat) K.Schum.	Zingiberaceae	Amatehe, Kongo amor	1	1.58	2.33	1.50	2.25	9.06	3.43	3.9
Erucastrum arabicum Fisch. & C.A.Mey.	Cruciferae	Oburobwenaku	1	1.37	3.96	1.50	2.00	7.46	2.51	3.1
Rubus pinnatus Willd.	Rosceae	Amakerre	1	1.49	3.06	1.50	2.00	7.91	2.67	2.9
Annona senegalensis Pers.	Annonaceae	Mubengeya, Obwolo	4	1.51	2.14	1.50	0.50	9.20	3.17	2.8
Tristemma mauritianum J.F.Gmel.	Melastomatacease	Oburo bw'enkombe	2	1.05	3.55	2.75	0.50	7.24	3.13	2.3
Vangueria apiculata K.Schum.	Rubiaceae	Matungunda	4	1.09	2.27	1.50	0.50	9.52	2.83	2.0
Ximenia Americana L.	Olacaceae	Enseka, Olimo	2	1.32	2.99	1.50	0.50	9.02	2.88	1.5
Dioscorea minutiflora Engl.	Dioscoreaceae	Kaama/Ekihama	2	0.45	2.15	1.50	1.00	7.90	3.09	0.7
Ficus sur Forssk.	Moraceae	Kabalira, Oduru	1	1.32	3.03	1.50	0.50	8.03	2.68	0.6

AI: availability index, QI: quotation index, FUI: frequency of utilization index, MFFI: multifunctional food use index, PUI: plant parts use index, TSAI: taste score appreciation index, FMRI: food-medicinal role index.

Imperata cylindrica (L.) Raeuschel (CFSI = 212.5)

Cleome hirta (Klotzsch) Oliv. (CFSI = 117.4)

Phaseolus lunatus L. (CFSI = 52.3)

Solanum macrocarpon L. (CFSI = 86.8)

Amaranthus graecizans L. (CFSI = 76.4)

Amaranthus lividus L. (CFSI = 74.5)

Plate 4.8 Some of the WSWFPs with moderate to very high CFSI values.

4.5.9 Local perceptions and social implications of consumption of WSWFPs in kingdom

Local perceptions about WSWFPs in Bunyoro-Kitara kingdom are presented in Figure 4.7. A majority (72.7 ± 4.3%) of the respondents perceived WSWFPs as medicinal in nature. Similarly, many (71.2 ± 2.3%) respondents said that WSWFPs are generally nutritious. Others perceived WSWFPs as emergency foods (60.7 ± 4.75%), income-generating (55.6 ± 3.7%) and supplementary food sources (33.5 ± 3.2%). About 17.9 ± 2.9% of the respondents said WSWFPs increase food choices available to households. Some (50.1 ± 6.1%) respondents, however, reported that most WSWFPs (e.g. *Bidens pilosa and Senna obtusifolia*) are weedy and problematic in the gardens.

About 11.4 ± 4.2% of the respondents said some WSWFPs (e.g wild yams and seeds of *Abrus precatorius*) are toxic and that they can be harmful if adequate care is not taken in their preparation before consumption. Asked about their opinion on whether WSWFPs consumption carries social implications or not, a majority (88 ± 3.4%) of the respondents said their consumption have negative social implications (Figure 4.8). For instance, most respondents reported that WSWFPs consumption is very often considered as a source of shame (75.5 ± 1.9%) and a sign of poverty (70.8 ± 4.3%) especially by the well to do households, educated people, and some of the local leaders.

About (52.8 ±2.1%) reported that consumption of WSWFPs is seen by others as a sign of uncivilized persons/households and backwardness. Loss of respect and dignity in the society was also reported to be associated with households or persons that rely much on WSWFPs to meet their food requirements. Other respondents said WSWFPs were regarded by some people as food for lazy ones, elderly or handicapped persons (Figure 4.9).

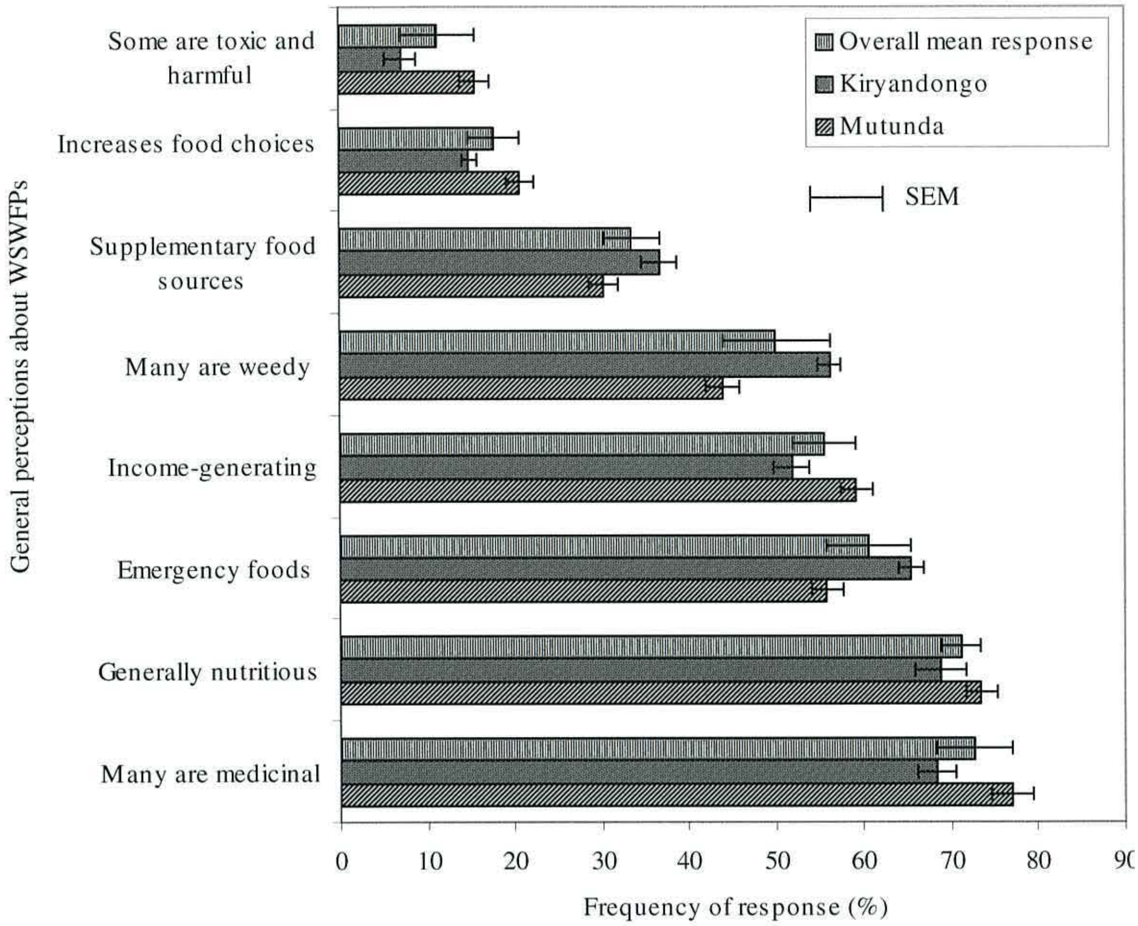


Figure 4.7 General perceptions about WSWFPs consumed in the study area.

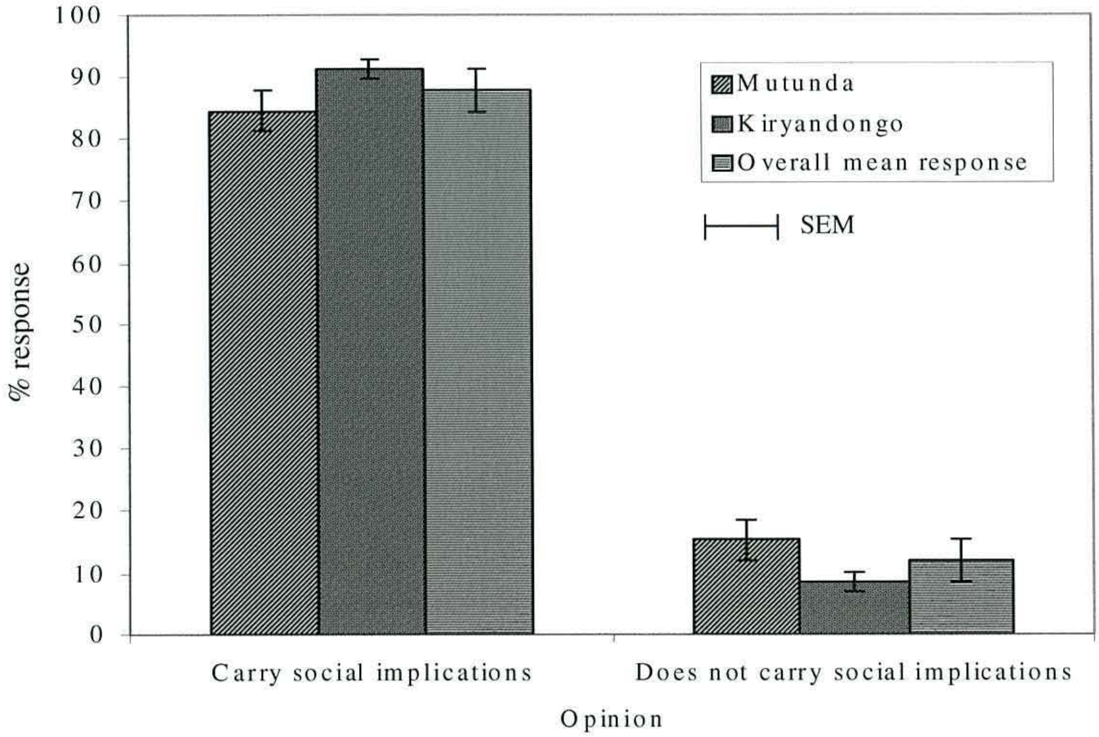


Figure 4.8 Opinion on whether consumption of WSWFPs carries social implications.

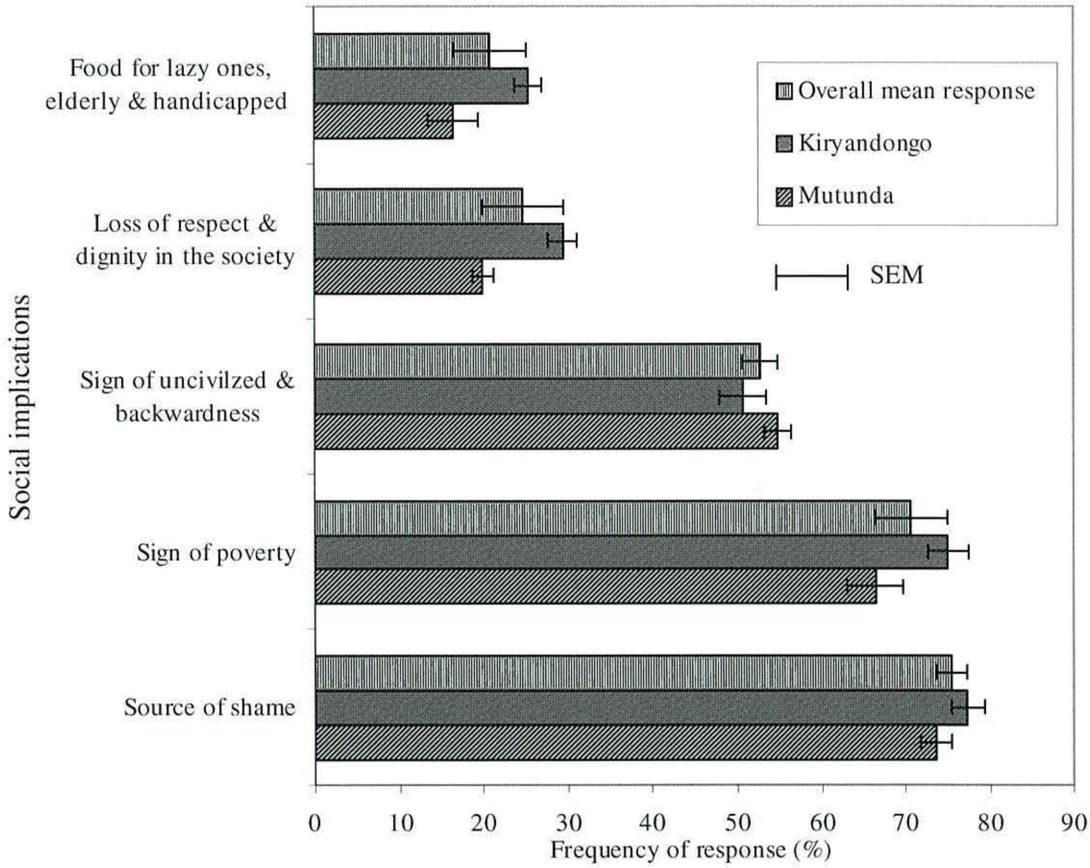


Figure 4.9 Social implications of the consumption of WSWFPs.

4.6 Discussion

4.6.1 Commonly consumed WSWFPS in the kingdom

A significant number of WSWFPs were documented from the study area. There was large evidence that local communities in this locality very often interact with their environment and make use of these WSWFPs to meet part of their household food requirements. Anthropologists and nutritionists often argue that contemporary humans are in a genetic sense, still stone agers and therefore constantly interacting with their environment in quest of meeting their livelihood needs and in most cases still adapted to the pre-agricultural nutritional pattern (Mann, 2004). The number (62) of WSWFPs reportedly consumed in this study is lower than some of those reported from other studies within and outside Uganda. For example, Tabuti *et al.* (2004) reported 105 edible species distributed in 77 genera and 39 families in Bulamogi county, eastern Uganda and in Rukungiri district of southwestern Uganda, Musinguzi *et al.* (2006) documented a total of 94 indigenous food plants (most of which were WSWFPs) as being consumed by local people. Elsewhere, Ali-Shtayeh (2008), recorded 100 wild edible plant species distributed across 70 genera and 26 families in Palestine (Northern West Bank).

There could be many possible explanations for these differences. However, the most realistic could be related to the higher data collection intensity employed in these other studies. While in the present study the households and key informants were only one-time interviewees, in others they used multiple interviews. Also, the diversity of WSWFPs in the study area could be lower than in areas where most other studies recorded higher number of edible wild plants. Bennett (1992) and Salick *et al.* (1999) opined that the diversity of plant resources is often reflected in people's interrelationship with their environment as expressed in the knowledge and use they make of plants. Hence, environments, which are more diverse, have more richness and abundance of the most useful species than less diverse environments.

The results however, compare closely with those of Balemie and Kebebew (2006) and Rashid *et al.* (2008), who recorded a total of 66 WSWFPs belonging to 54 genera and 34 families in Derashe and Kucha Districts of Southern Ethiopia, and a total of 57 WSWFPs belonging to 33 families used by the Gujjar tribe in Rajouri, Jammu and Kashmir states of India, respectively. Similarly, in Paphos and Larnaca countryside of Cyprus, Della (2006) reported 78 species of edible wild food plants as being consumed by the local community. Termote *et al.* (2008) also documented a total of 71 wild edible plant species belonging to 38 families and 60 genera as being consumed by the Turumbu people of Tshopo district in DR Congo.

4.6.2 Relationship between sex, age and knowledge of WSWFPs

The findings from this study suggested that the knowledge of WSWFPs increased with age of the respondents, impliying that, the younger generation have somewhat little local knowledge of WSWFPs than the elderly people. This could be attributed first, to the low interest of the younger generation to learn more about WSWFPs, and secondly, to more time spent at school because of the introduced universal primary and secondary education in Uganda that dictates compulsory enrolment of the younger people to schools, hence they have little time to interact with their families and the environment to learn more about the WSWFP resources. A case study by Ladio and Lozada (2004) among the Mapuche community of northwestern Patagonia also showed that the knowledge of WSWFPs increased with age of the respondents. Elsewhere, age of the respondents has also been shown to be a defining feature of the level of plant-based knowledge and a powerful indicator of the process of ethnobotanical decline over time (Voeks, 2006).

Although the findings from regression analysis suggest that knowledge of WSWFPs possessed by both men and women grows during their lifetimes, it was also apparent that women amass this knowledge more quickly throughout their life-times than men. Irrespective of their ages, women on average knew and reported more WSWFPs than their male counterparts. Luoga *et al.* (2000) also found that women in eastern Tanzania knew more about herbaceous plants than men. In northeast Thailand, women were reported to have more knowledge about wild food plants because they are gatherers (Price, 2003; Somnasang *et al.*, 1998). Northeast Thai women and girls are also said to be more likely to identify correctly wild food plants than men and boys (Somnasang, 1996). During the focus group discussions (FGDs), gathering of WSWFPs were reported to be the main work of the women and girls, and as such they would tend to interact more with their natural environment and hence know many different kinds of WSWFPs. Women also tend to learn at an early age before they get married how to find and use WSWFPs. Their teachers are usually their mothers, grandmothers and fellow village women.

4.6.3 Main parts of WSWFPs consumed and consumption patterns

Fresh leaves and shoots, and fruits were the most reported plant parts consumed by households in the study area. The preference of fresh leaves and shoots to other plant parts could be due to the fact that they are frequently harvested in relatively large quantity, prepared, and eaten often by the entire household members. Meanwhile, the preference for fruits to other plant parts could be attributed mainly to their consumption pattern. Most fruits are often eaten raw as snacks for instance between meals, while collecting firewood or herding. Elsewhere, Reddy *et al.* (2007) also reported leaves and fruits as the predominantly consumed parts of the WSWFPs collected by indigenous people in Andhra Pradesh state of India. Termote *et al.*

(2008) in their ethnobotanical research on the use and socio-economic value of wild edible plants by the Turumbu people, of Tshopo district in DR Congo, reported a higher preference of fruits and leaves to other plant parts.

In the present study, WSWFPs were largely consumed as the main sauce and side dishes after cooking, raw as a snack, and as condiments (spices) or appetizers. Consumption of these plants as wine and porridge component, juice (beverages), raw in salads, potash salt in other foods and as relishes were infrequent. Similar pattern of consumption of WSWFPs were also reported by Della *et al.* (2006) and Dogan *et al.* (2004) in Western and Central Anatolia (Turkey), and Paphos and Larnaca countryside of Cyprus respectively. The current consumption of WSWFPs as main meal (sauce) in Bunyoro-Kitara Kingdom reflects the growing importance of these plants in the household diet of the people. This pattern of consumption was uncommon in the past (Bukenya-Ziraba, 1996) because these WSWFPs were consumed mainly as side dishes or as snacks. But due to recent food crisis caused by recurrent cycles of drought leading to failure of conventional foods crops in this Kingdom as in most part of Uganda, many households have switched to consuming WSWFPs as main sauce (meal). One respondent had this to say "*I had never depended on wild food plants as main meal but because of the severe food shortage due to the yearly droughts, I now eat wild foods as the main meal. It is a shame to me but at least I am not alone*".

4.6.4 Main consumers and gatherers of WSWFPs in the Kingdom

Earlier reports (Goode, 1989) opined women, elderly people, and children as the main consumers of the WSWFPs in Uganda. In contrast, the present study indicates that the WSWFPs are now largely being consumed by entire household members- a practice that underscores the importance of these plants in household diet. This shift from women and children as the main consumers of WSWFPs in past to the entire household members today is perhaps due to the frequent severe food shortages being experience in most part of Kingdom, where by the little that is harvested from the wild is shared by the whole household members. It could also be due to the ever-rising food prices in the market beyond the purchasing power of a poor household, leaving them with little choice but to rely on WSWFPs.

In the study area, WSWFPs were gathered almost exclusively by women and children. It is only in rare cases such as when herding animals, producing charcoal, looking for construction materials or in search of other off-farm income generating products from nature that men are involved in the collection of WSWFPs (mainly fruits). Collection of other types of WSWFPs is deemed the work of women except in cases, where the man is living alone in his house. Even so, some of the men (widowers/bachelors) are reluctant to admit that they gather the leafy WSWFPs by themselves for fear of public disgrace. When asked, about who gathers the leafy WSWFPs that they cook and eat, they are often quick to point to women well-wishers and relatives who give them a portion of what they have gathered for their own households. Elsewhere, Vainio-Mattila (2000) reported the collection of wild vegetables as the sole responsibility of women and children among the Sambaa community in the Usambara Mountains of northeastern Tanzania. Similarly, amongst the Dinka (Monjeng) tribe of Northern Bahr el Ghazal in southern Sudan, collection of WSWFPs is reported to be dominated by women and children (Gullick, 1999). In Northern Ethiopia, Barnett (2001) also notes that the collection of WSWFPs is undertaken by the women and children. Roles of women and children as far as gathering of the WSWFPs is concerned, should therefore, not be underestimated.

4.6.5 Growth forms and collection niches of the commonly consumed WSWFPs

Most of the commonly harvested WSWFPs reported in this study were herbs and shrubs. Trees, vines (climbers), and graminoid were few. The high reliance on herbaceous and shrubby WSWFPs could perhaps be related to their diversities in the local environment. Most of them were reported to be growing on-farms as weeds and therefore are easily encountered by the gatherers especially when going about with the routine farm activities. This finding concurs with Rashid *et al.* (2008) who noted that the Gujjar tribe of Rajouri in Jammu and Kashmir State of India make use of mostly wild herbs for food, followed by trees, shrubs and climbers in descending order. According to Wehmeyer *et al.* (1969) and Wehmeyer and Rose (1983), the preference of wild herbaceous edible plants by local communities to other growth forms could be related to their highly perceived nutrient and vitamin values.

The present finding, revealed that WSWFPs are collected from a variety of habitats including the forests gaps and margins, grasslands, bushlands (woodlands), wetlands, roadsides (footpaths), and around kraals (animal enclosures) mainly by women and children while going about other chores like searching for firewood and fetching water from the village wells. Other WSWFPs, especially those that are weedy in nature were gathered mainly from homegardens, cultivated or abandoned farmlands, wastelands and farm borders. This is in agreement with Heywood (1999) and Agea *et al* (2007) who noted that non-cultivated plants grow spontaneously in self-maintaining populations in many natural and semi-natural ecosystems and that they can even exist independently of human action. Elsewhere, Reddy *et al.* (2007) reported that wild food plants in Andhra Pradesh state of India are often gathered by women from the forests and along the way to forests. Vainio-Mattila (2000) also found that wild green leafy vegetables consumed by the Sambaa people in Tanzania, most of which were ruderal and weedy were growing by the roadsides and on arable land. In addition, Woodcock (1995) indicated that in Eastern Usambara of Tanzania, wild food plants were collected by village communities from forests, bushlands, secondary forests, and fallow shambas. Similarly, Wilken (1970) reported that farmers in Mexico, who sell their domesticated produce, rely on wild food plants foraged from disturbed environments for their own survival.

4.6.6 Contribution of the WSWFPs to household diet

4.6.6.1 Mean per capita harvest WSWFPs

WSWFPs constitute a major proportion of the household diet of the local people in Bunyoro-Kitara Kingdom. On a per person basis, estimates from this study show that harvests varied substantially by species, as high as 31.59 g day^{-1} in *Amaranthus dubius* to about 0.04 g day^{-1} as in *Lantana camara*. The high per capita harvest of most WSWFPs that were reported reflects their importance in the local household economy. Findings from the market survey revealed that most of the WSWFPs with high mean per caipta harvests are those that are commonly marketed within the study area (see Chapter 6). The marketability potential coupled with a combination of other factors such as perceived relative availability, nutritional benefits, medicinal attributes, and taste appreciation partly explain their high per capita harvests. Misra *et al.* (2008) noted that wild food plants frequently harvested in large volumes by the inhabitants of Nanda Devi Biosphere Reserve, India were those that besides, their palatability, medicinal values and abundance in the local environment, have high market values.

Findings also indicated that some households gave out part of their wild harvests or received from other households. Sharing part of the harvest with other households or neighbours is perceived as a form of social capital and a local survival strategy. One key informant summarised this survival strategy of sharing part of their harvests with neighbouring households as "*scratch my back and I will scratch yours too*". Sharing part of the harvests is not recognised as a social norm but central as a coping mechanism in times of food insecurity. Elsewhere, food sharing between households has been reported. For instance, Harrigan and Changath (1998) reported the intra-household food sharing among the Dinkas of Sothern Sudan. Here, food sharing was regarded as a social norm and households who do not share part of their harvest with neighbours were often branded as 'kor' ('selfish like a lion'). A notion that like lions, people who eat alone give nothing to others, should expect nothing from other households (Mandalazi and Guerrero, 2008).

4.6.6.2 Mean per capita use (consumption) of WSWFPs

The present study indicates that WSWFPs play a significant role in household diet. For example, mean per capita consumption of *Hyptis spicigera*, *Borassus aethiopum* and *Dioscorea minutiflora* were higher than the reported vegetable and fruit per capita consumption of 79.45 g day^{-1} in sub Saharan Africa, although much lower than the world average of 205.48 g consumed per person per day (Ruel *et al.,* 2005). But generally the mean per capita consumption of WSWFPs estimated in this study is comparable with the estimated per capita consumption of African leafy vegetables in Uganda and other African nations. For instance, in Senegal and Burkina Faso, available estimated per capita consumption of leafy vegetables is 80 g of fresh leaves per day (Dalziel, 1937), while in Mauritania estimates are 65 g day^{-1} in urban areas and 16 g day^{-1} in rural areas (Frankenberger *et al.*, 1989). In Uganda, a survey by the Home Economics Department at Bukalasa Agricultural College indicated that average consumption of traditional vegetables was 160 g per head per day during the rainy season when green leafy vegetables are abundant (Goode, 1989). However, a survey of consumption in urban areas of Uganda, especially among the urban poor, indicated the per capita consumption of 12 g day^{-1} (Grant 1957), indicating that a large proportion of the population probably does not consume adequate amounts of vegetables. Oguntona (1998) reported a mean per capita consumption of 65 g day^{-1} in western Nigeria while in southeastern Nigeria, Hart *et al.* (2005) reported adult per capita consumption of 59-130 g day^{-1}.

4.6.6.3 Availability calendar and monthly dependency on WSWFPs

Most of the households in the study area were found to depend heavily on WSWFPs for most part of the year. During the FGDs, it was suggested that WSWFPs are mainly consumed during dry seasons and early in the cropping (rainy) seasons, when cultivated food resources are least available. Thus, it is possible to claim that the WSWFPs are often used as a substitute for cultivated species during the lean period of the year. Woodcock (1995) also reported heavy reliance on wild foods by local communities for most part of the year from two case studies conducted in East Usambaras, Tanzania. He attributed heavy reliance on wild food plant resources to lack of access to alternative food sources to the village communities at certain periods of the year.

During FGDs, it was apparent that most of the gathered WSWFPs are almost available throughout the year with exception of some few plants that are gathered mostly in the rainy and dry seasons. Although recently, rainfall is very infrequent in the area, its bimodal patterns with peaks around March-May and August-November could partly account for the almost year-round availability of most of the WSWFPs gathered in the study area. While cultivated food crops are in short supply during the beginning of the rains, many WSWFPs produce leaves and flowers at the onset of the rainy season, the annual 'hungry period' (Harris and Mohammed, 2003) when food granaries are running low and the harvest of the next crop is a long way off, making it possible for households to continuously access leafy vegetables (Mertz *et al.*, 2001).

There were suggestions from FGDs that the year-round availability of most WSWFPs in the study areas could be related to their drought tolerance habits. These suggestions concurs with Dzerefos *et al.* (1995), who reported that some wild foods plants such as *Corchorus tridens* are more drought tolerant compared to staple food crops. Similarly, Freiberger *et al.* (1998) reported that, most gathered wild food plants are often drought-resistant, providing a buffer against famine as well as supplying calories and nutrients during the dry season and the time before harvest when granaries may have become depleted of staple foods. In a nutshell, the consumption of WSWFPs could be a necessary part of the strategies adopted by poor households in order to survive in a harsh and sometimes unforgiving environment.

4.6.7 Cultural significances of commonly consumed WSWFPs

Cultural food significances indices (CFSI) help to show the cultural importance of WSWFPs in a given locality. The present study therefore, has been able to classify using CFSI, important WSWFPs gathered and consumed by local communities in Bunyoro-Kitara Kingdom. Simple qualitative ethnobotanical data, such as lists of plants consumed, may not generally be able to clarify the cultural role played by a given species within a particular area (Pieroni, 2001). Moreover, bias or personal interpretations, sometimes even suggestion, may occur while conducting qualitative field studies. On the other hand, consensus use indices, which have been frequently and successfully applied in inter-cultural ethnobotanical studies on medicinal plants (Heinrich *et al.*, 1998), do not permit a good investigation of the complex phenomenon of the consumption of edible plants (Pieroni, 2001). At times, certain WSWFPs may present very low quotation, availability, the plant parts use, multifunctional food use, and frequency of use indices, but are nevertheless appreciated for their taste (as in the present study for example *Vangueria apiculata*, *Annona senegalensis*, *Aframomum alboviolaceum*, *Aframomum angustifolium*, *Ximenia Americana*, *Canarium schweinfurthii* and *Hyptis spicigera*) or medicinal values (as in the cases of *Solanum anguivi, Hyptis spicigera*, *Mondia whitei* and *Abrus precatorius*). In these cases, the application of consensus use analysis would underestimate the value of these WSWFPs.

In the present study, consumption of most WSWFPs was found to be culturally important. However, with exception of few WSWFPs whose fruits were edible such as *Solanum lycopersicum* and *Capsicum frutescens*; and those whose rhizomes (roots) are chewed as in the case of *Imperata cylindrica*, very high to moderate CFSI values generally occurred for WSWFPs that are predominantly harvested and consumed as leafy vegetables. WSWFPs that are consumed predominantly as fruits, seeds and roots seem to play a subordinate cultural role. This finding agrees with Pieroni (2001) who reported higher CFSI values for 'wild greens' than the wild fruits in northwestern Tuscany region of Italy. According to (Johns, 1999), 'wild greens' or wild edible vegetables represent an important diet source of phytoceuticals that support the nutritional need to balance the traditional diet, which in Bunyoro- Kitara Kingdom, is rich in carbohydrates (maize, finger millet, cassava, rice, sorghum, yams, sweet potatoes and bananas) and proteins (beans, peas, and cowpeas), but relatively poor in minerals and vitamins.

The popularity of the WSWFPs (mainly consumed as leafy vegetables) with very high to moderate CFSI values and at the same time, the limited role played by WSWFPs with generally low CFSI values (mainly fruits), could also be explained by relative high quotation, availability, the plant parts use and multifunctional food use indices for the former. In addition, many of WSWFPs that are predominantly gathered and consumed as leafy vegetables were reported during the FGDs to taste bitter (e.g. *Vernonia amygdalina*) but their taste appreciation were also never very low. Pieroni (2001) opined that elderly people often tend to appreciate their bitter taste, and automatically attribute it to a medicinal role, even if its health role is not specific. There is therefore, need to popularize the management of WSWFPs with high cultural significance values or those that are highly appreciated for certain attributes such as taste, nutritional and medicinal importance among the local community in the study area.

4.6.8 Local perceptions and social implications of consumption of WSWFPs

The findings from the present study indicated that most people perceive WSWFPs are as medicinal and nutritious. One woman said *"Wild food plants are very useful; some like 'Kibirizi' (Vernonia amygdalina) and 'Gwanya' (Hibiscus acetosella) are* *medicinal, and also nutritious and tasty if well prepared".* This perception is supported by Green (1993) who reported that wild plants are good sources of minerals, fibre, vitamins and essential fatty acids, and enhance taste and colour of staple foods. Beyond their recognition as medicinal and nutritious, WSWFPs were perceived to have 'hidden' income-generating potentials, which in some households were reported as representing a significant source of income.

Some respondents also noted that WSWFPs often increase food choices available to households and indeed also complement food intake throughout the year. This assertion is clearly validated by many respondents who said their households consumed WSWFPs as main meals and side dishes, in addition to cases where they mixed WSWFPs and cook together with staple or other speciality dishes notably fish and beef. Gullick (1999) reported that wild foods enhance food texture and palatability. Addition of mucilaginous leaves of some WSWFPs such as *Corchorus trilocularis*, *Corchorus tridens* and *Crotalaria ochroleuca* to staple food gives the food a slimy texture, which is believed to aid ingestion of accompanying foods.

Some WSWFPs were perceived as emergency foods and supplementary food sources. In fact, it is a common understanding in the study locality that WSWFPs can play a crucial role in supplying essential nutrients, especially during times of acute and chronic food shortages as well as on routine diet supplementary basis. It is common for poor households to depend on WSWFPs between harvests, when harvested and stored stocks have been depleted, and before new crops are mature. Elsewhere, wild edible plants are reported as vital insurance against malnutrition or famine during times of seasonal food shortage and emergencies such as droughts, floods or wars (Irvine, 1952; Campbell, 1986; Falconer, 1990 and Tardío *et al.*, 2005). The current finding is therefore, not surprising because of the frequent and recurrent drought that have resulted into food crisis in the study area just like in other parts of Uganda.

Perceptions by some respondents that certain WSWFPs are weedy and problematic in the gardens cannot be contested. Many studies (e.g. Zmarlicki *et al.*, 1984; Altieri *et al.*, 1987; Grivetti, 1987; Mergen, 1987; Brandoa and Zurlo, 1988; Sharland, 1989) have reported that a range of wild plants grow in agricultural fields as weeds also represent potential food. However, as noted by Scoones *et al.* (1992), the perception of whether these plants are weeds (potential competitors with the major crop), depends on the observer. To many agronomists anything apart from the major crop itself is regarded as a weed and yet many plants deemed weedy may have a variety of uses to local people.

The opinion that some WSWFPs are toxic, harmful, and that they could be fatal if adequate care is not taken in their preparation before consumption have also been reported elsewhere (e.g. Coursey, 1967; Guil *et al.,* 1997). Toxicity and harmfulness of some WSWFPs as perceived by the respondents are often due to the presence in these plants of anti-nutritional and toxic factors such oxalic acid, nitrate, erucic acid, phytic acid and alkaloids (Guil *et al.,* 1997). For example wild yams whose tubers are liked by some respondents in the present study contain dioscorine, a toxic alkaloid (Webster *et al.,* 1984; David and Michael, 1985), which triggers the fatal paralysis of the nervous system when a fragment of the tuber weighing about 100 g is ingested without adequate procedural preparation (Coursey, 1967). This confirms the claims of respondents who said that over consumption of wild yams often causes headache and stomach-ache.

4.7 Conclusions

Sixty (62) WSWFPs belonging to 31 botanical families were reported as being consumed in the study area. Most of these WSWFPs comprise a major part of the dietary intake of poor households for most part of the year (7 to 9 months). Many are almost available throughout the year for gathering, with exception of few that are gathered mainly in the rainy or dry seasons. The findings also showed that local knowledge of WSWFPs increased with age of the respondents. Younger people have somewhat little local knowledge of WSWFPs than their elderly counterparts. Irrespective of their ages, women on average knew and reported more WSWFPs than their male counterparts.

Fresh leaves and shoots, and fruits were the most predominantly consumed plant parts in the study area. Most WSWFPs were largely consumed as main sauce and side dishes after cooking, raw as snacks, and as condiments (spices or appetizers).

Their consumption as wine and porridge component, juices/beverages, raw in salads, potash salts in other foods and as relishes were infrequent.

Unlike in the past where WSWFPs were consumed mainly by women, elderly persons, and children in Uganda; findings from the present study indicated, these plants are largely now consumed by entire household members in Bunyoro-Kitara Kingdom. Their gathering was found to be almost exclusively by women and children. Men only occasionally collected wild fruits.

Most of the WSWFPs were predominantly herbs and shrubs. Trees, vines (climbers), and graminoid were few. They were collected from a variety of habitats including the forests gaps and margins, grasslands, bushlands (woodlands), wetlands, roadsides (footpaths), around kraals (animal enclosures), homegardens, cultivated or abandoned farmlands, wastelands and farm borders.

On a per person basis, current estimates suggests that harvests of WSWFPs vary substantially by species, as high as 31.59 g day^{-1} in *Amaranthus dubius* to about 0.04 g day^{-1} as in *Lantana camara*. Mean per capita consumption of some WSWFPs such as *Hyptis spicigera*, *Borassus aethiopum* and *Dioscorea minutiflora* were higher than the reported vegetable and fruit per capita consumption of 79.45 g day^{-1} in sub Saharan Africa.

The bulk of WSWFPs had very high to moderate cultural food significance indices (CFSI) values. Most people perceived WSWFPs as medicinal, nutritious, sources of income; emergency and supplementary foods. Others perceived some WSWFPs as weedy and problematic in the gardens; toxic, harmful, and/or fatal if adequate care is not taken in their preparation before consumption.

CHAPTER 5

HARVESTING, PREPARATION AND PRESERVATION OF COMMONLY CONSUMED WILD AND SEMI-WILD FOOD PLANTS IN BUNYORO-KITARA KINGDOM, UGANDA

5.1 Introduction

From time immemorial, millions of people dwelling in the rural areas of tropical countries have continued to depend on gathering, processing, and utilisation of Wild and semi-wild food plants (WSWFPs) for food, income, and other livelihood security options. Studies have shown that households gathering WSWFPs can avoid hunger, boost rural employment and generate income (Mithofer, 2004), through processing and value addition (Saka *et al*, 2004). Most of the WSWFPs utilized by local peoples require some sort of processing before they are eaten. Processing of WSWFPs is therefore, a critical factor in the promotion of their production, consumption, and conservation. Calls have been made for programs aimed at promoting the use of WSWFPs to always involve an exploration of local methods of processing (preparing) these categories of food plants into a palatable meal (Tabuti *et al.,* 2004).

Indigenous knowledge on food processing, food preservation and shelf life represents an important basis to utilise WSWFPs and to improve food security, nutrition, and livelihood. Rural people, notably women, hold enormous, yet neglected knowledge on food processing and preservation techniques (Eyzaguirre *et al.,* 1999). For example, Jackson (1991) reported that rural women in California have rich knowledge of processing acorns from oak trees before consumption- a process that entails cracking the acorns, pounding, sifting, leaching, and cooking. Similarly Zimmerman (1991) reported that rural folks in central and northern California know very well that *Arctostaphylos manzanita* berries must be pounded before cooking. Eyzaguirre *et al.* (1999) also pointed out that home garden crops and wild food plants are often linked to extensive indigenous knowledge around food processing and preservation. The local knowledge about processing and preservation of WSWFPs therefore, deserves recognition, support, and improvement.

Documentation of local practices pertaining to the processing and preservation of traditional food plants (WSWFPs) has been reported to be a gateway to simple and affordable technology development (Rubaihayo *et al.*, 2003) that could improve local practices through well targeted technical support. For instance, in the case of indigenous fruits, documentation of local methods of their preparation, preservation and value addition have been reported to facilitate their domestication, consumption and commercialisation (Dietz, 1999; Kwesiga *et al.*, 2000; Saka *et al.*, 2002; Schomburg *et al.*, 2002). However, Singh and Roy (1984) noted that there is wide neglect of the values of WSWFPs because little information is documented about their traditional preparations and value addition practices.

In the case of Uganda, Tabuti *et al.* (2004) reported under-utilisation of WSWFPs due to lack of knowledge on appropriate post-harvest processing technologies. Although different communities may have their own traditional methods for processing (preparing) of WSWFPs, there has been limited documentation of such information (Tabuti *et al.*, 2004). In addition, the promotion of exotic foods has shrouded the value of WSWFPs, which may ultimately threaten the continued existence of local knowledge pertaining to preparation and preservation of WSWFPs (Tabuti *et al.*, 2004). This study was therefore, aimed at exploring the local methods of harvesting, preparation and preservation of the commonly consumed WSWFPs in Bunyoro-Kitara Kingdom, Uganda as a way of promoting their use for improved livelihood of the local people.

5.2 Objectives

5.2.1 Overall objectives

The overall objective was to improve the understanding of the use of WSWFPs by exploring and documenting local methods on their harvesting, preparation and preservation in Bunyoro-Kitara Kingdom, Uganda.

5.2.2 Specific objectives

i. Document common methods of harvesting WSWFPs that are regularly consumed in the Kingdom.
ii. Explore local processes of preparation of the commonly consumed WSWFPs in the area.
iii. To document local preservation techniques and shelf life of popularly consumed WSWFPs in the area.

5.3 Research questions

The following questions were explored:

How are the commonly consumed WSWFPs harvested, and prepared by the local people? How are the gathered WSWFPs preserved by the local people? How long do they preserve the gathered WSWFPs before they start to get bad (shelf-lives)?

5.4 Methods of data collection

The study was conducted in Mutunda and Kiryandongo sub-counties of Kibanda County in Bunyoro-Kitara Kingdom. Eight (8) in-depth focus group discussions (FGDs) using a checklist (Appendix III) were conducted with key informants drawn from the two sub-counties. Data collected during these FGDs sessions included common methods of harvesting WSWFPs that are regularly consumed in the Kingdom, preparation processes and preservation methods of the commonly consumed WSWFPs. Local knowledge on shelf-life of the freshly harvested and/or preserved WSWFPs (how long they are stored) were also sought during the discussions. Group scoring were also conducted using dry lima beans to assess the relative importance of the local methods of harvesting WSWFPs and local preservation methods.The helpful question and phrases (Appendix V) adapted from Krueger (1994) in Henn *et al.* (2006) were used during these discussions. Plate 5.1 depicts one of the FGD sessions held in Kiryandongo sub-county.

Participants for the FGDS were selected purposively based on the experience and knowledge they have in the preparation and preservation of WSWFPs in the area.

The starting points of their selection were community meetings that were held in the two sub-counties. Most research endeavours based on FGDs rely on purposive sampling (Miles and Huberman, 1994), with researchers selecting participants based on the potential contributions that they would make. Notes were made while the FGDs were going on in order to capture as much information as possible. Close attention was paid to what participants said, how they said it as well as their body language. After each FGDs session, preliminary notes captured in flipcharts were reviewed in participatory manner, to validate them and to make any additions where possible (Miles and Huberman, 1994; Kitzinger and Barbour, 1999). Some important quotable statements were also captured during the FGDs. According to Corden and Sainsbury (2006), quoted words and phrases from research participants are common features of qualitative research reports. Quotes are used to support research claims and findings, illustrate ideas, illuminate experience, and evoke emotion (Beck, 1993; Long and Godfrey, 2004; Sandelowski, 2007).

Plate 5.1 One of the FGDs sessions in Kiryandongo sub-county.

5.5 Data analysis

Analysis of data from FGDs often involved three major approaches: content analysis, coding, and analytical comparisons (Miles and Huberman, 1994). The basic task of content analysis was to reduce words, transcripts of interviews and discussions to themes or concepts that have meaning to questions being explored. All information given by participants were objectively analysed for relevance (Strauss and Corbin, 1990). Coding was aimed at reviewing set of field notes and transcribes in order to dissect them meaningfully, while keeping the relations between the parts intact (Miles and Huberman, 1994). Coding systems involves three main categories: open, axial, and selective coding. In this study, only open and axial coding sytems were used. Open coding facilitated the development of categories of themes emerging from data while axial coding assisted in building connections within categories (Miles and Huberman, 1994). After each focus group session, recorded notes were reviewed and re-evaluated for their truthfulness and to identify the recurrent ideas that came out during the discussions. Tape recorded sessions of the group discussions were played and listened to again. Outcomes of discussions were grouped according to key themes (topics). Key statements and ideas expressed for each topic explored in the discussion were identified and different positions that emerged under each key theme were summarised. A systematic comparison was made on the emerging themes and positions (Neuman, 1994) to identify the common ideas. Verbatim phrases that represent each position/theme were pulled out. A full report of the discussion which reflected the outcome of the discussions as completely as possible were later prepared, using the participants' own words. Where there were scoring exercises, mean scores were computed.

5.6 Results

5.6.1 Methods of harvesting popularly consumed WSWFPs

Gathering of WSWFPs involve various harvesting techniques (Table 5.1). The techniques, which are determined to a great extent by the plant parts that are collected (Table 5.2) included hand plucking of edible parts such as the leaves, shoots, fruits, pods and flowers from the plant; picking or collecting from the ground floor naturally fallen fruits due to the influence of winds (storms) and rainfall; up-rooting by hand pulling the whole plant; cutting off the tender top parts of the stem bearing edible parts (leaves, shoots and fruits); digging out the tubers and roots, knocking down fruits from the branches or the crown of trees/shrubs with short sticks, stones or any other solid throwable objects; climbing and careful shaking of tree or shrub branches to dislodge the fruits.

Table 5.1 Relative importance of the local methods of harvesting WSWFPs.

Local harvesting methods	Scores from FGDs held in three parishes			
	Dii	Kic	Kit	Mean (±SEM) score*
Plucking of edible plant parts such as the leaves, shoots, fruits, pods and flowers.	15	13	10	12.7 (1.5)
Climbing and careful shaking of tree or shrub branches to dislodge the fruits.	6	8	5	6.3 (0.9)
Cutting off the tender top parts of the stem bearing edible parts (leaves, shoots and fruits).	3	6	8	5.7 (1.5)
Picking or collecting from the ground floor naturally fallen fruits.	5	6	4	5.0 (0.6)
Up-rooting by hand pulling the whole plant.	5	3	5	4.3 (0.7)
Shooting (knocking) down fruits from branches/crown of trees/shrubs with sticks, stones or any other throwable objects.	4	3	4	3.7 (0.3)
Digging for the tubers and roots.	2	1	4	2.3 (0.9)

Dii: Diima, Kic: Kichwabugingo, Kit: Kitwara.*High scores imply the relative importance of the harvesting method. Scores were made using 40 dry lima bean seeds in three focus group discussions.

Table 5.2 Methods of harvesting popularly consumed WSWFPs.

WSWFPs	Methods of harvesting
Abrus precatorius L.	Plucking the leaves and shoots.
Acalypha bipartita Müll. Arg.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Aframomum alboviolaceum (Ridley) K.Schum	Plucking the fruits.
Aframomum angustifolium (Sonnerat) K.Schum.	Plucking the ripe fruits.
Amaranthus dubius Mart. *ex* Thell.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Amaranthus graecizans L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Amaranthus lividus L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Amaranthus spinosus L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Ampelocissus Africana (Lour.) Merr.	Plucking ripe fruits, cutting the stem for leaves.
Annona senegalensis Pers.	Climbing and plucking the ripe fruits.
Asystasia gangetica (L.) T.Anders.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Asystasia mysorensis (Roth) T.Anders.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Basella alba L.	Plucking the leaves from the vines.
Bidens pilosa L.	Up-rooting the whole plant.
Borassus aethiopum Mart.	Picking the ripe fallen fruits.
Canarium schweinfurthii Engl.	Picking the ripe fallen fruits, climbing and shaking for ripe fruits.
Capsicum frutescens L.	Plucking the leaves, picking the ripe fruits, cutting the stems bearing ripe fruits.
Carissa edulis (Forssk.) Vahl	Plucking the ripe fruits.
Cleome gynandra L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Cleome hirta (Klotzsch) Oliv.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Corchorus tridens L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Corchorus trilocularis L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Crassocephalum crepidioides (Benth.) S.Moore	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Crotalaria ochroleuca G.Don	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Cymbopogon citratus (DC.) Stapf	Cutting the leaves.
Dioscorea minutiflora Engl.	Digging for the tubers.
Erucastrum arabicum Fisch. & C.A.Mey.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Ficus sur Forssk.	Climbing and plucking the ripe fruits.
Garcinia buchananii Bak.	Climbing and plucking the ripe fruits, shooting the ripe fruits with sticks.
Hibiscus acetosella Welw. *ex* Hiern	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Hibiscus sabdariffa L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.

Hyptis spicigera Lam.	Cutting the stem of plant bearing seeds, plucking leaves and flowers.
Imperata cylindrical (L.) Raeuschel	Up-rooting the whole plant for its rhizomes.
Ipomoea eriocarpa R.Br.	Up-rooting the whole plant and plucking the leaves later.
Lantana camara L.	Plucking the ripe fruits.
Mondia whitei (Hook.f.) Skeels	Digging for the roots.
Ocimum gratissimum L.	Plucking the leaves from the plant.
Oxalis corniculata L.	Up-rooting the whole plant.
Oxalis latifolia Kunth	Up-rooting the whole plant.
Oxygonum sinuatum Hochst. & Steud. *ex* Meisn.) Dammer	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Phaseolus lunatus L.	Plucking leaves, pods or flowers.
Phoenix reclinata Jacq.	Cutting the ripening clusters of fruits.
Physalis peruviana L.	Plucking/picking ripe fruits.
Rhus pyroides var. pyroides Burch.	Bending the branches and plucking the fruits.
Rubus pinnatus Willd.	Plucking the ripe fruits.
Senna obtusifolia (L.) Irwin & Barneby	Plucking the tender leaves and shoots.
Sesamum calycinum Welw.	Plucking the leaves, cutting the stem bearing leaves.
Sida alba L.	Plucking the young leaves.
Solanum anguivi Lam.	Plucking unripe fruits from the plant.
Solanum lycopersicum L.	Plucking the fruits.
Solanum macrocarpon L.	Plucking unripe fruits or leaves.
Solanum nigrum L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Sonchus oleraceus L.	Plucking tender leaves and shoots, cutting stem bearing leaves or up-rooting the whole plant.
Tamarindus indica L.	Climbing and plucking the ripe fruits, knocking the fruits using throwable objects (e.g. stones and sticks).
Tristemma mauritianum J.F.Gmel.	Plucking the young leaves/shoots and fruits.
Urtica massaica Mildbr.	Cutting the stem bearing leaves and shoots.
Vangueria apiculata K.Schum.	Climbing and plucking ripe fruits.
Vernonia amygdalina Del.	Plucking the young leaves.
Vigna unguiculata (L.) Walp.	Plucking the young leaves and shoots.
Vitex doniana Sweet.	Climbing and shaking for ripe fruits, picking fallen fruits from the ground, knocking the fruits using throwable objects (e.g. stones and sticks).
Ximenia americana L.	Climbing and plucking ripe fruits.

5.6.2 Procedure for preparation of commonly consumed WSWFPS

Because most of the WSWFPs documented in this study area are consumed in different ways, there were varied procedures for their preparation. Figure 5.1 presents the general issues captured from FGDs sessions concerning their preparation process, while Figure 5.2 shows generalised procedural steps for preparation of most WSWFPs in Bunyoro-Kitara Kingdom. For many WSWFPs whose tender leaves and shoots are cooked, some preparation procedures including sorting, wilting, washing, and cutting (chopping) of the plants into small pieces prior to cooking, as well as the cooking time are similar but the actual procedure was dependent on each food plant (Table 5.2). For instance, there was general similarity in the preparation procedures for *Asystasia mysorensis* and *Asystasia gangetica*. In both cases, tender leaves, shoots, and young stems are collected, washed in a dish of water, chopped and boiled for 10-15 minutes. But in the case of *Asystasia gangetica*, 'magadi' (bi-carbonate of soda/rock salt) or potash is added while boiling to soften the leaves. The boiled leaves, shoots, and young stems are then either mixed with groundnut or simsim paste and cooked for additional 2 to 3 minutes or they are added to cooked peas and beans and boiled for extra 3-5 minutes.

Similarly, all members of Amaranthaceace family reported in this study (*Amaranthus dubius*, *Amaranthus graecizans*, *Amaranthus hybridus* subsp. *cruentus*, *Amaranthus lividus*, and *Amaranthus spinosus*) had common methods of preparation whereby young leaves and shoots were collected, sorted, chopped into small pieces, washed in a dish of water and boiled for 7-10 minutes with either tomatoes or onions or both; afterwards groundnut or simsim paste was added, mixed and the mixture cooked for additional 10-15 minutes under low heat. Alternatively, the chopped and washed leaves and shoots were fried with cooking oil with addition of onions, tomatoes, and salt for about 10 minutes before serving. Some times, leaves and shoots are just washed without chopping, wrapped in banana leaves and steamed with boiling 'matooke' (cooking type of plantain banana), cassava or sweet potatoes.

However, some WSWFPs such as *Rhus pyroides var. pyroides*, *Carissa edulis*, *Lantana camara*, *Vangueria apiculata* and *Ximenia americana* were reported to be consumed without any special preparation procedures required. In most cases, ripe fruits are simply plucked from the tree or the shrub and eaten immediately fresh as snacks. For others like *Ficus sur*, the figs are just ripped open, seeds removed and fleshy pulp eaten. In the case of *Physalis peruviana*, the outer papery coverings/wrappings enclosing the ripe fleshy yellow fruits is first removed before the fruits are eaten as snacks or as part of salads (Table 5.3).

Table 5.3 Procedure of preparation of commonly consumed WSWFPS.

WSWFPs	Procedure of preparation of commonly consumed WSWFPS
Asystasia gangetica (L.) T.Anders. *Asystasia mysorensis* (Roth) T. Anders.	Leaves, shoots, and young stems are collected, sorted, washed in a dish of water, chopped and boiled for 10-15 minutes. In the case of *Asystasia gangetica*, 'magadi' salt (bi-carbonate of soda/rock salt) or potash is added while boiling to soften them. Boiled leaves, shoots, and young stems are then either mixed with groundnut or simsim paste and cooked for additional 2-3 minutes or added to cooked peas/beans, and boiled for extra 3-5 minutes. Some times the chopped and washed leaves, shoots, and young stems are added towards the end cooking time (about 10-15 minutes) to beans or peas.
Amaranthus dubius Mart. *ex* Thell. *Amaranthus graecizans* L. *Amaranthus hybridus* subsp. *cruentus* (L.) Thell. *Amaranthus lividus* L. *Amaranthus spinosus* L.	Young leaves and shoots are collected, sorted, chopped into small pieces, washed in a dish of water and boiled for 7-10 minutes with either tomatoes or onions or both. Then groundnut or simsim paste is added, mixed and the mixture cooked for additional 10-15 minutes under low heat. Alternatively, the chopped and washed leaves and shoots are fried with cooking oil with addition of onions, tomatoes, and salt for about 10 minutes before serving. Some times, leaves and shoots are just washed without chopping, wrapped in banana leaves and steamed with boiling 'matooke' (cooking type of banana), cassava or sweet potatoes.
Phaseolus lunatus L. *Vigna unguiculata* (L.) Walp.	Fresh pods of *Phaseolus lunatus* are harvested, shelled and the beans boiled for about 2 hours; then either fried with cooking oil, onions and tomatoes or pasted with groundnuts/simsim and cooked under low heat for another 3-5 minutes. For dry seeds, they are soaked for about 6 hours, seed coat removed, washed for about 3-4 times and boiled with potash or 'magadi' (rock salt) for about 2 hours until its porridge-like (relish). Simsim paste or ghee may be added and served. The fresh young leaves, shoots and flowers are also harvested, wilted in the sun shine for about 5 minutes, chopped, washed and boiled for 15-20 minutes with some potash or rock salt ('magadi') and *Corchorus* spp. Then groundnut/simsim paste is added and the mixture cooked for additional 3-5 minutes under low heat. In the case of *Vigna unguiculata*, the fresh leaves and shoots are pick off the stem, wilted in the sun for about 5 minutes, chopped into small pieces, washed in a plenty of water and boiled with addition of chopped pieces of *Corchorus* spp and potash or rock salt ('magadi') while stirring occasionally for about 20 minutes. Then groundnut/simsim paste is added, and the mixture cooked for additional 3-5 minutes under low heat.
Crotalaria ochroleuca G.Don *Senna obtusifolia* (L.) Irwin & Barneby	Young leaves including flowers of *Crotalaria ochroleuca* are harvested, sorted, wilted in the sun for about 3-5 minutes, washed, chopped into small pieces and boiled with addition of *Corchorus* spp and potash or rock salt ('magadi') for 10-15 minutes. Excess water is drain off and then ghee, groundnut or simsim paste is added, and the mixture cooked for additional 3-5 minutes under low heat. In the case of *Senna obtusifolia*, young leaves are collected, wilted in the sun for about 3-5 minutes, chopped into small pieces, washed and boiled for about 20 minutes. Raw (not roasted) simsim paste is added, and the mixture cooked again for additional 20-30 minutes to make a thicken dish without soup. Alternatively, the leaves are added to boiling beans or peas towards end of cooking time (30-40 minutes). Afterwards ghee, groundnut/simsim paste is added reheated for about 5 minutes under low heat.

Annona senegalensis Pers. *Carissa edulis* (Forssk.) Vahl *Ficus sur* Forssk. *Lantana camara* L. *Physalis peruviana* L. *Rhus pyroides var. pyroides* Burch. *Vangueria apiculata* K.Schum. *Vitex doniana* Sweet *Ximenia americana* L.	No special preparation required before consumption for *Rhus pyroides var. pyroides*, *Carissa edulis*, *Lantana camara*, *Vangueria apiculata* and *Ximenia americana*. Ripe fruits are simply plucked from the tree/shrub and eaten fresh as snacks.. Soiled fruits of *Vitex doniana* collected from the ground are cleaned by water or on the cloth before the fleshy part is eaten. In the case of *Annona senegalensis*, ripe fruits are plucked from the tree and the hard rough coat is removed often using teeth before the inner fleshy part is eaten. The seeds are spewed out of the mouth. For *Ficus sur*, the figs are ripped/cut open, seeds removed and fleshy pulp eaten. The ripe fruits of *Physalis peruviana* are collected, outer papery coverings (wrappings) removed and the fleshy yellow fruits eaten as snacks or part of salads.
Borassus aethiopum Mart. *Canarium schweinfurthii* Engl. *Phoenix reclinata* Jacq.	Ripe yellow fruits of *Borassus aethiopum* are crushed open by hitting it several times against hard objects (mostly a rock outcrop or a stone) or beating them many times using a pestle. The fruit pulp is then either eaten immediately as a snack or mixed with water and used to make porridge, juice or local wine. Meanwhile, the ripe yellow fruits of *Phoenix reclinata* plucked from the fruit clusters are eaten directly as snacks. Seeds are either discarded or collected, dried, cracked open and seed kernels boiled and eaten as a snack. In the case of *Canarium schweinfurthii*, ripe fruits are either eaten immediately or blanched in boiling water for about 2-3 minutes to soften the rind and flesh and then eaten, seeds are discarded. The seeds are discarded or occasionally roasted, cracked open and the kernel eaten.
Aframomum alboviolaceum (Ridley) K.Schum *Aframomum angustifolium* (Sonnerat) K.Schum. *Garcinia buchananii* Bak. *Tamarindus indica* L.	Ripe fruits of *Aframomum* spp. are collected, cracked open often using the teeth and the pulp eaten as a snack with or without seeds. Fruit pulp is occasionally macerated and mixed with water, filtered and added to orange juice, porridge or used as an ingredient for making local wine. The seeds are discarded seeds are dried, grounded and used as condiments/spices for local breads. For *Tamarindus indica*, ripe fruits are collected and fruit coatings removed by hand before fruit pulp is either eaten immediately as snacks or soaked in water to make juice upon addition of sugar or used in the preparation of local bread and porridge. In the case of *Garcinia buchananii*, ripe fruits are harvested, peeled and the pulp eaten as snacks. The discarded seeds are either roasted directly using a pan or wrapped in banana leaves and baked in hot ash and eaten as a snack.
Dioscorea minutiflora Engl. *Imperata cylindrical* (L.) Raeuschel *Mondia whitei* (Hook.f.) Skeels	*Mondia whitei* roots are harvested, washed and the outer cover is chewed as a snack. Alternatively, rootstocks are washed, peeled and dried in the sun, pounded and used as condiments/flavourings for food, juices, teas and porridge. In the case of *Dioscorea minutiflora*, the harvested tubers are cleaned by washing with water and placed in a banana leaf in a pan or a pot and either boiled or steamed with or without peeling for about one hour before serving. The rhizomes of *Imperata cylindrical* are dug or just pulled, cleaned often with leaves or on a cloth and chewed immediately to quench thirst while herding, collecting firewood or coming back from a day's hard farming activities away from home.

Cymbopogon citrates (DC.) Stapf	Leaves of *Cymbopogon citrates* are cut, tied together in a loop to weigh about 50-100 grams and boiled with tea for about 5-10 minutes. The leaves are also tied in a loop and cooked with food to impart flavour. When the food is ready to be served, the loop is removed and thrown away. The leaves are also harvested and boiled in water for 5-10 minutes to impart flavour in the water. The water is then cooled and used for making juices and local wines.
Abrus precatorius L. *Oxalis corniculata* L. *Oxalis latifolia* Kunth *Rubus pinnatus* Willd. *Tristemma mauritianum* J.F.Gmel.	No special preparation is required for this group of food plants. Leaves of *Abrus precatorius*, *Oxalis corniculata* and *Oxalis latifolia* are plucked and chewed immediately as snacks. Ripe fruits and young leaves/shoots of *Tristemma mauritianum* are also plucked and eaten immediately as a snack; its young leaves/shoots are also mixed with other salads and eaten. In the case of *Rubus pinnatus*, the ripe fruits are picked and eaten mostly as a snack or part of local salad dish.
Bidens pilosa L. *Vernonia amygdalina* Del.	Young leaves of *Vernonia amygdalina* and *Bidens pilosa* are harvested, sorted, wilted for about 5 minutes in the sun, washed, chopped into small pieces, and boiled for 15-20 minutes; after which the water is drained off. Ghee, groundnut or simsim paste may be added, and cooked for additional 3-5 minutes under low heat. The drained water from the boiled leaves is drunk or kept for medicinal use. Leaves of *Bidens pilosa* are alternatively mixed with beans or peas towards the end of cooking time (15-20 minutes). Again ghee, groundnut or simsim paste may be added and the mixture cooked for extra time of about 5 minutes under low heat. Young leaves of *Bidens pilosa* are also boiled in water for about 5 minutes and served as a substitute of tea with little addition of sugar. It is locally nicknamed 'herbal tea'.
Crassocephalum crepidioides (Benth.) S.Moore *Erucastrum arabicum* Fisch. & C.A.Mey. *Sonchus oleraceus* L.	Tender leaves of *Sonchus oleraceus*, are collected, sorted, wilted in sun for much longer time (10-15 minutes) and added to boiling beans or peas towards the end of cooking time (15-20 minutes) to form a thickened or mashed dish. In the case of *Crassocephalum crepidioides*, young leaves and sometimes young stems are collected, sorted, wilted in the sun for about 5 minutes, washed, cut into small pieces and added to cooking beans, peas or meat towards the end of cooking time (15-20 minutes). For *Erucastrum arabicum*, fresh leaves are collected, sorted, wilted for about 5 minutes in the sun, chopped into small pieces, washed and boiled for 10-15 minutes. Afterwards excess water is drained off, little milk, ghee, groundnut or simsim paste is added and the mixture cooked for extra 5-10 minutes under gentle heat.
Basella alba L. *Cleome gynandra* L. *Cleome hirta* (Klotzsch) Oliv.	Tender leaves of *Basella alba* are collected, wilted in the sun shine for 5-10 minutes, washed, chopped and either added to the boiling beans, peas or meat towards to end of the cooking time (10-15 minutes) or boiled separately for about 10 minutes, followed by draining off excess water. Little milk/ghee, groundnut or simsim paste is added and cooked for extra 3-5 minutes under low heat. Alternatively, the tender leaves are washed and wrapped in bananas leaves and steamed with cooking type of plantain banana, cassava, yams or sweet potatoes. In the case of *Cleome gynandra* and *Cleome hirta*, tender stems, leaves and shoots are harvested, sorted, wilted for about 5 minutes in the sun shine, washed, chopped intosmall pieces and boiled for about 1.5 hours. After the water is drain off and ghee, groundnut/simsim paste is added and the mixture is cooked for extra 5-10 minutes under gentle heat. Alternatively, tender stems, leaves and shoots are mixed with *Amaranthus* spp., chopped, washed and fried with cooking oil or ghee, onions and tomatoes for about 20-30 minutes before serving.

Corchorus tridens L. *Corchorus trilocularis* L. *Hibiscus acetosella* Welw. *ex* Hiern *Hibiscus sabdariffa* L. *Sida alba* L.	Tender leaves and shoots of *Hibiscus sabdariffa* and *Hibiscus acetosella* are harvested, sorted, wilted in the sun for about 10 minutes, washed, chopped and boiled for about 5 to 10 minutes. Afterwards, excess water is drained off. Groundnut/simsim paste or the mixture of the two pastes is added, and cooked under low heat for extra 3 to 5 minutes before serving. Alternatively, the wilted, chopped and washed tender leaves and shoots are added to cooking beans/peas often towards of the end of cooking time (20-30 minutes). In the case of *Corchorus trilocularis* and *Corchorus tridens*, young leaves are harvested, sorted, wilted in the sun for about 5 minutes, washed, chopped into small pieces and added to other cooking foods like fresh and smoked meat, fish, peas, beans or other vegetables like *Vigna unguiculata*. Similarly, the tender leaves of *Sida alba* are collected, wilted in the sun for about 5 minutes, chopped into small pieces, washed and added to other cooking foods especially beans, peas and meat towards the end of cooking time (10-20 minutes).
Solanum anguivi Lam. *Solanum macrocarpon* L.	Fruits of *Solanum anguivi* are harvested, washed and either added to other cooking foods such as beans, peas and meat towards the end of cooking time (15-20 minutes) or boiled separately for 15-20 minutes before serving. Alternatively, the fruits are wrapped in banana leaves and steamed for about 30-40 minutes before serving. Similarly, the tender leaves and shoots of *Solanum macrocarpon* are collected, washed, chopped and either wrapped in bananas leaves and steamed for 30-40 minutes before serving or boiled for 15-20 minutes. Alternatively, the leaves are fried with cooking oil or ghee, onions and tomatoes for 10-15 minutes before serving. The fruits of *Solanum macrocarpon* are collected, washed and cut into halves or quarters and either boiled (for 15-20 minutes)/steamed (for 30-40 minutes) before serving or added to boiling beans or peas towards the end of cooking time (15-20 minutes).
Capsicum frutescens L. *Solanum lycopersicum* L. *Solanum nigrum* L.	Tender leaves and shoots of *Solanum nigrum* are harvested, sorted, washed, chopped and either fried with cooking oil/ghee, onions and tomatoes for 10 to 15 minutes or steamed for 30-40 minutes before serving. Alternatively, it is boiled for 20-30 minutes, after which the excess water is drained off and either groundnut or simsim paste is added and the mixture cooked for extra 3-5 minutes under low heat. Occasionally after the leaves and shoots are boiled for 20-30 minutes, it is mixed with boiling beans/peas 5-10 towards the cooking time. The ripe fruits of *Solanum nigrum* are harvested and chewed immediately as snacks. Few fruits of *Capsicum frutescens* are harvested, crushed/chopped and added to either cooking food or served food as spices/appetizer; its tender leaves are harvested, washed and either fried for about 10 minutes or boiled for about 15 minutes before adding groundnut or simsim pastes and cooking for extra 3-5 minutes under low heat. In the case of *Solanum lycopersicum*, fruits are harvested, washed, cut into halves or quarter pieces and either added to other cooking foods often towards the end of cooking time (5 to 10 minutes) or boiled for about 10 minutes and pasted with groundnut/simsim paste. Alternatively, the chopped fruits eaten raw as in salads or are fried for 5 to 10 minutes before serving.

Acalypha bipartite Müll. Arg. *Hyptis spicigera* Lam. *Ipomoea eriocarpa* R.Br. *Ocimum gratissimum* L.	Tender leaves and shoots of *Acalypha bipartite* and *Ipomoea eriocarpa* are collected, sorted, wilted in the sun for 3-5 minutes, washed, chopped and either added to other cooking foods mostly beans, peas and meat often towards the end of the cooking time (20-30 minutes) or boiled separately for 15-20 minutes, after which the excess water is drained off and groundnut or simsim paste is added and the mixture cooked for more 5-10 minutes under low heat. In the case of *Ocimum gratissimum*, young leaves are harvested, sorted, washed and either boiled with tea for about 5 minutes before the tea is served or added to cooking food as flavouring spice. Meanwhile the seeds of *Hyptis spicigera* are harvested, dried properly in the sun, threshed, roasted and pounded using mortar and pestle and used as paste for preparing other foods. Young leaves and flowers of *Hyptis spicigera* are also harvested, wilted in the sun for about 5 minutes, washed, chopped and either fried with cooking oil/ghee for about 10-15 minutes before serving or they are added to other cooking foods mostly beans, peas, fresh or smoked meat towards the end of cooking time (20-30 minutes).
Oxygonum sinuatum (Hochst. & Steud. *ex* Meisn.) Dammer *Sesamum calycinum* Welw.	Young leaves of *Sesamum calycinum* harvested, sorted, washed, chopped and either steamed for 30-40 minutes before serving or added to other cooking foods to thicken the sauce. Alternatively, harvested leaves are dried in the sunshine, grounded into powder, and added to other cooking foods as thickener. Young leaves of *Oxygonum sinuatum* are harvested, sorted, washed chopped, and either added to cooking foods mostly beans and peas towards the end of cooking time (20-30 minutes) or boiled for 10 to 15 minutes before pasting it with groundnut or simsim paste and cooking for extra 5-10 minutes under low heat.
Ampelocissus africana (Lour.) Merr. *Urtica massaica* Mildbr.	Fresh young leaves of *Urtica massaica* are harvested, wilted in the sun shine for about 5 minutes, washed, chopped and added to cooking beans or peas towards the end of cooking time (15-20 minutes) or boiled for 10 to 15 minutes before draining of excess water. Later ghee, milk, groundnut or simsim paste is added and stirred, the mixture cooked for extra 5-10 minutes under low heat. In the case of *Ampelocissus africana*, leaves are collected, washed and boiled for 5-10 minutes before draining off water. Afterward, groundnut/simsim paste is added and the mixture cooked for extra 3-5 minutes under low heat. Ripe fruits of this plant are also harvested and chewed immediately as snacks.

General issues related to preparation of WSWFPs

- Meals usually prepared by women and girls. Men rarely cook. They wait to eat.
- We sort and remove all the foreign bodies and unwanted plant parts like the over mature yellowish leaves before cooking.
- We wash the food well with plenty of water to remove soil particles and dust before cooking.
- We normally chopped vegetables after washing them so that we lose less nutrients in the water.
- We regularly use of oil, ghee, simsim or groundnut pastes in cooking.
- Salt is often added to all foods being cooked to make it tasty.
- Food prepared by frying must be stirred constantly to ensure even cooking and to prevent burning.
- We boil some food first, drain off excess water before mixting with groundnut or simsim paste. The drained water is afterwards to make the mixture lighter. Nutrients are boiled away into the water.
- Steaming food helps keep the flavour and nutrients because the nutrients aren't leached away into the water.
- We always spread harvested leafy WSWFPs in sun to wilt for some few minutes.
- We normally mix and cook more than two WSWFPs together in dishes to get good flavour.
- When frying leafy WSWFPs, we also add tomatoes and onions, and sometimes curry powder. Even those that are boiled first and later mixed with simsim or groundnut pastes, we sometimes add tomatoes.
- We often peel wild yams after cookingto keep the nutrients in.
- For most leafy WSWFPs, we always cook under low heat.
- When you reach a certain age you become more aware of why you should prepare and eat a lot of WSWFPs.

Figure 5.1General issues related to preparation of WSWFPs captured from FGDs.

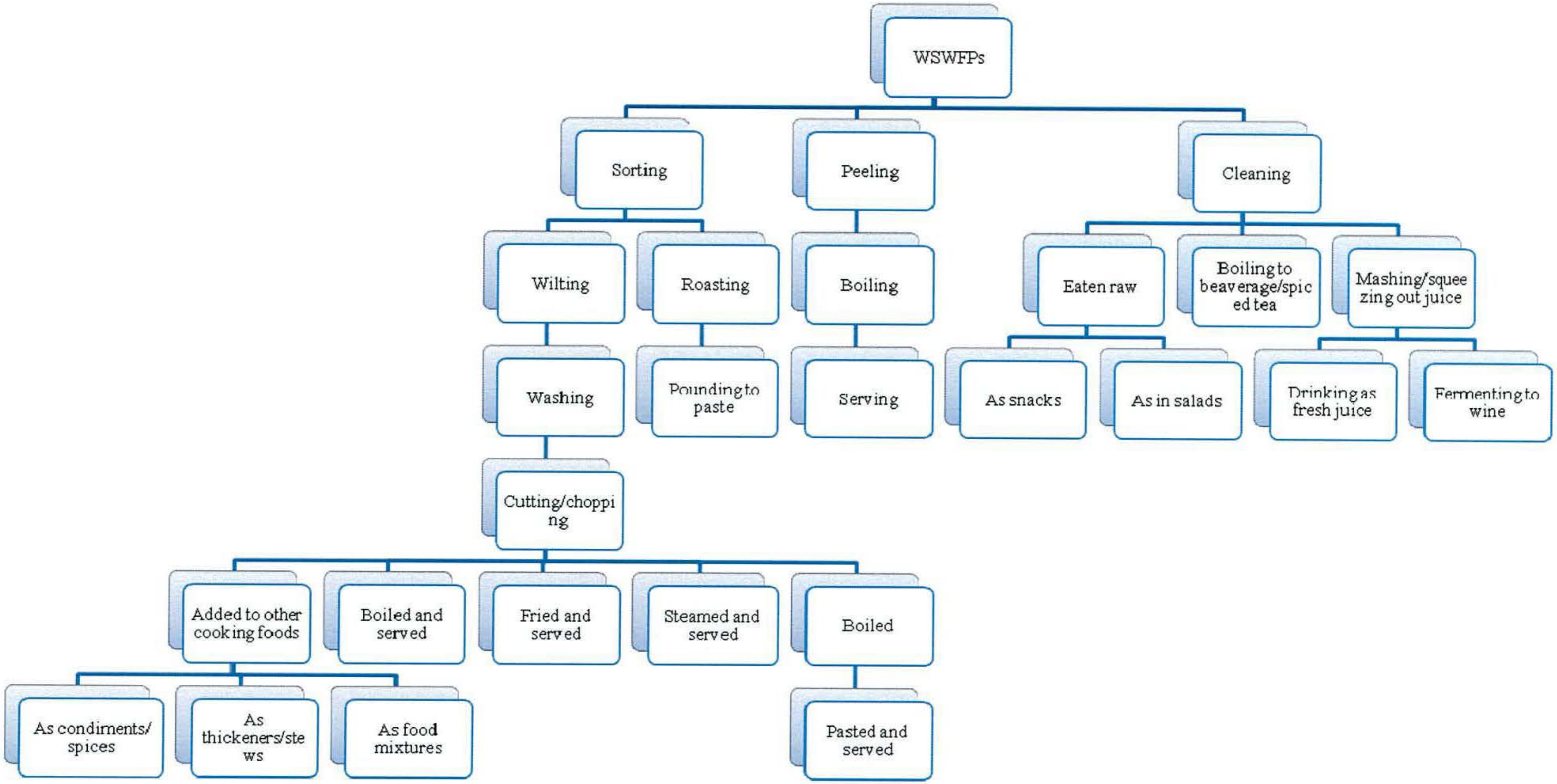


Figure 5.2 Generalised procedures for preparation of commonly consumed WSWFPS in Bunyoro-Kitara Kingdom.

5.6.3 Local preservation techniques of popularly consumed WSWFPs

Eight local preservation techniques were reportedly used to preserve commonly harvested and consumed WSWFPs in the present study. Mean scores from three FGDs indicated that direct sun drying was the major preservation technique for most gathered WSWFPs in the study area (Table 5.4). Other preservation techniques included boiling, parboiling or blanching of the plant materials prior to sun drying; sun drying followed by sprinkling with chilli (*Capsicum frutescens*) powder; smoking in the kitchen roof ceiling over fireplace; keeping the plant material in a moist cool place; wrapping in fresh banana leaves prior to storage; and burying in a moist light soil.

Table 5.4 Relative importance of the local preservation methods

Local preservation methods	Scores from FGDs held in three parishes			
	Dii	Kic	Kit	Mean (±SEM) score*
Direct sun drying	15	17	15	15.7 (0.7)
Boiling/parboiling/blanching prior to sun drying	4	5	3	4.0 (0.6)
Sun drying followed by sprinkling with chilli (*Capsicum frutescens*) powder.	3	2	4	3.0 (0.6)
Sun drying followed by sprinkling with salt (sodium chloride).	3	1	1	1.7 (0.7)
Smoking in the kitchen roof over fireplace.	1	2	2	1.7 (0.3)
Keeping in moist cool/cold place.	2	1	2	1.7 (0.3)
Wrapping in fresh banana leaves and storing.	1	1	2	1.3 (0.3)
Burying in moist sandy soil.	1	1	1	1.0 (0.0)

Dii: Diima, Kic: Kichwabugingo, Kit: Kitwara. *High scores imply the preservation method is popular whereas low scores imply it is less popular. Scores were made using 30 dry lima bean seeds.

The choice of preservation techniques, however, depends on individual WSWFPs (Table 5.5). For instance, ripe fruits of *Canarium schweinfurthii* (mwafu) are gathered washed and boiled in salted water for 5-10 minutes, after which the fruits are cooled and stored in airtight containers in a cool place. In the case of *Cleome gynandra*, leaves are parboiled or blanched in hot water for about 5 to 8 minutes, then dipped in cold water for about 5 minutes before sun drying and pounding the leaves. Other people simply cook the leaves of *Cleome gynandra* by boiling it for about 20-30 minutes, before draining off excess water. The cooked leaves are then mashed to form cakes, which are sun-dried and stored in shielded containers for future use. Plate 5.2 depict boiled and salted mwafu fruits and a mixture of sun-dried leafy WSWFPs. Some WSWFPs such as *Abrus precatorius*, *Acalypha bipartita*, *Ampelocissus africana*, *Annona senegalensis*, *Crassocephalum crepidioides*, *Cymbopogon citratus* and *Vitex doniana* are not preserved.

Plate 5.2 Boiled and salted mwafu fruits and sun dried mixture of leafy WSWFPs.

Table 5.5 Local preservation techniques for popularly consumed WSWFPs

WSWFPs	Local methods of preservation
Abrus precatorius L.	Not preserved and stored.
Acalypha bipartita Müll. Arg.	Not preserved.
Aframomum (Ridley) K.Schum *alboviolaceum*	Ripe fruits are preserved by keeping in a moist cool/cold place.
Aframomum angustifolium (Sonnerat) K.Schum.	Same as with *Aframomum alboviolaceum*
Amaranthus dubius Mart. *ex* Thell.	Sun drying and pounding the leaves and shoots.
Amaranthus graecizans L.	Sun drying and pounding the leaves and shoots.
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	Sun drying and pounding the leaves and shoots.
Amaranthus lividus L.	Sun drying and pounding the leaves and shoots.
Amaranthus spinosus L.	Often not preserved but leaves can also be sun-dried, pounded and kept for future use.
Ampelocissus Africana (Lour.) Merr.	Not preserved and stored.
Annona senegalensis Pers.	Not preserved.
Asystasia gangetica (L.) T.Anders.	Sun drying and pounding the leaves and shoots.
Asystasia mysorensis (Roth) T.Anders.	Not preserved in the past but now, leaves are sun-dried, pounded and kept for future use.
Basella alba L.	Leaves not preserved.
Bidens pilosa L.	Sun drying and pounding the leaves.
Borassus aethiopum Mart.	Fresh ripening fruits preserved by keeping in a moist cold place (often kept outside at night).
Canarium schweinfurthii Engl.	Ripe fruits are boiled in salted water for 5-10 minutes, cooled and stored in airtight containers in a cool place.
Capsicum frutescens L.	Leaves not preserved but fruits are sun dried. Fruits are also smoke-dried by hanging them in the kitchen roof ceiling over the fireplace.
Carissa edulis (Forssk.) Vahl	Fruits neither preserved nor stored.
Cleome gynandra L.	Parboiling or blanching the leaves in hot for about 5 to 8 minutes, then transferring the leaves to cold water for about 5 minutes before sun drying and pounding the leaves. Alternatively, the leaves are cooked for about 20-30 minutes, water drained off and the cooked leaves mashed to form cakes, which are dried in sunshine and stored in shield containers for future use.
Cleome hirta (Klotzsch) Oliv.	Rarely preserved or stored. When preserved the same process as in *Cleome gynandra* is followed.
Corchorus tridens L.	Parboiling leaves and shoots in hot for about for 2-3 minutes, before sun drying and crushing them to powder.
Corchorus trilocularis L.	Preserved in the same ways as with *Corchorus tridens.*
Crassocephalum crepidioides (Benth.) S.Moore	Neither preserved nor stored.
Crotalaria ochroleuca G.Don	Sun drying the leaves and flowers
Cymbopogon citratus (DC.) Stapf	Neither preserved nor stored.
Dioscorea minutiflora Engl.	Fresh tubers buried in a dug hole and covered with sandy soil watered sparingly every day to keep soil moist.
Erucastrum arabicum Fisch. & C.A.Mey.	Neither preserved nor stored.
Ficus sur Forssk.	Fruits (figs) are split open, dried and ground into flour, which are stored or mixed with grain flour for porridge.
Garcinia buchananii Bak.	Fruits not preserved or stored.

Hibiscus acetosella Welw. *ex* Hiern	Sun drying the leaves. Ripe fruits are also sun dried and the seeds threshed out.
Hibiscus sabdariffa L.	Same as with *Hibiscus acetosella.*
Hyptis spicigera Lam.	Sun drying the seeds. Leaves and flowers not preserved.
Imperata cylindrical (L.) Raeuschel	Rhizomes neither preserved nor stored.
Ipomoea eriocarpa R.Br.	Leaves neither preserved nor stored.
Lantana camara L.	Fruits neither preserved nor stored.
Mondia whitei (Hook.f.) Skeels	Peeling and sun drying the fleshy part of the roots, which are then pounded.
Ocimum gratissimum L.	Sun drying and grinding the leaves to powder.
Oxalis corniculata L.	Leaves neither preserved nor stored.
Oxalis latifolia Kunth	Leaves neither preserved nor stored.
Oxygonum sinuatum Hochst. & Steud. *ex* Meisn.) Dammer	Sun drying and grounding the leaves and shoots into powder.
Phaseolus lunatus L.	Fresh seeds are blanched by placing them into boiling water for about 5 minutes, removed and then placed in cold water for 5 to 10 minutes. Mature pods are harvested, dried in sunshine for about 7 days, before shelling and drying seeds for addition 3-5 days.
Phoenix reclinata Jacq.	Not preserved.
Physalis peruviana L.	Ripe fruits are wrapped in fresh banana leaves to preserve them. The leaves act as a coolant.
Rhus pyroides var. pyroides Burch.	Fruits neither preserved nor stored.
Rubus pinnatus Willd.	Fruits neither preserved nor stored.
Senna obtusifolia (L.) Irwin & Barneby	Boiling the leaves for10 to 15 minutes and then sun drying and grounding the boiled leaves.
Sesamum calycinum Welw.	Sun drying and pounding leaves into powder.
Sida alba L.	Neither preserved nor stored.
Solanum anguivi Lam.	Sun drying the fruits.
Solanum lycopersicum L.	Ripe fruits not preserved
Solanum macrocarpon L.	Sun drying the leaves and shoots.
Solanum nigrum L.	Same as with *Solanum macrocarpon.*
Sonchus oleraceus L.	Neither preserved nor stored.
Tamarindus indica L.	Sun drying the fruits.
Tristemma mauritianum J.F.Gmel.	Neither preserved nor stored.
Urtica massaica Mildbr.	Neither preserved nor stored.
Vangueria apiculata K.Schum.	Neither preserved nor stored.
Vernonia amygdalina Del.	Sun drying the harvested leaves
Vigna unguiculata (L.) Walp.	Sun drying and crushing the leaves into smaller pieces.
Vitex doniana Sweet	Ripe fruits not preserved for storage.
Ximenia americana L.	Same as in *Vitex doniana.*

5.6.4 Shelf life of preserved/collected WSWFPs

The shelf life of preserved or freshly harvested WSWFPs was reported to vary from 2 days to about 8 months (Table 5.6). Unpreserved WSWFPs generally had a short shelf life while preserved ones had longer shelf life. For instance, dried leaves of *Amaranthus dubius, Amaranthus graecizans, Amaranthus hybridus* subsp. *cruentus, Amaranthus lividus, Amaranthus spinosus* were said to have shelf life of about six (6) months when kept in shielded containers or pots. Similarly, dried fruits of *Capsicum frutescens* (Plate 5.3) and seeds of *Hyptis spicigera* had the longest reported shelf life of about 8-10 months and 10-12 months, respectively. On the contrary, freshly gathered leaves of *Acalypha bipartite*, can only keep fresh for up to 2 days even after being watered sparingly. Similarly, gathered ripe fruits of *Annona senegalensis* and *Aframomum alboviolaceum* can only keep fresh for up to 3 and 10 days respectively. No information was provided on the shelf life of some of gathered WSWFPs such as *Abrus precatorius*, *Ampelocissus Africana*, *Crassocephalum crepidioides*, *Erucastrum arabicum* and *Garcinia buchananii* because these plants are neither preserved nor stored before their consumption (Table 5.6). Most WSWFPs that are eaten as snacks immediately after they are harvested, falls into this category where no information on their shelf life was reported in FGDs.

Plate 5.3 Dried fruits and powdered Kamulari (*Capsicum frutescens* L).

Table 5 6 Shelf life of preserved/collected WSWFPs

WSWFPs	Shelf-life
Abrus precatorius L.	–
Acalypha bipartita Müll. Arg.	If watered sparingly, can keep fresh only for 2 days
Aframomum alboviolaceum (Ridley) K.Schum	Ripe fruits can be kept for up to 10 days.
Aframomum angustifolium (Sonnerat) K.Schum.	Same as with *Aframomum alboviolaceum.*
Amaranthus dubius Mart. *ex* Thell.	Dried materials are stored for up to 6 months in shield containers/pots.
Amaranthus graecizans L.	Dried materials are stored for up to 6 months in shield containers/pots.
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	Dried materials are stored for up to 6 months in shield containers/pots.
Amaranthus lividus L.	Dried materials are stored for up to 6 months in shield containers/pots.
Amaranthus spinosus L.	Dried materials can also be stored for about 6 months in shield containers/pots.
Ampelocissus Africana (Lour.) Merr.	–
Annona senegalensis Pers.	Harvested ripened fruits often keep fresh for up 3 days.
Asystasia gangetica (L.) T.Anders.	Dried materials stored for 3 to 4 months in shield containers/pots.
Asystasia mysorensis (Roth) T.Anders.	Dried materials stored for 3 to 4 months in shield containers/pots.
Basella alba L.	Harvested leaves can keep fresh 2 to 3 days.
Bidens pilosa L.	Dried materials stored for 5 to 6 months in shield containers/pots.
Borassus aethiopum Mart.	Fruits are preserved for up to 2 months.
Canarium schweinfurthii Engl.	Fruits are preserved for 3 to 4 months.
Capsicum frutescens L.	Dried fruits can be stored for about 8 to 12 months.
Carissa edulis (Forssk.) Vahl	Fresh harvested fruits often consumed with 2 days.
Cleome gynandra L.	Dried materials in this way often stored for about 3 to 4 months.
Cleome hirta (Klotzsch) Oliv.	Dried crush leaves can also be kept for up to 4 months.
Corchorus tridens L.	Powder often kept for about 4 to 5 months in shield containers.
Corchorus trilocularis L.	Same as with *Corchorus tridens* L.
Crassocephalum crepidioides (Benth.) S.Moore	–
Crotalaria ochroleuca G.Don	Dried material often kept for about 5 to 7 months in shield containers.
Cymbopogon citratus (DC.) Stapf	–
Dioscorea minutiflora Engl.	Buried tubers are preserved for up to 2 months.
Erucastrum arabicum Fisch. & C.A.Mey.	–
Ficus sur Forssk.	Flour can be kept for up to 3 months.
Garcinia buchananii Bak.	–
Hibiscus acetosella Welw. *ex* Hiern	Both dried seeds and leaves often stored for about 5-6 months.
Hibiscus sabdariffa L.	Same as with *Hibiscus acetosella* Welw. *ex* Hiern.
Hyptis spicigera Lam.	Dried seeds can be kept for 10 to 12 months.
Imperata cylindrical (L.) Raeuschel	–

Ipomoea eriocarpa R.Br.	–
Lantana camara L.	–
Mondia whitei (Hook.f.) Skeels	Powder is often stored for 8 to 12 months in shield containers.
Ocimum gratissimum L.	Powder often kept for up to 6 months in shield containers.
Oxalis corniculata L.	–
Oxalis latifolia Kunth	–
Oxygonum sinuatum Hochst. & Steud. *ex* Meisn.) Dammer	Powder can be stored for 4 to 6 months in shield containers.
Phaseolus lunatus L.	Shelf life of the fresh seeds is prolonged for 3 to 5 days after blanching. Dried seeds are stored for about 6 months.
Phoenix reclinata Jacq.	Ripening fruit clusters often kept fresh for up to 2 days.
Physalis peruviana L.	Wrapped ripe fruits in fresh banana leaves have shelf-life prolonged for 5 to 7 days.
Rhus pyroides var. pyroides Burch.	–
Rubus pinnatus Willd.	–
Senna obtusifolia (L.) Irwin & Barneby	Dried powder can be stored for up to 6 months, when sprinkled with crushed chilli pepper.
Sesamum calycinum Welw.	Dried powder often kept for 5 to 7 months in shield containers.
Sida alba L.	–
Solanum anguivi Lam.	Dried fruits can be stored for 4 to 6 months.
Solanum lycopersicum L.	Ripe fruits often for about 4 days.
Solanum macrocarpon L.	Dried crushed leaves often stored up to 5 months.
Solanum nigrum L.	Same as with *Solanum macrocarpon* L.
Sonchus oleraceus L.	–
Tamarindus indica L.	Dried fruits often stored for about 3 to 4 months.
Tristemma mauritianum J.F.Gmel.	–
Urtica massaica Mildbr.	–
Vangueria apiculata K.Schum.	–
Vernonia amygdalina Del.	Dried leaves can be kept for up to 12 months.
Vigna unguiculata (L.) Walp.	Dried leaves preserved for about 6 months in a shield containers/pots.
Vitex doniana Sweet	Ripe fruits can be kept fresh for 2 days.
Ximenia americana L.	Same as in *Vitex doniana* Sweet.

"–" implies no information provided on shelf life because the plant part is neither preserved nor stored.

5.7 Discussion

5.7.1 Methods of harvesting popularly consumed WSWFPs

Gathering of WSWFPs for their nutritional or medicinal value is something humans have done since time immemorial. In this study, it was noted that the gathering process involves several harvesting techniques which are determined to a great extend by the plant parts that are collected for consumption or sale. Hand plucking of edible plants parts such as the fresh leaves, shoots, fruits and pods was one of basic and flexible harvesting technique for most WSWFPS gathered for consumption in the study area. For most gathered leafy WSWFPs, tender leaves and shoots are simply picked by snipping them off stalk with fingers. In the case of shrubs or low-branched trees, fruits are plucked directly from the lowered branches by the collector while standing on the ground, a finding which is similar to what Morning (1962) described as a typical technique of harvesting fruits for seed extractions.

Hand plucking of the edible parts has many benefits. Firstly, the ideal or target edible parts of the plant are easily selected by eye and the non-target edible parts such as immature or damaged leaves, pods or fruits are straight away excluded from the collection batch thus, easing the sorting of the plants during the preparation process. Secondly, picking the leaves from the plants is known to stimulate growth of the plant (Moss, 1988; Ken, 2007). Harvesting by either up-rooting the whole plant through hand pulling or cutting off the tender top parts of the stem was a common practice for harvesting certain WSWFPs such as amaranthus species and other weedy WSWFPs growing on-farm, a finding which corroborates to what Guárico (1997) reported; that most underutilized and neglected African traditional vegetables are often harvested by hand pulling or cutting off the aerial plant parts.

The importance of hand pulling as a gathering technique was echoed during FGDs, where one participant said *"Gathering dodo (Amaranthus dubius) is the easiest way to feed my family when I don't have what to cook. I just walk around and simply pull them out of the field and carry them home"*. Other than pulling the whole plant, sometimes, the stems of the plant are cut to nearly ground level. Cutting the tender top parts of the stem was reported in the FGDs to encourage branching out and production of more leaves and side shoots. However, it must be noted that there is a danger that some plants (e.g. *Acalypha bipartite*) can completely die out after the stems have been cut. Pulling out the whole plant was reported as a common practice mainly for edible weeds on-farms and was noted as the simplest way of controlling edible weeds, when still small, before they develop a larger root system that makes pulling them difficult. The practice is often done after a good rainfall, when the soil is softened so that the roots pull out smoothly from the earth to avoid injuries to the hand.

On the other hand, tubers and roots of some WSWFPs such as *Dioscorea minutiflora* (wild yams) and *Mondia whitei* (Omurondwa), were dug out either using small hoes or pointed 'pangas' (large cleaver-like cutting machetes frequently used to cut through rainforest undergrowth and for agricultural purposes or to perform crude cutting tasks such as making simple wooden handles for other tools) and some times the whole plant is completely up-rooted. This practice however, contrasts with the gathering practices elsewhere like in Australia where Aboriginal women and children used sharp pointed digging sticks for harvesting tubers of wild yams (*Microseris scapigera*) and edible roots (e.g. Braken fern- *Pteridium esculentum*) instead of using farm implements (Isaacs, 1987).

Collection of edible fruits from the ground floor, which fallen after natural ripening and abscission have been reported as common practice with a number of large-fruited genera (Robbins *et al.*, 1981; Rai and Uhl, 2004; Kadzere *et al.,* 2006). It is cheap, less dangerous harvest practice and does not require as skilled labour as, for example, climbing and shaking the tree branches to dislodge fruits. However, in the present study, gathering wild fruits from the ground below fruit trees or shrubs were said to be a common practice mostly by women and girls because culture restricts them from climbing trees. On a similar note, Byaruhanga and Opedum (2008) opined that is a taboo across many cultures in Uganda for girls and adult men to climb trees. For girls, they alleged that prohibition on climbing trees has its origin in the belief that a girl's chance of marriage would be ruined by a fall from a tree, and if a girl accidentally fell from a tree, she might get injuries or fractures that could leave life-long scars or deformation; and few grooms would be willing to take a deformed or scarred bride. Although fruit collection from ground floor was said to be cheap and less dangerous, there were concerns from women in the FGDs that most of the fruits gathered from the ground are often damaged by pests or infected by pathogens since the fruits might have fallen and been on the ground for several days.

Climbing and shaking of tree or shrub branches will often dislodge the ripe fruits, which can later be collected or picked from the ground (Stein *et al.,* 1974; Rai and Uhl, 2004; Kadzere *et al.,* 2006). Outcomes of FGD sessions indicated that climbing and shaking of the tree branches was common mainly for big fruit trees (e.g. *Vitex doniana*), and generally for those fruits out of reach of hand plucking as well as in cases where one foresees danger of his/her weight causing the breakage of the branch when he/she moves near the apex of the branch to reach for the fruits. Shaking tree branches was also reported to result in falling of some unripe fruits as well, thus causing wastage. On the hand, little has been reported about shooting (knocking down) fruits from the tree branches or crowns either using short sticks, stones or other throwable objects (Kadzere *et al.,* 2006), yet in the present study it was reported that children mostly enjoy this practice of fruits harvest; a practice which is often discouraged and sometimes not tolerated by elders because it causes fruit wastes, damage to the tree, and may also injure or dislodge non-target plant parts.

5.7.2 Preparation procedures for commonly consumed WSWFPS

Preparation procedures for WSWFPs that are often consumed after processing tend to rely on the nature of the plant itself. However, there is some commonality in preparation procedures for most WSWFPs whose tender leaves and shoots are cooked and enjoyed as vegetables. The foods were prepared either inside the small kitchen (Plate 5.4), outside in the open area or under shade of a compound tree if the weather permitted. Where the kitchen is not available, food is often cooked under the veranda of the main house (hut) often on a three stone hearth or charcoal stove. Almost all cooked leafy WSWFPs undergo the following procedures of preparation: First, apart from gathering activity, there is a sorting process where the over-mature (old) and damaged plant parts, foreign non edible material like visible insects and worms are removed. Secondly, the plants are washed and rinsed in clean water to remove soil, dirt and other foreign materials (e.g. stones, insects and worms) that escaped from being seen in the sorting stage. Prior to washing, some leafy WSWFPs are first wilted in sun shine for some few minutes depending on the plant species. It is a common believe that wilting vegetables helps to kill worms and thus they are easily dislodged from the surfaces of the plants.

Once sorted and/or wilted vegetables have been washed, they are cut (chopped) into smaller pieces as indicated by one key informant *"the thinner the chopped pieces of vegetables are, the faster it cooks and hence saves you the cooking time and firewood"*. It was also noted that some people chopped leafy vegetables before washing and that the sequence of these two operations does matter. However, it has been reported that chopping vegetables before washing causes some nutrient loss especially water-soluble vitamins and this is actually noted by the greenish colour of the washing water indicating presence of the nutrients in the water (Sharma, 2005; Kimiywe *et al.*, 2007). So it is advisable to chop vegetables after washing to reduce leakages of vitamins to water used for washing.

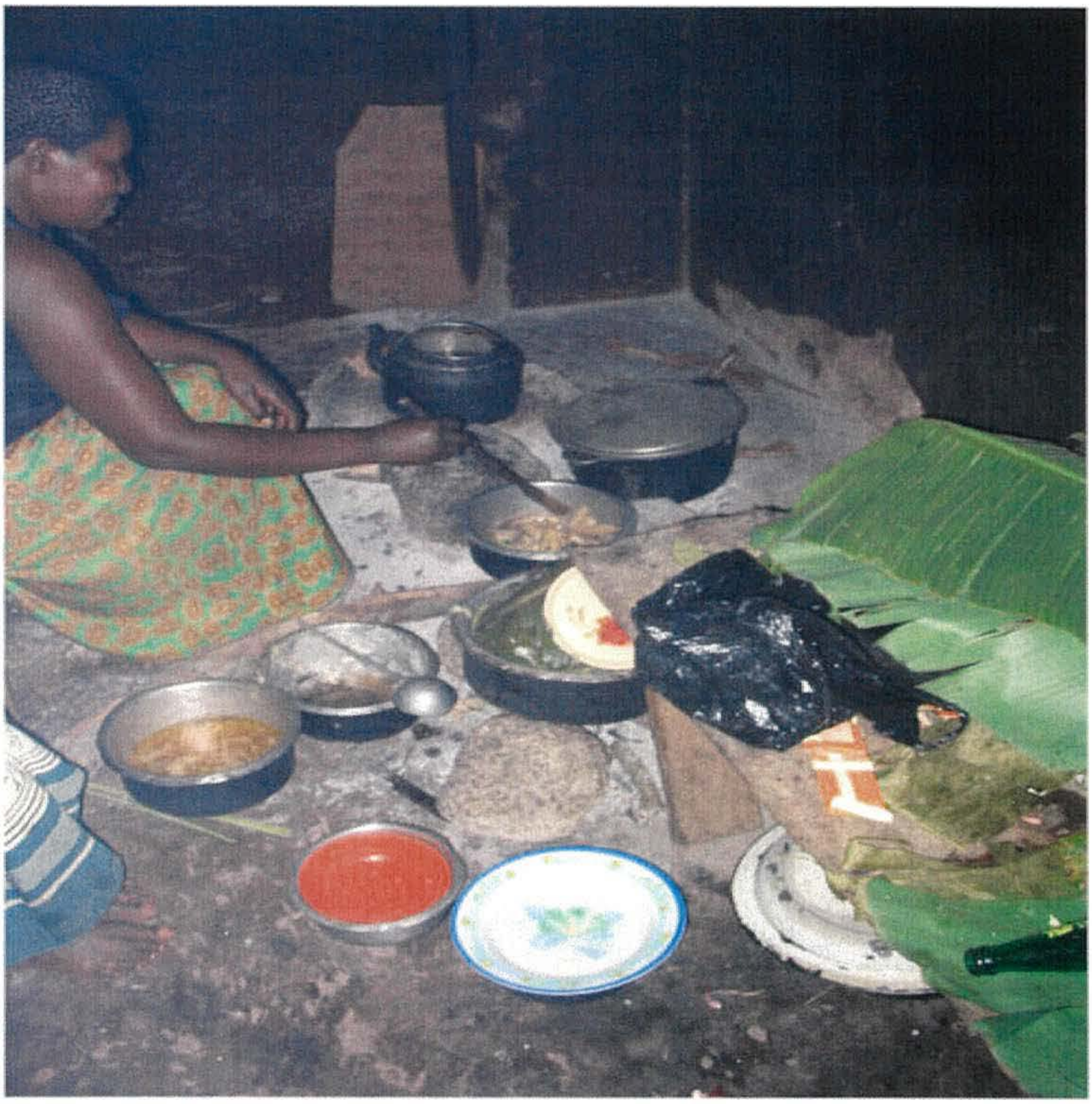


Plate 5.4 A woman preparing a meal for her family inside the kitchen.

Almost all leafy WSWFPs are cooked in a similar way. Most of them are boiled, fried, added to other cooking foods or steamed. Variation was mainly in the cooking time and often in the added ingredients such as tomatoes, curry powder, ghee and groundnut or sesame paste. Quite often these plants are boiled or fried for a short period of time with few exceptions such as *Cleome gynandra* and *Cleome hirta*, which were said to take up to one and half hours of boiling before it is ready for serving. Some of the vegetables like *Vigna unguiculata* are boiled with the addition of a small quantity of 'magadi' (bi-carbonate of soda) or potash that is locally made from burnt ashes of some amaranthus species especially *Amaranthus spinosus* to soften them. In other cases, some plants are boiled together with other vegetables mostly *Corchorus* spp. which imparts the slippery texture to the sauce. Elsewhere, similar observations were made by Jones (1963) who noted that Swazi women cook most green vegetables for a short time except in the case of coarser green European vegetables such as cabbage or spinach that were boiled for lengthy periods. Ogle and Grivetti (1985) reported that Swazi women also use bi-carbonate of soda to cook 'igushe' or other leafy vegetables if the leaves are not tender. They noted that instead of amaranthus ashes like in the present study, women preferred the traditional aloe ash to make the potash which is a cheap alternative to bi-carbonate of soda. In Kenya, it is common to boil vegetables with trona, crude hydrated sodium carbonate to soften and improve the flavour of vegetables (Bittenbender *et al.*, 1984).

Steaming vegetables has been reported as one of the easiest and most nutritious way to cook vegetables (Lowe, 1943). In steaming, vegetables are cooked gently over but not in hot water. As opposed to the ideal way of steaming vegetables using perforated steaming basket placed over a pot or saucepan containing boiling water. In the present study, local people mostly wrapped the vegetables firmly in fresh banana leaves with or without adding spices and steamed them over the boiling cassava, sweet potatoes or the cooking type of bananas locally called 'matoke'. This practice of preparing vegetables has also been reported in Uganda by Manoko and van der Weerden (2004) who noted that the young shoots and leaves of some vegetables such as *Solanum nigrum* are mixed with groundnut paste, wrapped in banana leaves and steamed either alone over the boiling water or over other boiling foods. One advantage of steaming vegetables to boiling them is that steamed vegetables retain many more of their vitamins and minerals than boiled ones (Lowe, 1943). When people boil vegetables, they are typically cooked for an extended period of time thereby destroying most nutrients. Besides, steamed vegetables tend to retain their original colours than the boiled ones.

Given that the eating habits in Uganda have been changing fairly fast, the frying of foods such as green vegetables, which used to be a culinary practice of town and city dwellers, has been adopted by the rural dwellers and is now becoming a traditional way of preparing some specific dishes (Musinguzi *et al.*, 2006). In the present study, most leafy WSWFPs are also stir-fried and consumed. Here, little oil is first heated in a saucepan until when it begins fuming, then the sliced onions are added and cooked for about 1-2 minutes while stirring them all the time, before adding the chopped vegetables. Tomatoes, curry powder or other spices like powdered or freshly crushed ginger, are later added. The mixture is continuously stirred until it is ready for serving. The duration (time) of frying, depends on the type of vegetable being cooked.

Previous work in different parts of Uganda (Katende *et al.*, 1999; Tabuti *et al.*, 2004; Musinguzi *et al.*, 2006) indicates that wild snacky foods are often eaten immediately with little or no preparation. Similarly in the present study, people generally reported eating snacky WSWFPs without any special preparation procedures except in some few cases where the plant has multiple pattern of consumption like in the case of *Borassus aethiopum*, where the ripe fruit is crushed open by hitting it several times against hard surface (mostly a rock outcrop) or beating it many times using a pestle to expose the fruit pulp. The fruit pulp is then either eaten immediately as a snack or mixed with water and used to make porridge or local wine. Similarly, after the collection of the ripe fruits of *Tamarindus indica*, the fruit coatings are removed by hand before the fruit pulp is either eaten immediately as a snack or soaked in water to make juice upon addition of sugar or used in the preparation of local bread and porridge.

5.7.3 Local preservation techniques for popularly consumed WSWFPs

Results from this study indicate that local people use many techniques to preserve some of the collected WSWFPs that they gather. Although preservation procedures tend to be more specific for each WSWFPs as described in the result section, direct sun drying technique was generally popular for those WSWFPs that are normally stored for future use. Sun drying is one of the oldest methods of food preservation. Drying preserves foods by removing enough moisture from it to prevent decay and spoilage. Most WSWFPs especially the leafy vegetables are sun-dried directly after edible parts including leaves, shoots, young stems or flowers are harvested, sorted, washed and/or chopped to small pieces, by spreading them on rocky cleaned surfaces or locally made trays, a practice similar to what Beemer (1939) described in Swaziland- "cultivated and wild vegetables were cut into small pieces and spread on a flat surface to dry in the sun. In the evenings and on windy days the vegetables were brought indoors until they were dry"

No specific information was gathered on the duration of sun drying. Some informants said the duration of sun-drying depend on the WSWFPs being dried and on brightness of the sunshine (implying hot or high temperatures) but what they well know is that the product must be dried properly and be kept dried in storage. Interestingly, they also use colour and weight change to determine whether the leafy vegetables are already dry and ready for storage. Because drying removes moisture, the food becomes smaller and lighter in weight accompanied with colour changes (green to brown). For instance, it was claimed that 10 to 15 kg of fresh leafy vegetables would reduce in weight to about 1-1.5 kg or even less when it is completely dry and ready for storage, but that it returns to its original size when water is added. Other people simply crush the leaves between the fingers and when the leaves crumble to a fine powder, it is said to be perfectly dry and therefore ready for storage. Sun drying technique is not only cheap but has also received much emphasis in the tropics (Ajayi and Osifo, 1977; Katende *et al.*, 1999; Musinguzi *et al.*, 2006; Osunde and Musa-Makama, 2007; Oladele and Aborisade, 2009) compared to other methods of food preservation described in the literature.

Other WSWFPs (e.g. *Corchorus tridens* and *Senna obtusifolia*) are however, first boiled, parboiled or blanched prior to sun-drying. The duration of boiling, parboiling or blanching were said to be dependent on each species of WSWFPs although most plants were parboiled or blanched for about 2 to 8 minutes. There is general consensus that blanching and parboiling prior to drying improves nutrient retention and sensory attributes of vegetables (Lee, 1958), however in the present study, it was reported during FGDs that parboiling and blanching help to soften vegetables. Besides, being slightly cooked, the dried food would require less cooking time in future. Others believed that blanching or parboiling WSWFPs prior to sun drying helps to prevent the stored products from discolouring or developing an off flavour or strong odour.

Sprinkling of hot chilli (*Capsicum frutescens*) powder or common salt (sodium chloride) to dried products before storage was not uncommon among the households in the study locality. It was a common belief that sprinkling little chilli powder (kamulari) or common salt over dried vegetables helps to extend shelf life of the stored product. Salting of dried vegetables prior to storage has been reported previously in literature (Chioffy and Mead, 1991). However, there is a dearth of documented information on use of hot chilli powder in food preservation. It was generally believed here that use of hot chilli would deter or repel the deteriorating agents. Salting dried vegetables prior to storage reduces the moisture activity of vegetables and makes free moisture less available for spoilage microorganisms; it also lessens soluble oxygen in the moisture and thus prohibits the growth of aerobic microorganisms (Wang, 1999; Wahlqvist, 2002; Azam-Ali *et al.,* 2003). However, dried vegetables may lose much of their nutrients through salting (Chioffy and Mead 1991) and according to Agrodok (1997) vegetables should only be salted when other methods of preservation cannot be used.

Smoking certain food plants put in the kitchen roof ceiling over fireplace; keeping them in moist cool environment, burying in the moist light soil or wrapping them in fresh banana leaves before storage although uncommon were nevertheless being used by some people. Hot chilli (*Capsicum frutescens*) fruits for instance are quite often preserved by smoking them over time inside the kitchen roof directly above the cooking fireplace. The theory behind smoking technique is that the combination of smoke and heat helps to dry and drive away microbes and moisture from the foods. To some people smoke drying food adds an interesting flavour to dried food, yet to others smoke drying imparts a bad smell to the dried food products. On the other hand, most fresh fruits are preserved for some few days by wrapping them in fresh banana leaves or simply keeping them in a clean cool place especially around clay pots that are traditional used to store and cool drinking water inside a house. Tubers and rootstocks such as yams are buried in a light-moistured soil especially sandy in nature. Elsewhere, Madge (1994) reported similar preservation techniques of collected wild food plants in Gambia. Notably the use of banana leaves to wrap and keep fruits fresh because of their power to remain 'cold and airproof' for several days.

5.7.4 Shelf life of freshly gathered and preserved WSWFPs

Shelf life of a product is critical in determining both its quality and profitability. Many gathered WSWFPs are quite perishable and will often start to spoil (taste bad, smell bad or look bad) a few days after harvest. These changes are often a result of chemical, physical and microbial reactions. Findings of this study show that local people are well acquainted with the shelf life of many gathered WSWFPs in their locality as well as their storage conditions for extended shelf-life. For example, most fresh leafy WSWFPs were said to have shelf life of less than 5 days while being sparingly watered and kept in a cool place. Similarly, stored wild fruits can only keep fresh for few days, very often less than 5 days or up to 10 days at most under special conditions such as wrapping in fresh banana leaves before storage. However, most properly dried leafy WSWFPs accompanied by proper storage requirements have a long shelf life of 4 to 6 months. Moreover, some dried seeds, fruits and rootstocks of some WSWFPs were said to have shelf-life of between 8 to 12 months.

The dried WSWFPs especially vegetables were almost in many cases stored in airtight and water proof containers/packages such as clay pots, tins and plastic bags to ensure long shelf life. The fact that local people use air-tight and or water proof containers to store their dried food materials implies their awareness of the influence of free air (oxygen) and moisture in causing deterioration of dried vegetables. Much as they may not understand the chemistry behind this deterioration (oxidative reactions), at least they know it is safer to keep dried food products especially vegetables in airtight and water proof containers for elongated shelf life. The storing or keeping dried food materials in a dry, cool and dark place away from direct light also indicates their awareness of the influence of light on stored products. However, when probed during FGDs, participants could not, explain why dried vegetables should always be kept in a dry, cool and dark place. What they are sure of is keeping dried vegetables in a dry, cool and dark place helps extend the shelf life. Of course the literature suggests that low storage temperatures extend the shelf life of dried products and that all dried vegetables deteriorate to some extent during storage when exposed to direct light, losing flavour, colour and aroma (Dauthy, 1995). For this reason, dried vegetables will not retain their appeal indefinitely when they are not precautionary stored in dry, cool and dark place.

5.8 Conclusions

This case study was geared at improving the understanding of the use of WSWFPs by exploring local methods of their harvesting, processing and preservation in Bunyoro-Kitara Kingdom, Uganda. It was obvious that the gathering processes for WSWFPs involves various harvesting techniques, which are determined to a great, extend by the plant parts that are collected for domestic consumption or sale. These techniques included hand plucking of edible parts such as the leaves, shoots, fruits and pods from the plant; picking or collecting fruits from the ground floor; pulling (up-rooting) the whole plant from the soil by hands; cutting off the tender top parts of the stem bearing the edible parts; digging out the tubers and roots, knocking down ('shooting') fruits from the branches/crown of trees or shrubs with throwable objects; climbing and shaking of tree or shrub branches to dislodge the fruits.

There were varied procedures of preparing WSWFPs. For many leafy WSWFPs that are cooked, some preparation procedures including sorting, wilting, washing, and cutting (chopping) of the plants into smaller pieces before cooking were common but the actual procedure such as boiling, stir-frying, steaming or adding to other cooking foods, as well as cooking time and needed ingredients (like rock salt, ghee, groundnut or sesame pastes) were dependent on each WSWFPs. Most WSWFPs eaten as snacks, were consumed without any special preparation procedures except in some few cases like in *Borassus aethiopum*, where fruit pulps are either eaten immediately as snacks or mixed with water and used to make porridge or local wine.

Direct sun drying was the major preservation technique for the gathered and often stored WSWFPs in the study locality. Other preservation techniques included boiling/parboiling or blanching of the plant materials prior to sun drying; sprinkling hot chilli (*Capsicum frutescens*) powder or common salt (sodium chloride) to dried vegetables before storage; smoking in the kitchen roof over fireplace; keeping in moist cool place, and wrapping in fresh banana leaves.

The shelf life of preserved or freshly harvested WSWFPs was reported to vary from 2 days to about 12 months. Most fresh leafy WSWFPs have shelf life of up to 5 days if sparingly watered and kept in a cool place. Wild fruits could be kept up to 10 days under special conditions (e.g. wrappings in fresh banana leaves). Most properly dried plant materials accompanied by proper storage requirements have a long shelf life of 4 to 12 months.

CHAPTER 6

MARKET POTENTIAL OF WILD AND SEMI-WILD FOOD PLANTS IN BUNYORO-KITARA KINGDOM, UGANDA

6.1 Introduction

Wild and semi-wild food plants (WSWFPs) are central to food security in many developing nations as a food or income supplement or a fall-back resource (Falconer and Arnold, 1991). In Sub-Saharan Africa, WSWFPs play vital roles in food and nutritional security, especially during periods of famine and food scarcity (Saka *et al.,* 2002, 2004, Akinnifesi *et al.,* 2004). In Zimbabwe, for example, wild fruit trees represent about 20% of total woodland resource use by rural households (Campbell *et al.,* 1997) and fruits of *Uapaca kirkiana* (Muell., Arg), *Ziziphus mauritiana* (Lam), *Strychnos cocculoides* (DC ex Perleb) and *Parinari curatellifolia* (Planchon ex Benth.) are sold to buy staple food and other household goods (Ramadhani, 2002; Mithofer, 2004). Collectors (often women and children) can obtain substantial incomes for supplying local markets (Schomburg *et al.,* 2002, Ramadhani, 2002).

Gathering and selling of WSWFPs may represent a significant proportion of total household incomes, particularly where farming is marginal and may represent a better option than wage labour or farming (Scoones *et al.,* 1992). In Botswana, gathering of WSWFPs has a larger economic contribution than farming for many households (Butynski, 1973; Butynski and von Richter, 1974). In Brazil, the sale of kernels from the fruit of the babassu palm, Orbignya martiana, supports over two million people (May *et al.,* 1985). In South Africa, 94% of households use *Sclerocarya birrea* fruits for making a liqueur (Amarula), jam and juice (Shackleton, 2004) which contribute much to the regional and export trade of southern Africa. In Ethiopia, a number of wild food plants are of economic value and are traded in markets in certain areas. For example, the ripe fruits of *Opuntia ficus-indica*, a cactus plant are traded for cash on markets in Tigray Region during the rainy season. In addition, the fruits and oil of *Borassus aethiopum*, African fan palm, are marketed in Afar Region. The leaves, stalks, and seeds of *Brassica carinata* are traded on remote markets such as in Jana Mora Woreda in North Gonder. Fruits of *Cordia africana* and *Ziziphus spina-christi* are also offered on markets in Jana Mora Woreda (Guinand and Lemessa, 2000).

The markets for wild edible products have been compared with cultivated products in Nigeria (Okafor, 1980). Prices for wild products are comparatively higher, especially during the seasonal shortfall periods when other cultivated products are unavailable. For instance, the marketing of *Irvingia gabonenesis* is particularly important in this period in southern Nigeria (Johnson and Johnson, 1976) where traders even import this wild fruits from Cameroon. Many more wild products have potential economic value, which are, yet unexploited (Anorld *et al.*, 1985; Rasoanaivo, 1990). Although wild resources make a significant contribution to rural livelihoods and to the national economies of many countries, the magnitude of the income derived from wild resources and particularly wild food plants is not well known, due to a lack of systematic and rigorous data collection at country level (FAO, 2000). Besides this, a recent analysis of markets in Sub-Saharan and southern Africa revealed that markets for indigenous and wild edible plants are largely informal, small, and volatile (Russell and Franzel, 2004) which often escape the attention of policy makers. As such, these resources are often ignored in official nutritional investment projects.

In Uganda there are surprisingly few accounts of documented trade in WSWFPs, notable exceptions being studies by Agea *et al* (2004*a*), Agea *et al* (2008) and Okia (2010), despite growing importance of the WSWFPs in the country. The present study therefore, addressed market issues of WSWFPs as rationale for their continued gathering by the local communities in Bunyoro-Kitara Kingdom. Some of the specific parameters that were investigated under this study are shown Figure 5.1 (adopted and modified from Waldman and Jensen, 1998; Davies *et. al.*, 1988).

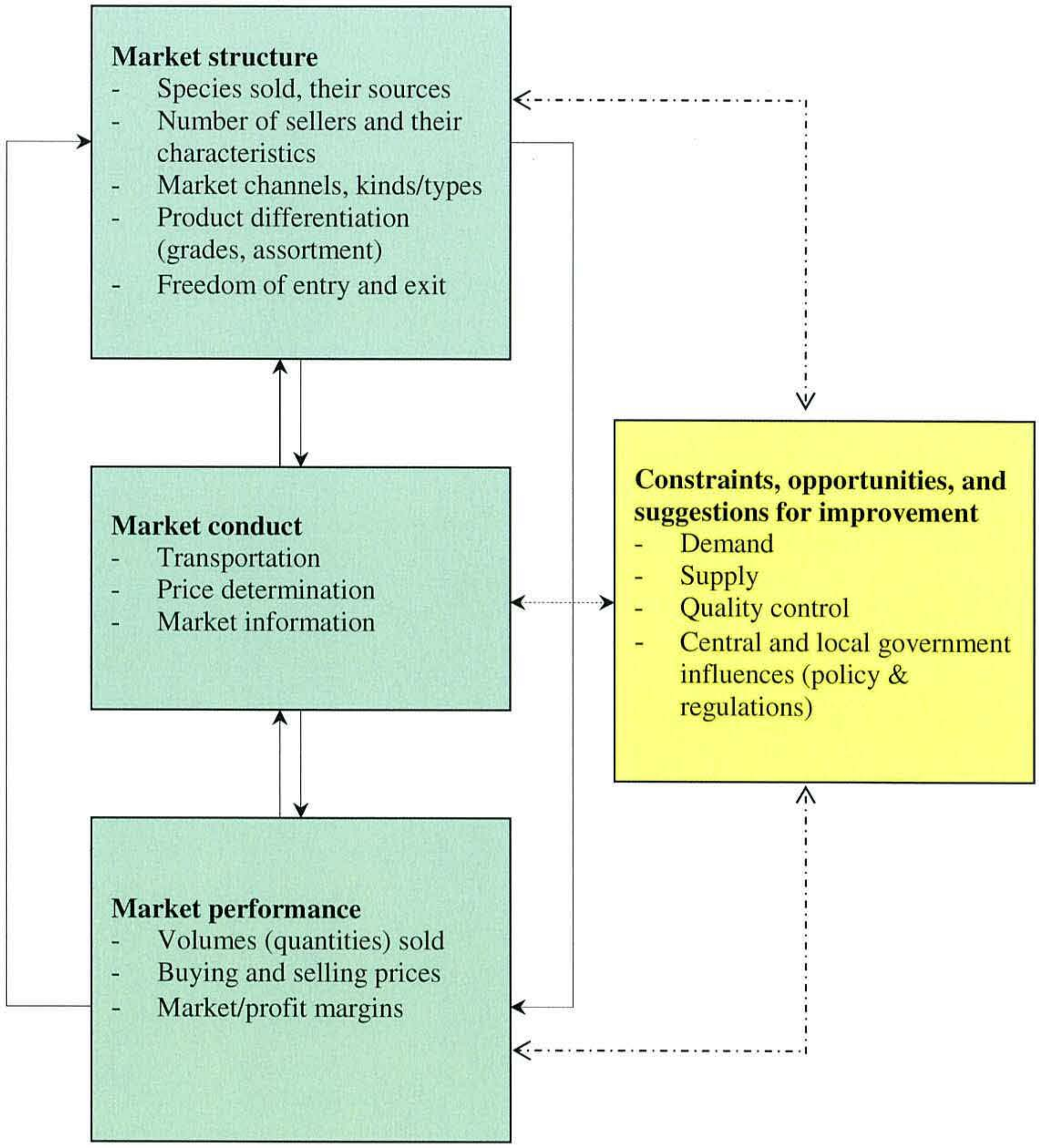


Figure 5.3 Parameters of the framework for analyzing the structure, conduct, performance, opportunities, and constraints for marketing study (*adopted and modified from Waldman and Jensen, 1998; Davies et. al., 1988*).

6.2 Objectives

6.2.1 Overall objectives

The overall objective of this study was to explore market potentials of WSWFPs in Bunyoro-Kitara Kingdom of Uganda.

6.2.2 Specific objectives

i. Describe the market characteristics of WSWFPs traded in Bunyoro-Kitara Kingdom.
ii. Assess the market conduct and performance of traded WSWFPs.
iii. Document the market-related opportunities and constraints to the trade of WSWFPs in the Kingdom.
iv. Assess the strategies to improve the marketing of WSWFPs in the Kingdom.

6.3 Research questions

Which WSWFPs are traded in by local people in Bunyoro-Kitara Kingdom? Who sells them and who are the customers (buyers) of WSWFPs? How many buyers and sellers of WSWFPs are in the area? What is the nature of the marketing channels of the traded WSWFPs? What are the quantities of WSWFPs traded weekly in the market? What are the average unit prices of the traded WSWFPs? How are their market prices determined? What are the sources of market information? What are the market-related opportunities and challenges to trade in WSWFPs within the Kingdom? How can the market of WSWFPs be improved in the future?

6.4 Methods of data collection

A Rapid Market Survey (RMS) was conducted in 17 local markets in Kiryandongo and Mutunda sub-counties of Kibanda County. These included Kiryadongo, Kattulikire, Tecwa, Chopelwor, Bweyale, Kalwala, Pumuzika, Kiryampungura, Karungi, all in Kiryandongo sub-county, and Diima, Karuma, Kawiti, Laboke, Mutunda, Nanda, Okwece and Teyango in Mutunda sub-county. Five mobile hawkers and eleven home-based/roadside markets were also surveyed. Rapid Market Survey (RMS) is a procedure for analysing commodity markets using a combination of techniques such as structured and semi-structured questionnaires with key informant informants, direct observations, and other participatory rural appraisal tools (Simmons *et al.*, 1994). The method is very useful in trying to identify and understand the current market trends, opportunities and constraints (Simmons *et al.*, 1994).

The framework is best suited to research studies in which either little research has been done before, poorly conducted or needs an update (Holtzman *et al.*, 1993). Its strength includes its practicability on identifying and sharpening research problems and ranking them according to importance. It can also detect emerging issues, themes, and opportunities facing marketing systems. So far, the framework has been widely used to analyse market systems. Examples are the analysis of fuelwood and charcoal markets in Asia (Padoch, 1988; FAO, 1993). It is obvious that probability sampling allows a random selection of elements, each with non-zero chance of being selected for the sample and hence produces good representation of the population. However, due to the descriptive nature of this study, purposive sampling was used to select traders selling WSWFPs for informal interviews.

Semi-structured questionnaire (Appendix II) was administered face-to-face to sixty six (66) traders that were encountered selling WSWFPs in the formal markets, five (5) mobile hawkers that were met selling mainly wild fruits, and eleven (11) home-based/roadside traders selling WSWFPs. Because of their small numbers, all traders that were found selling WSWFPs were interviewed. During the RMS, WSWFPs that were being marketed, quantity sold, buying and selling prices, mechanisms of market prices determination; pre-sale processing and value addition activities if any, types of customers, and promotional arrangements undertaken if any, challenges experienced in marketing the wild food plants and possible strategies to improve the marketing of the WSWFPs were documented.

6.5 Data analysis

In order to describe the market potential for WSWFPs; data from RMS which included market characteristics, market conduct and performance, market opportunities, constraints and strategies were analysed using simple descriptive statistics in Excel spreadsheet and MINITAB statistical package. Data were coded to obtain a limited set of attributes for a variable (Babbie and Mouton, 2001), cleaned (checked) for mistake and entered into the computer. As a coding process, lists of responses were made for variables, groups identified and numbers assigned to these groups. However, some data were not coded but used descriptively. Market prices and weekly volumes of traded WSWFPs were compared to some of the selected conventional food plants (e.g. *Abelmoschus esculentus, Brassica oleracea var capitat, Mangifera indica* and *Sesamum indicum*) traded in the same locality. Weekly volumes of traded WSWFPs based on the usual units of the measurement (including bundles and heaps) within the markets were estimated per species sold. The profit margin, which is the dollar value difference in the selling price and total cost (Holland, 1998), was computed per traded species. Transport expenses were excluded in the cost computation because only 4% of the traders incurred transport expenses in form of hired bicycles.

6.6 Results

6.6.1 Market characteristics

6.6.1.1 Socio-demographic characteristics of the traders

Socio-demographic characteristics of the interviewed traders (vendors) selling WSWFPs are presented in Table 6.1. The majority (82%) of the traders were women. Traders' ages ranged from 13 to 75 years, although the majority (59%) were above 36 years old. About 15% were less than 18 years old and the rest were aged between 18 and 36 years. About 74% of traders were married, 15% had not yet married (single) and the rest were either widowed/widower or divorced/separated. The majority (51%) of the traders had attained primary level of education and only 9% had no formal education. The rest were either secondary school leavers or had attained tertiary level of education.

Although, all respondents interviewed were traders, only 51% reported trading as their main occupation and 43% said their chief occupation was subsistence farming. The rest were mainly occupied in housewifery, in school as students, and in small scale brick making activities. Most (66%) traders had more than six persons per household and the average family size was seven persons. The majority (62%) of the traders had annual cash income greater than UGX 400,000 (USD 200). Thirty-one percent had annual cash income ranging from UGX 200,000 to 400,000 (≈USD 100 to 200) and the rest earned less than 200,000 (≈USD 100) per year. The majority

(71%) of the traders earned their cash income mainly from on-farm activities and the rest (29%) from off-farm activities.

Table 6.1 Socio-demographic characteristics of the traders selling WSWFPs.

Variable	% response
Sex	
Male	18.3
Female	81.7
Age	
<18	14.6
18-36	26.8
>36	58.6
Marital status	
Single	15.7
Married	73.9
Divorced/separated	2.4
Widow/widower	8.0
Education level	
No formal education	9.4
Primary	51.4
Secondary	31.7
Tertiary	7.5
Major occupation	
Market vendor/trader	55.1
Subsistence farming	42.6
Others (Housewifery, students, brick making)	2.3
Family size	
<3 people	15.3
3-6 people	18.5
>6 people	66.2
*Annual cash income (UGX)**	
<200,000 (≈USD 100)	7.4
200,000-400,000 (≈USD 100-200)	31.0
>400,000 (≈USD 200)	61.6
Main sources of cash incomes	
On-farm	70.8
Off-farm	29.2

*USD1 = 2010 Uganda shilling (UGX).

6.6.1.2 Distribution of sellers by the market

Generally, there were few traders selling WSWFPs in all the surveyed formal markets, the highest number being only seven traders in Bweyale and Kiryadongo trading centres (Table 6.2). Most sellers were found mainly trading in markets located within the trading centres such as Bweyale, Diima, Kiryadongo, Karuma trading centres. In all the markets, women dominated the selling of WSWFPs. In addition, they also dominated the homestead and roadside stalls. Five hawkers (three men and two women), who moved from place to place, visiting especially people's homes and drinking locations were also encountered. Plate 6.1 depicts some women selling some WSWFPs in Diima trading centre.

Table 6.2 Distribution of sellers in the markets within the study area.

Markets	Market type	Market days	Number		Total
			Men (boys inclusive)	Women (girls inclusive)	
Kiryandongo sub-county					
Bweyale*	Trading centre	Daily	1	6	7
Kiryadongo	Trading centre	Daily	2	5	7
Kiryampungura	Village	Sundays	1	4	5
Chopelwor	Village	Sunday	1	3	4
Kalwala	Village	Thursday, Sunday	-	3	3
Kattulikire	Village	Mondays, Thursday	-	3	3
Pumuzika	Village	Thursday, Sunday	-	3	3
Karungi	Village	Sunday	-	2	2
Tecwa	Village	Sunday	-	2	2
Mutunda sub-county					
Diima*	Trading centre	Daily	2	5	7
Karuma	Trading centre	Daily	1	4	5
Kawiti	Village	Daily	-	4	4
Mutunda	Trading centre	Daily	1	3	4
Okwece	Village	Daily	-	3	3
Laboke	Village	Daily	-	2	2
Nanda	Village	Daily	1	2	3
Teyango	Village	Daily	-	2	2
-	Homestead/road sides	-	2	9	11
-	Hawkers	-	3	2	5
Grand total			15	67	82

* Daily markets but main market days are Wednesday and Saturday.

Plate 6.1 Women selling some of the WSWFPs in the surveyed markets.

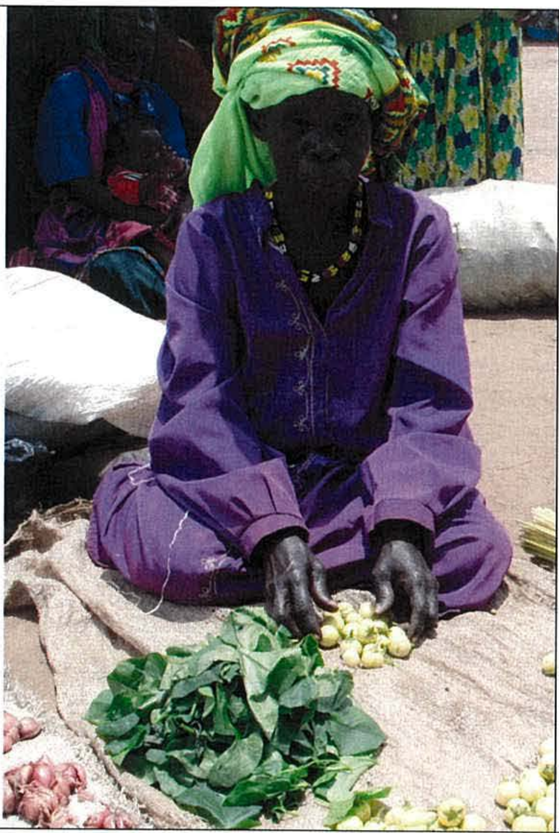
6.6.1.3 WSWFPS traded in the market

Twenty nine (29) WSWFPs belonging to 12 botanical families were recorded being traded during the rapid market survey (RMS) (Table 6.3). The most frequently recorded species were *Amaranthus dubius* (42.7%), *Hibiscus sabdariffa* (39.0%), *Cleome gynandra* (32.9%), *Solanum lycopersicum* (31.7%), *Solanum nigrum* (29.3%), *Tamarindus indica* (26.8%), *Amaranthus spinosus* (24.4%), *Basella alba* (24.4%), *Amaranthus graecizans* (22%), *Canarium schweinfurthii* (22%) and *Physalis peruviana* (22.0%). In terms of botanical family, members of Amaranthaceace, Solanaceae and Malvaceae were the most represented in the markets (Table 6.3). Plates 6.2 and 6.3 exemplify some of the WSWFPs in the markets.

Plate 6.2 *Physalis peruviana* L being sold by a mobile vendor.

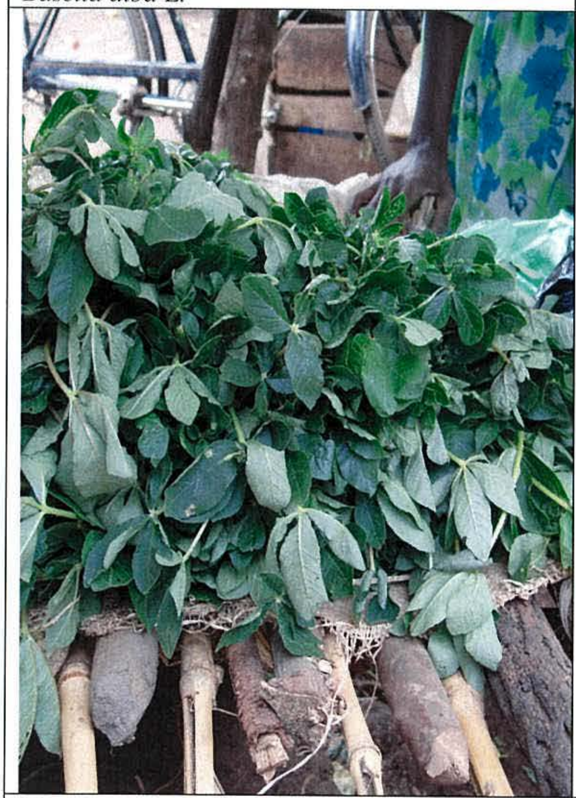
Table 6.3 WSWFPS traded in the market within the study locality.

WSWFPs	Local names	Botanical family	% of traders selling the plant
Amaranthus dubius Mart. *ex* Thell.	Doodo	Amaranthaceace	42.7
Hibiscus sabdariffa L.	Bamya, Ekikenke	Malvaceae	39.0
Cleome gynandra L.	Eyobyo	Brassicaceae	32.9
Solanum lycopersicum L.	Bunyanya bunyoro	Solanaceae	31.7
Solanum nigrum L.	Enswiga	Solanaceae	29.3
Tamarindus indica L.	Mukoge	Fabaceae	26.8
Amaranthus spinosus L.	Doodo y'amahwa	Amaranthaceace	24.4
Basella alba L.	Enderema	Basellaceae	24.4
Amaranthus graecizans L.	Nyabutongo, Ocoboro	Amaranthaceace	22.0
Canarium schweinfurthii Engl.	Empafu	Burseraceae	22.0
Physalis peruviana L.	Ntuutu	Solanaceae	22.0
Aframomum angustifolium (Sonnerat) K.Schum.	Amatehe, Kongo amor	Zingiberaceae	20.7
Crotalaria ochroleuca G.Don	Kumuro, Alaju	Fabaceae	20.7
Solanum anguivi Lam.	Obuhuruhuru, Katukuma	Solanaceae	20.7
Phaseolus lunatus L.	Amaijalero, Okuku	Fabaceae	19.5
Borassus aethiopum Mart.	Ekituugu, Tugo	Arecaceae	18.3
Hibiscus acetosella Welw. *ex* Hiern	Makawang kulo, Gwanya	Malvaceae	18.3
Corchorus tridens L.	Eteke	Malvaceae	17.1
Corchorus trilocularis L.	Otigo lum	Malvaceae	17.1
Cleome hirta (Klotzsch) Oliv.	Akayobyo akasajja	Brassicaceae	15.9
Vernonia amygdalina Del.	Kibirizi	Asteraceae	15.9
Aframomum alboviolaceum (Ridley) K.Schum	Amasaasi, Ocao	Zingiberaceae	14.6
Amaranthus lividus L.	Bwora, Mboog'ennene	Amaranthaceace	14.6
Mondia whitei (Hook.f.) Skeels	Omurondwa	Apocynaceae	14.6
Vitex doniana Sweet	Muhomozi, Owelo	Verbenaceae	13.4
Bidens pilosa L.	Obukurra	Asteraceae	12.2
Solanum macrocarpon L.	Bugorra	Solanaceae	12.2
Amaranthus hybridus (L.) Thell. subsp. *Cruentus*	Omujuiga	Amaranthaceace	9.8
Hyptis spicigera Lam.	Amola, Lamola	Lamiaceae	9.8



Basella alba L.

Bidens pilosa L.



Cleome gynandra L.

Crotalaria ochroleuca G.Don

Plate 6.3 Some WSWFPs in the surveyed markets.

6.6.1.4 Main customers (buyers) of WSWFPs

Asked about who the main buyers of WSWFPs were, 51% of traders said they mainly sell to customers coming from within or nearby villages. Thirty five percent of the traders reported that they sell to customers in trading centres or those coming from towns (Figure 6.1). Some traders however, said their main buyers were elderly persons particularly the elderly women irrespective of where they come from or reside. About 5% said they do not have particular categories of customers who buy what they sell. This 5 % group of traders are those perhaps who do not pay attention to their customers.

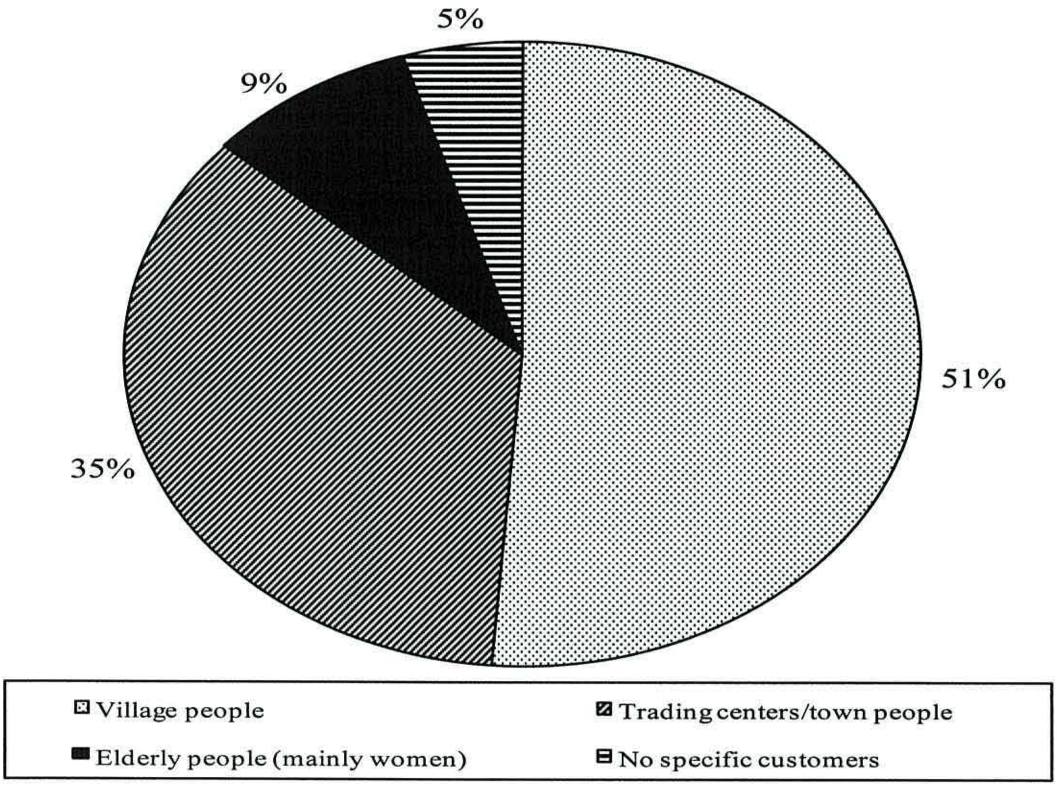


Figure 6.1 Main customers (buyers) of WSWFPs.

6.6.1.5 Market chains and relationship between traders and their suppliers

The market chains for WSWFPs traded in the study locality are presented in Figure 6.2. Generally, the chains are very short, simple and are dominated (97.5%) by traders who also double as gatherers of WSWFPs, and sell directly to consumers. Only 2.5% of the traders purely relied on supplies from gatherers. Some (8.6%) of the traders who doubled as the gatherers were also supplied by other gatherers (non-traders) often directly to their homes or market stalls (Figure 6.3). The majority (67.1%) of the traders had some form of ties (relationships) with their suppliers (Figure 6.4). In fact most of their suppliers were family members (89.1%) (Figure 6.5). The market outlets for traded WSWFPs were trading centres, village markets, roadside stalls and homesteads; besides mobile hawkers.

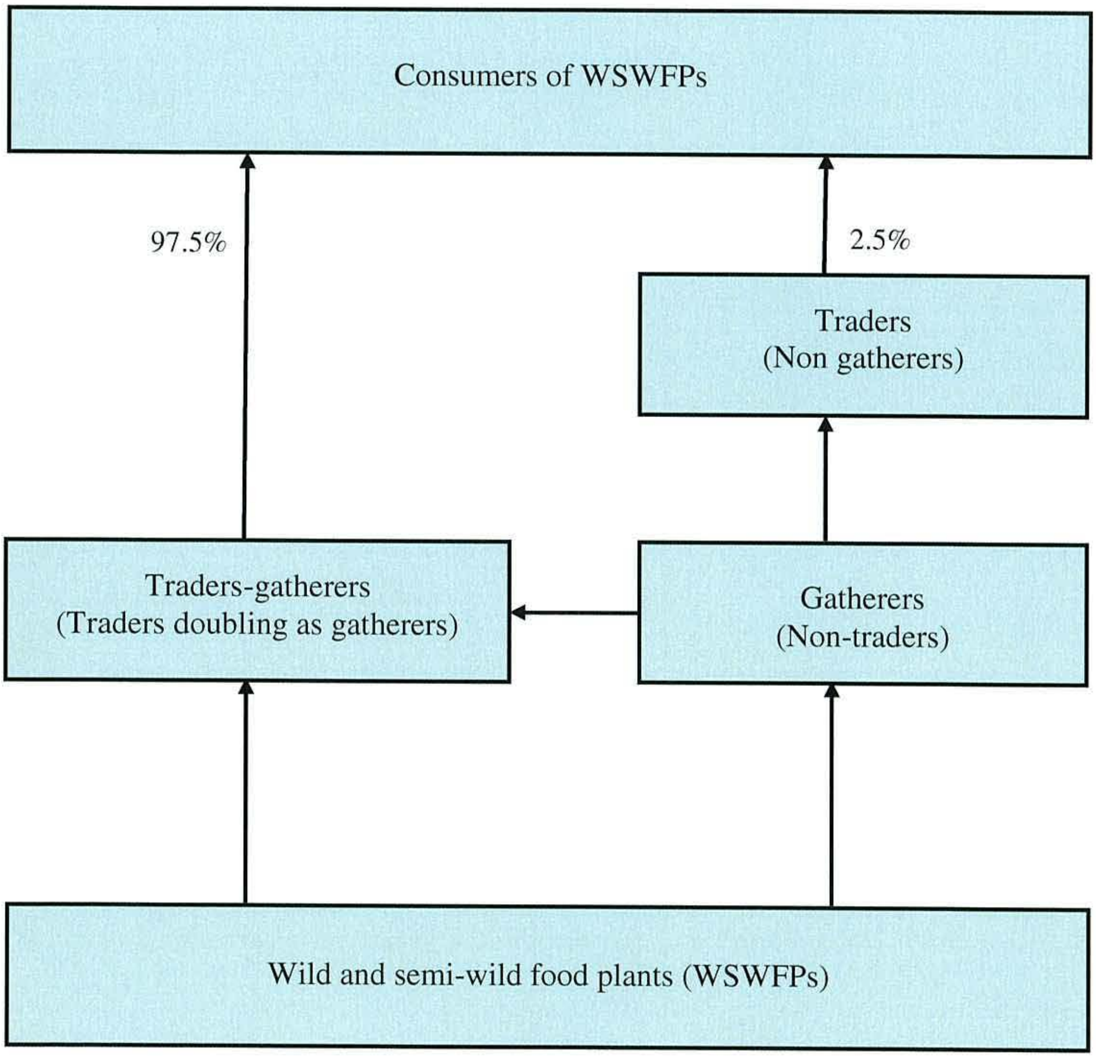


Figure 6.2 Marketing chain for WSWFPs in Bunyoro Kitara Kingdom.

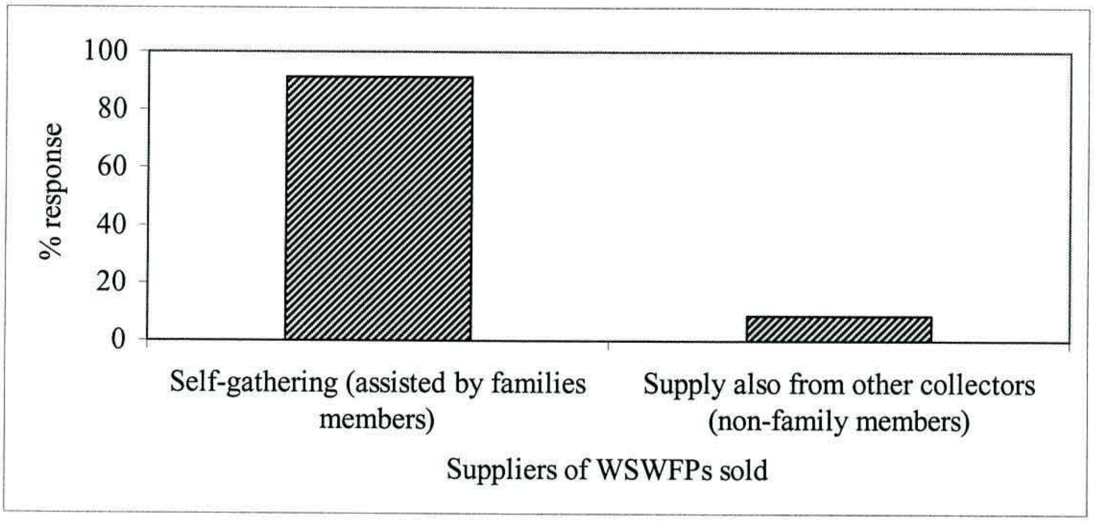


Figure 6.3 Suppliers of WSWFPs traded in the markets.

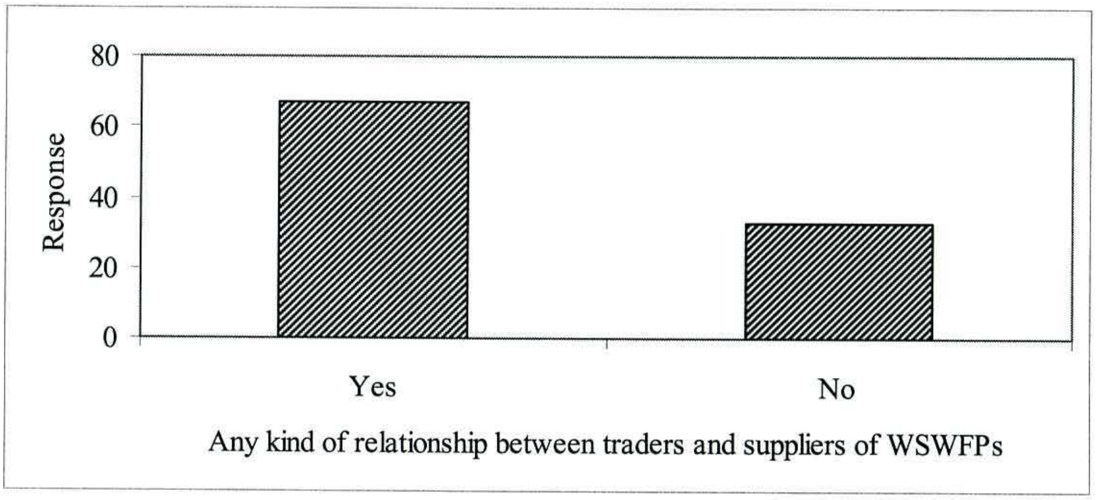


Figure 6.4 Responses on whether there is any relationship/ties between traders and their suppliers.

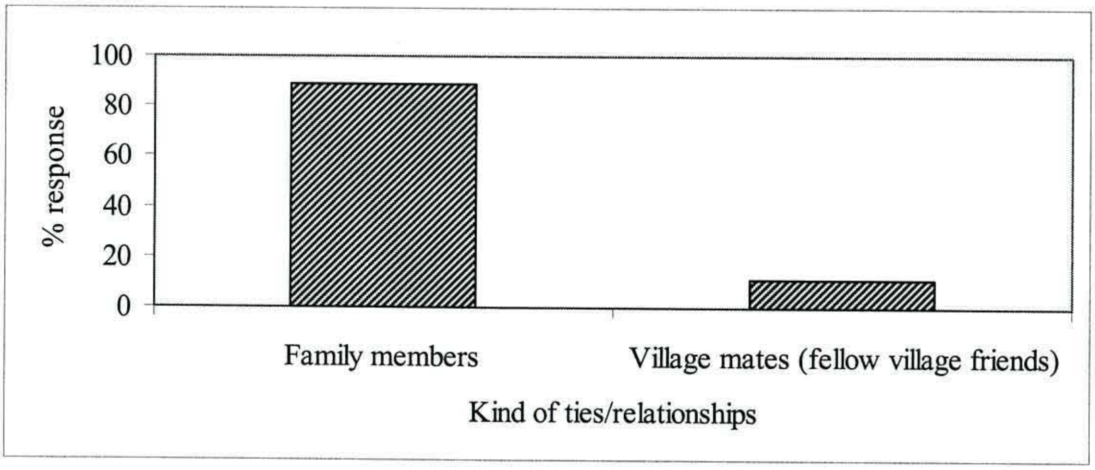


Figure 6.5 Kind of ties/relationships between the traders and their suppliers.

6.6.1.6 Processing and value addition before sale

The majority (71%) of traders sell WSWFPs that they trade-in without any form of processing or value addition. Only 29% of traders attempted to process or add value to the WSWFPs that they sell (Figure 6.6), and these processing or value addition attempts were mainly limited to preliminary activities such as washing the plants to remove dirt and soil particles (61.7 ± 1.1%), sorting bad or old ones away from the batches (50.3 ± 2.6%), grading into quality batches (24.2 ± 4.5%) and parboiling (15 ± 2.3%). Drying and crushing the plant into powder as well as processing the plant into juice and wine prior to sale were not common (Figure 6.7).

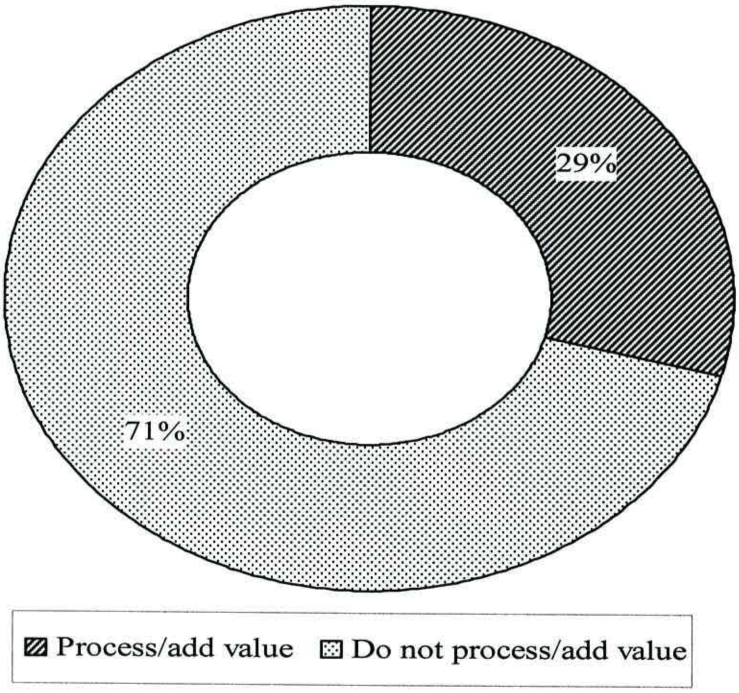


Figure 6.6 Responses on whether traders process/add value to some WSWFPs before selling.

Only three species were encountered during the market survey being sold in a dried and crushed form. These species were *Corchorus tridens*, *Corchorus trilocularis* and *Vernonia amygdalina*. Processing of wild fruits into local wines and juices by traders was limited mainly to a handful of species such as *Tamarindus indica* locally known as Mukoge and *Borassus aethiopum*, also called Ekituugu or simply Tugo. Plate 6.4 shows some of locally processed juice from *Tamarindus indica* for sale.

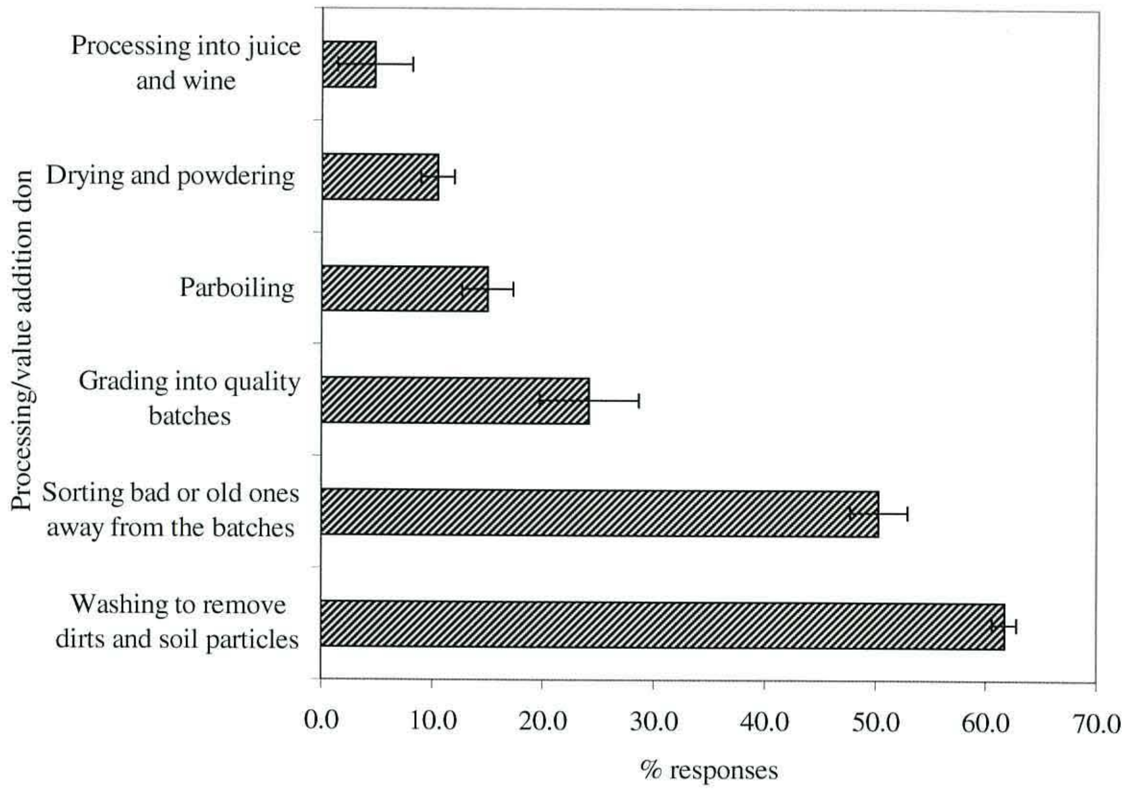


Figure 6.7 Forms of processing/value addition done on some traded WSWFPs.

Plate 6.4 Locally processed juice from *Tamarindus indica* L in Kiryadongo trading centre.

6.6.2 Market conduct and performance of the WSWFPs traded in the Kingdom

6.6.2.1 Transportation of WSWFPs to market location

The majority (74%) of the traders transported WSWFPs they deal-in to the market locations on foot (walking) carrying them on their heads (Plate 6.5). Others transported their products to the markets using family bicycles (10%), hired bicycles (4%) and family wheelbarrows (2%) (Figure 6.8). Ten percent of traders did not transport their products to the formal market locations as customers come to buy from their homestead stalls. Only 4% of the traders incurred transport costs in the form hired bicycles.

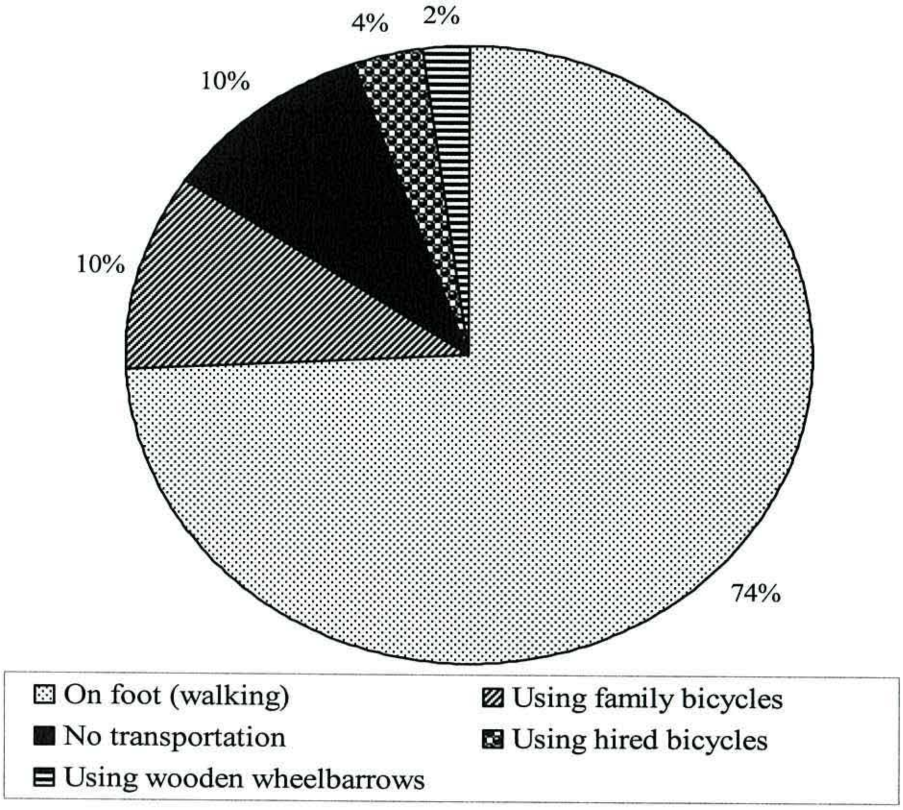


Figure 6.8 Modes of transport for traded WSWFPs from collection sources to the market locations.

Plate 6.5 A woman walking to a market carrying her produce on her head.

6.6.2.2 Price setting

Results presented in Figure 6.9 indicate that most (73.2 ± 5.5%) traders assign prices to WSWFPs they sell based on the daily market demand of each product as well as on the time and risks involved in gathering of the plant (56.1 ± 3.2%). Other traders rely on price information of alternative (substitute) food plants being sold in the market (48.8 ± 2%) as well as price information from other areas (40.2 ± 6.4%). In addition, 35.4 ± 1.4% of the traders depend on price information of the previous or past seasons; while some (22 ± 4.4%) traders particularly those who are supplied by the gatherers simply rely on costs incurred from suppliers to determine the prices upon which they can sell their products.

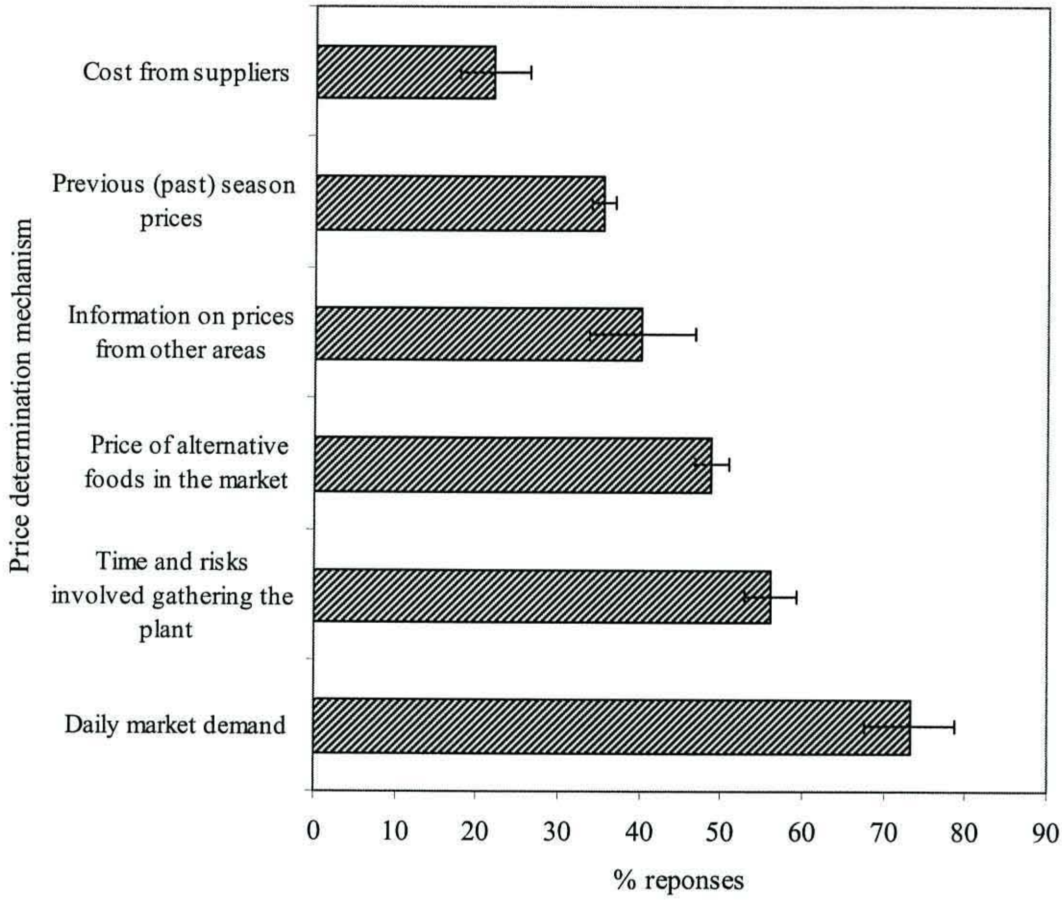


Figure 6.9 Avenues through which traders determine market prices of WSWFPs sold.

6.6.2.3 Market information for WSWFPs

Most (62%) traders of WSWFPs rely on communication from other traders either from within the same market location or from different markets as the main sources of market information (Figure 6.10). Other traders (33%) depended more on interaction with their customers (buyers) as the source of market information such as what they prefer, and how much they pay for similar products elsewhere. Reliance on media and service providers are very limited. Only 3% of traders ever received market information through media sources (e.g. local FM radios). Similarly, only 2% received market information from service providers operating within the area.

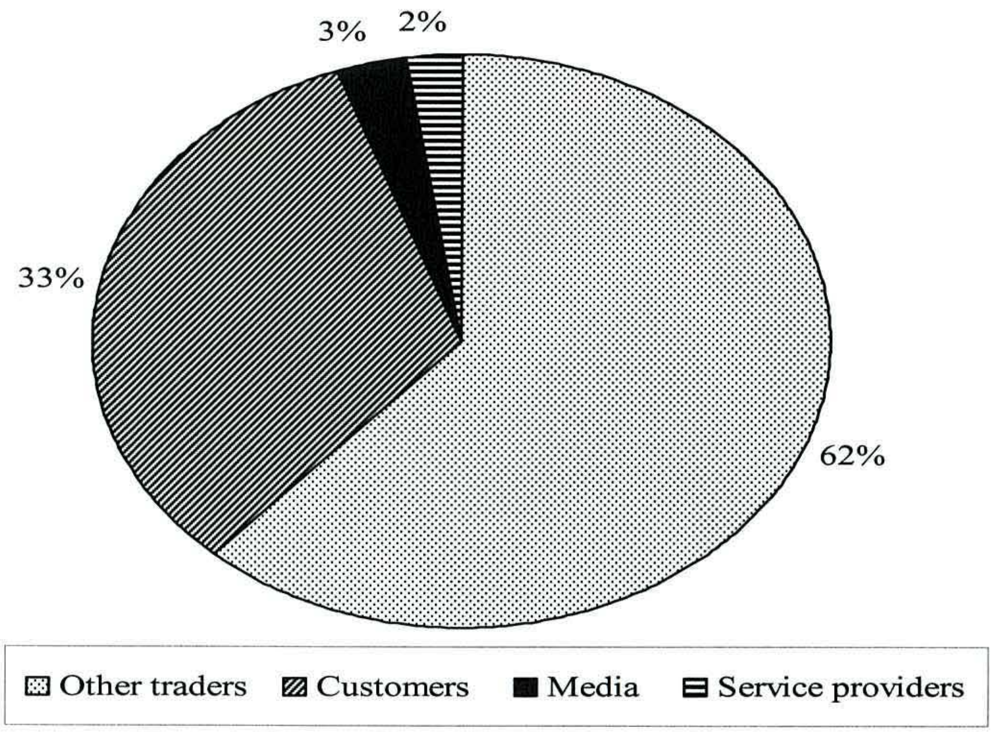


Figure 6.10 Sources of market information for traders selling WSWFPs.

6.6.2.4 Estimated quantities of WSWFPs sold per week during the harvest season

Among WSWFPs that are often sold in terms of bundles, *Hibiscus sabdariffa* (20 bundles), *Solanum nigrum* (19 bundles), *Amaranthus dubius* (16 bundles), *Amaranthus graecizans* (16 bundles) and *Cleome gynandra* (14 bundles) were sold in the highest quantities per trader weekly during their harvest seasons (Table 6.4). Whereas among those that are measurable and sold in terms of heaps, *Physalis peruviana* (16 heaps), *Solanum anguivi* (15 heaps), *Basella alba* (14 heaps), *Tamarindus indica* (13 heaps) and *Solanum lycopersicum* (Bunyanya bunyoro) (13 heaps) were sold in highest quantities per trader weekly during their harvest seasons. Estimated quantities of *Mondia whitei* roots (24 pieces) sold per trader weekly was high while the quantities of *Canarium schweinfurthii* fruits (14 plastic mugs/trader) and *Borassus aethiopum* fruits (12 fruits/trader) marketed weekly were low. Similarly, the amount of fresh seeds of *Phaseolus lunatus* (7.8 kg/trader) and seeds of *Hyptis spicigera* (6.4 kg/trader) sold weekly were low. The rest of WSWFPs were generally sold in very small quantities per trader per week (Table 6.4).

Table 6.4 Estimated quantities sold per week during the harvest season.

WSWFPs sold	Local names	Parts sold	Estimated quantity/week in the harvest season				
			No. of traders selling	Units	Total	Range	Average/ trader
Aframomum alboviolaceum (Ridley) K.Schum.[¥]	Amasaasi, Ocao	Fruits	12	Heaps	105	5 - 15	8.8
Aframomum angustifolium (Sonnerat) K.Schum.[¥]	Amatehe, Kongo amor	Fruits	17	Heaps	197	5 - 20	11.6
Amaranthus dubius Mart. *ex* Thell.*	Doodo	Leaves & shoots	35	Bundles	571	8 - 30	16.3
Amaranthus graecizans L.*	Nyabutongo, Ocoboro	Leaves & shoots	18	Bundles	290	8 - 25	16.2
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.*	Omujuiga	Leaves & shoots	8	Bundles	72	5 - 13	9.0
Amaranthus lividus L.*	Bwora, Mboog'ennene	Leaves & shoots	12	Bundles	122	5 - 15	10.2
Amaranthus spinosus L.*	Doodo y'amahwa	Leaves & shoots	20	Bundles	218	5 - 15	10.9
Basella alba L.[##]	Enderema	Leaves & shoots	20	Heaps	288	5 - 25	14.4
Bidens pilosa L.[#]	Obukurra	Leaves & shoots	10	Bundles	55	3 - 08	5.5
Borassus aethiopum Mart.[†]	Ekituugu, Tugo	Fruits	15	Fruits	172	5 - 15	11.5
Canarium schweinfurthii Engl.[††]	Empafu	Fruits	18	Plastic mugs	255	8 - 20	14.2
Cleome gynandra L.*	Eyobyo	Leaves & shoots	27	Bundles	376	8 - 20	13.9
Cleome hirta (Klotzsch) Oliv.*	Akayobyo akasajja	Leaves & shoots	13	Bundles	107	5 - 15	8.2
Corchorus tridens L.**	Eteke	Leaves & shoots	14	Bundles	150	5 - 15	10.7
Corchorus trilocularis L.**	Otigo lum	Leaves & shoots	14	Bundles	119	5 - 13	8.5
Crotalaria ochroleuca G.Don*	Kumuro, Alaju	Leaves & shoots	17	Bundles	191	5 - 15	11.2
Hibiscus acetosella Welw. *ex* Hiern*	Makawang kulo, Gwanya	Leaves & shoots	15	Bundles	177	8 - 15	11.8
Hibiscus sabdariffa L.*	Bamya, Ekikenke	Leaves & shoots	32	Bundles	635	10 - 35	19.8
Hyptis spicigera Lam.	Amola, Lamola	Seeds	8	Kg	51	3 - 10	6.4
Mondia whitei (Hook.f.) Skeels[Ω]	Omurondwa	Roots	12	Pieces	283	15 - 35	23.6

Phaseolus lunatus L.	Amaijalero, Okuku	Fresh seeds	16	Kg	124	3 - 20	7.8
Phaseolus lunatus L.[ΩΩ]	Amaijalero, Okuku	Fresh mature seeded pods	10	Heaps	88	6 - 16	8.8
Physalis peruviana L.[♀]	Ntuutu	Fruits	18	Heaps	287	10 - 25	15.9
Solanum anguivi Lam.[♀♀]	Obuhuruhuru, Katukuma	Fruits	26	Heaps	395	10 - 20	15.2
Solanum lycopersicum L.[®]	Bunyanya bunyoro	Ripe fruits	17	Heaps	217	8 - 20	12.8
Solanum macrocarpon L.[®]	Bugorra	Unripe fruits	10	Heaps	98	5 - 15	9.8
Solanum macrocarpon L.*	Bugorra	Young leaves	8	Bundles	83	7 - 18	10.4
Solanum nigrum L.*	Enswiga	Leaves	24	Bundles	459	10 - 30	19.1
Tamarindus indica L.[®®]	Mukoge	Fruits	22	Heaps	293	5 - 20	13.3
Vernonia amygdalina Del.[#]	Kibirizi	Leaves & shoots	13	Bundles	160	8 - 20	12.3
Vitex doniana Sweet[††]	Muhomozi, Owelo	Fruits	11	Plastic mugs	109	3 - 15	9.9
Conventionally cultivated food plants							
Abelmoschus esculentus (L.) Moench.[♀♀]	Okra	Fruits	27	Heaps	270	5-20	10
Brassica oleracea var capitata. L. (Alef.)[Θ]	Cabbages	Head	42	Heads	689	10 - 30	16.4
Mangifera indica L.[¥¥]	Mangos	Fruits	50	Heaps	1100	15 - 35	22.7
Passiflora edulis Sims.[¥]	Passion fruits	Fruits	35	Heaps	534	8-25	15.5
Phaseolus vulgaris L.	Common beans	Fresh seeds	45	Kg	653	9 - 18	14.5
Sesamum indicum Linn.	Simsim	Seeds	39	Kg	531	5-22	13.6
Vigna unguicullata (L.)Walp*	Cowpeas	Leaves	30	Bundles	537	15 - 25	17.9

[¥]1 heap = 8–15 fruits; *1 bundle = 300–450 g; **1 bundle = 200–300 g; [#]1 bundle = 300–500 g; [##]1 heap = 250–400 g; [†]1 fruit = 1.4–1.6 kg; [††]1 plastic mug (cup) = 0.5 kg; [Ω]1 piece of *M. whytei* root ≈ 0.01–0.02 m in diameter & 0.3–0.4 m in length; [ΩΩ]heap = 500–800 g; [♀]1 heap = 150–300 g; [♀♀]1 heap = 200–400 g; [®]1 heap = 200–400 g; [®®]1 heap = 300–400 g; [¥¥]1 heap = 300–600 g; [Θ]1 head = 400–1200 g.

6.6.2.5 Selling price and market demand

The market price of WSWFPs sold varied from species to species as well as on the unit of measurements. Among the leafy WSWFPs, the most valuable species were *Hibiscus acetosella* with an average price of UGX 493.3 ± 88.4 bundle^{-1}, followed by *Basella alba* selling at UGX 440 ± 80.3 heap^{-1} (Table 6.5). Majority of other leafy WSWFPs including *Crotalaria ochroleuca*, *Hibiscus sabdariffa*, *Cleome gynandra*, *Cleome hirta*, *Amaranthus dubius*, and *Amaranthus hybridus* subsp. *Cruentus*, *Solanum nigrum* and *Amaranthus lividus* had the average market price ranging between UGX 370.6 ± 84.9 to 308.3 ± 79.3 bundle^{-1}. Among leafy WSWFPs sold per bundle, *Bidens pilosa* had the lowest average market price of UGX 160 ± 51.6 bundle^{-1}.

Hyptis spicigera (dry seeds) and *Phaseolus lunatus* (fresh seeds) locally called Amaijalero commanded the highest average market price of UGX 1187.5 ± 241.6 kg^{-1} and 675 ± 85.6 kg^{-1} respectively. Fruits of *Aframomum alboviolaceum* and *Aframomum angustifolium* were traded at an average market price of UGX 641.7 ± 202.1 heap^{-1} and 558.8 ± 127.8 heap^{-1} respectively. *Borassus aethiopum* fruits also commanded a high average market price of UGX 620.0±178.1fruit^{-1}. Fruits of *Canarium schweinfurthii* and *Vitex doniana* were traded at average market price of UGX 433.3 ± 45.4 and 363.6 ± 50.5 plastic mug^{-1} respectively. While those of *Physalis peruviana* were sold at a relatively low market price (UGX 305.6 ± 72.5).

Table 6.5 Selling price and market demand of commonly sold WSWFPs.

WSWFPs sold	Local names	Parts sold	Market price (Ugandan Shillings)[@]	Average price (±StDev)	SEM	Market demand
Aframomum alboviolaceum (Ridley) K.Schum.[¥]	Amasaasi, Ocao	Fruits	500 - 1000 heap^{-1}	641.7 (202.1)	58.3	High
Aframomum angustifolium (Sonnerat) K.Schum.[¥]	Amatehe, Kongo amor	Fruits	400 - 800 heap^{-1}	558.8 (127.8)	31	High
Amaranthus dubius Mart. *ex* Thell.*	Doodo	Leaves & shoots	200 - 500 bundle^{-1}	345.7 (103.9)	17.6	Very high
Amaranthus graecizans L.*	Nyabutongo, Ocoboro	Leaves & shoots	100 - 300 bundle^{-1}	211.1 (75.8)	17.9	Low
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.*	Omujuiga	Leaves & shoots	300 - 400 bundle^{-1}	337.5 (51.8)	18.3	Very high
Amaranthus lividus L.*	Bwora, Mboog'ennene	Leaves & shoots	200 - 400 bundle^{-1}	308.3 (79.3)	22.9	low
Amaranthus spinosus L.*	Doodo y'amahwa	Leaves & shoots	100 - 300 bundle^{-1}	215.0 (74.5)	16.7	Low
Basella alba L.[##]	Enderema	Leaves & shoots	300 - 600 heap^{-1}	440.0 (80.3)	19.7	High
Bidens pilosa L.[#]	Obukurra	Leaves & shoots	100 - 200 bundle^{-1}	160.0 (51.6)	16.3	Very low
Borassus aethiopum Mart.[†]	Ekituugu, Tugo	Fruits	500 - 1000 fruit^{-1}	620.0 (178.1)	46	High
Canarium schweinfurthii Engl.[††]	Empafu	Fruits	400 - 500 plastic mug^{-1}	433.3 (45.4)	10.7	High
Cleome gynandra L.*	Eyobyo	Leaves & shoots	300 - 500 bundle^{-1}	363.0 (79.2)	15.2	High
Cleome hirta (Klotzsch) Oliv.*	Akayobyo akasajja	Leaves & shoots	200 - 500 bundle^{-1}	346.2 (112.7)	31.2	Low
Corchorus tridens L.**	Eteke	Leaves & shoots	100 - 300 bundle^{-1}	200.0 (78.4)	21	Low
Corchorus trilocularis L.**	Otigo lum	Leaves & shoots	100 - 300 bundle^{-1}	228.6 (82.5)	22.1	Low
Crotalaria ochroleuca G.Don*	Kumuro, Alaju	Leaves & shoots	300 - 500 bundle^{-1}	370.6 (84.9)	20.6	Low
Hibiscus acetosella Welw. *ex* Hiern*	Makawang kulo, Gwanya	Leaves & shoots	400 - 700 bundle^{-1}	493.3 (88.4)	22.8	Very high
Hibiscus sabdariffa L.*	Bamya, Ekikenke	Leaves & shoots	300 - 500 bundle^{-1}	368.7 (73.8)	13	High
Hyptis spicigera Lam.	Amola, Lamola	Seeds	1000 - 1600 kg^{-1}	1187.5 (241.6)	85.4	High
Mondia whitei (Hook.f.) Skeels[Ω]	Omurondwa	Roots	100 - 200 piece^{-1}	158.3 (46.9)	13.5	High
Phaseolus lunatus L.	Amaijalero, Okuku	Fresh seeds	600 - 800 kg^{-1}	675 (85.6)	21.4	Low
Phaseolus lunatus L.[ΩΩ]	Amaijalero, Okuku	Fresh mature seeded pods	300 - 500 heap^{-1}	370 (82.3)	26	Low
Physalis peruviana L.[♀]	Ntuutu	Fruits	200 - 400 heap^{-1}	305.6 (72.5)	17.1	High
Solanum anguivi Lam.[♀♀]	Obuhuruhuru,	Fruits	200 - 300 heap^{-1}	265.38 (48.5)	9.51	High

	Katukuma					
Solanum lycopersicum L.[®]	Bunyanya bunyoro	Ripe fruits	100 - 400 heap^{-1}	247.1 (80.0)	19.4	Low
Solanum macrocarpon L.[®]	Bugorra	Unripe fruits	200 - 500 heap^{-1}	380.0 (91.9)	29.1	Low
Solanum macrocarpon L.*	Bugorra	Leaves & shoots	200 - 300 bundle^{-1}	262.5 (51.8)	18.3	Low
Solanum nigrum L.*	Enswiga	Leaves	200 - 400 bundle^{-1}	316.7 (70.2)	14.3	Very high
Tamarindus indica L.[®®]	Mukoge	Fruits	100 - 300 heap^{-1}	231.8 (71.6)	15.3	Low
Vernonia amygdalina Del.[#]	Kibirizi	Leaves & shoots	200 - 300 bundle^{-1}	261.5 (50.3)	14	Very low
Vitex doniana Sweet[††]	Muhomozi, Owelo	Fruits	300 - 400 plastic mug^{-1}	363.6 (50.5)	15.2	High
Conventionally cultivated food plants						
Abelmoschus esculentus (L.) Moench.[♀♀]	Okra	Fruits	200 - 600 heap^{-1}	355.5 (98.4)	22.3	High
Brassica oleracea var capitata. L. (Alef.)[Θ]	Cabbages	Head	300 - 700 head^{-1}	489.9 (67.8)	15.1	High
Mangifera indica L.[¥¥]	Mangos	Fruits	100 - 500 heap^{-1}	365.0 (70.1)	28.5	Very low
Passiflora edulis Sims.[¥]	Passion fruits	Fruits	400 - 1000 heap^{-1}	600.9 (157.3)	42.6	High
Phaseolus vulgaris L.	Common beans	Fresh seeds	700 - 1200 kg^{-1}	845.4 (100.5)	33.4	High
Sesamum indicum Linn.	Simsim	Seeds	1200 - 2200 kg^{-1}	1670.6 (125.8)	38.8	Very high
Vigna unguicullata (L.)Walp*	Cowpeas	Leaves	200 - 500 bundle^{-1}	315.3 (49.4)	17.7	Low

[¥]1 heap = 8–15 fruits; *1 bundle = 300–450 g; **1 bundle = 200–300 g; [#]1 bundle = 300–500 g; [##]1 heap = 250–400 g; [†]1 fruit = 1.4–1.6 kg; [††]1 plastic mug (cup) = 0.5 kg; [Ω]1 piece of *M. whytei* root ≈ 0.01–0.02 m in diameter & 0.3–0.4 m in length; [ΩΩ]heap = 500–800 g; [♀]1 heap = 150–300 g; [♀♀]1 heap = 200–400 g; [®]1 heap = 200–400 g; [®®]1 heap = 300–400 g; [¥¥]1 heap = 300–600 g; [Θ]1 head = 400–1200 g; [@]USD1 = 2010 Uganda shilling (UGX).

6.6.2.6 Profit margins for traded WSWFPs during the harvest seasons

Average weekly profit yielded from the trade of various WSWFPs per trader ranged from UGX 764.5 to 6754.2 to (USD 0.38–3.36) (Table 6.6). Highest profit comes from selling *Hyptis spicigera* seeds (UGX 6754.2 trader^{-1}), *Hibiscus sabdariffa* (5944 trader^{-1}), *Aframomum angustifolium* (5914.2 trader^{-1}), *Borassus aethiopum* (5749.2 trader^{-1}), *Basella alba* (5410.1 trader^{-1}), *Solanum nigrum* (5343.2 trader^{-1}), *Aframomum alboviolaceum* (5191.9 trader^{-1}), and *Canarium schweinfurthii* (4922.4 trader^{-1}). Average weekly profit margins for most plants ranged from UGX 4922.4 to 2314.7. However, species such as *Amaranthus spinosus* (UGX 1873.4 trader^{-1}), *Corchorus tridens* (UGX 1749.4 trader^{-1}), *Corchorus trilocularis* (UGX 1608.9 trader^{-1}) and *Bidens pilosa* (UGX 764.5 trader^{-1}) had the lowest weekly profit margins.

Weekly average cost incurred per trader during marketing process varied depending on the species. *Borassus aethiopum, Hibiscus sabdariffa, Canarium schweinfurthii, Amaranthus dubius, Amaranthus graecizans, Hibiscus acetosella, Phaseolus lunatus* had the highest average costs of over UGX 1000 (USD 0.5) trader^{-1} (Table 6.6). Costs incurred included mainly market dues as well as packing materials (polythene bags). Transport expenses were excluded in the cost computation because only 4% of the traders incurred transport expenses in the form of hired bicycles.

Table 6.6 Average weekly profit margins (Ugandan shillings) for the traded WSWFPs during the harvest seasons.

WSWFPs sold	Local names	Parts sold	Average quantity/trader	Average price/unit	Average cost incurred/ trader*	Average income/trader	Average profit/trader[@]
Aframomum alboviolaceum (Ridley) K.Schum.	Amasaasi, Ocao	Fruits	8.8 heaps	641.7	455.1	5647.0	5191.9
Aframomum angustifolium (Sonnerat) K.Schum.	Amatehe, Kongo amor	Fruits	11.6 heaps	558.8	567.9	6482.1	5914.2
Amaranthus dubius Mart. *ex* Thell.	Doodo	Leaves & shoots	16.3 bundles	345.7	1152.4	5634.9	4482.5
Amaranthus graecizans L.	Nyabutongo, Ocoboro	Leaves & shoots	16.2 bundles	211.1	1097.8	3419.8	2322.0
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	Omujuiga	Leaves & shoots	9.0 bundles	337.5	520.3	3037.5	2517.2
Amaranthus lividus L.	Bwora, Mboog'ennene	Leaves & shoots	10.2 bundles	308.3	458.6	3144.7	2686.1
Amaranthus spinosus L.	Doodo y'amahwa	Leaves & shoots	10.9 bundles	215.0	470.1	2343.5	1873.4
Basella alba L.	Enderema	Leaves & shoots	14.4 heaps	440.0	925.9	6336.0	5410.1
Bidens pilosa L.	Obukurra	Leaves & shoots	5.5 bundles	160.0	115.5	880.0	764.5
Borassus aethiopum Mart.	Ekituugu, Tugo	Fruits	11.5 fruits	620.0	1380.8	7130.0	5749.2
Canarium schweinfurthii Engl.	Empafu	Fruits	14.2 plastic mugs	433.3	1230.5	6152.9	4922.4
Cleome gynandra L.	Eyobyo	Leaves & shoots	13.9 bundles	363.0	751.7	5045.7	4294.0
Cleome hirta (Klotzsch) Oliv.	Akayobyo akasajja	Leaves & shoots	8.2 bundles	346.2	422.3	2838.8	2416.5
Corchorus tridens L.	Eteke	Leaves & shoots	10.7 bundles	200.0	390.6	2140.0	1749.4
Corchorus trilocularis L.	Otigo lum	Leaves & shoots	8.5 bundles	228.6	334.2	1943.1	1608.9
Crotalaria ochroleuca G.Don	Kumuro, Alaju	Leaves & shoots	11.2 bundles	370.6	669.6	4150.7	3481.1
Hibiscus acetosella Welw. *ex* Hiern	Makawang kulo, Gwanya	Leaves & shoots	11.8 bundles	493.3	1078.5	5820.9	4742.4

Hibiscus sabdariffa L.	Bamya, Ekikenke	Leaves & shoots	19.8 bundles	368.7	1356.3	7300.3	5944.0
Hyptis spicigera Lam.	Amola, Lamola	Seeds	6.4 kg	1187.5	845.8	7600.0	6754.2
Mondia whitei (Hook.f.) Skeels	Omurondwa	Roots	23.6 pieces	158.3	296.7	3735.9	3439.2
Phaseolus lunatus L.	Amaijalero, Okuku	Fresh seeds	7.8 kg	675	1010.4	5265.0	4254.6
Phaseolus lunatus L.	Amaijalero, Okuku	Fresh mature seeded pods	8.8 heaps	370	600.7	3256.0	2655.3
Physalis peruviana L.	Ntuutu	Fruits	15.9 heaps	305.6	790.5	4859.0	4068.5
Solanum anguivi Lam.	Obuhuruhuru, Katukuma	Fruits	15.2 heaps	265.4	875.6	4033.8	3158.2
Solanum lycopersicum L.	Bunyanya bunyoro	Ripe fruits	12.8 heaps	247.1	785.5	3162.9	2377.4
Solanum macrocarpon L.	Bugorra	Unripe fruits	9.8 heaps	380.0	650.0	3724.0	3074.0
Solanum macrocarpon L.	Bugorra	Young leaves	10.4 bundles	262.5	415.3	2730.0	2314.7
Solanum nigrum L.	Enswiga	Leaves	19.1 bundles	316.7	705.8	6049.0	5343.2
Tamarindus indica L.	Mukoge	Fruits	13.3 heaps	231.8	425.5	3082.9	2657.4
Vernonia amygdalina Del.	Kibirizi	Leaves & shoots	12.3 bundles	261.5	510.9	3216.5	2705.6
Vitex doniana Sweet	Muhomozi, Owelo	Fruits	9.9 plastic mugs	363.6	488.2	3599.6	3111.4

* Costs incurred included mainly market dues and packing materials (polythene bags). Transport expenses were excluded in the cost computation because only 4% of the traders incurred transport expenses in form of hired bicycles. [@]USD1 = 2010 Uganda shilling (UGX).

6.6.3 Market opportunities and impediments to trade of WSWFPs in Kingdom

6.6.3.1 Impediments to trade in WSWFPs in the Kingdom

Marketing of WSWFPs just like the trade of conventionally cultivated food crops, face several challenges. In general, high perishability of most traded WSWFPs was the major setback for many (88.6 ± 2.6%) traders dealing in these categories of plants (Table 6.7). Most (81.1 ± 4.2%) traders also complained of the market dues they have to pay irrespective of what they are selling in the markets. Inaccurate consumers' perceptions of WSWFPs (73.0 ± 1.8%), for instance perception of WSWFPs as food for the poor and uncivilized people greatly affect the trade. Seasonal nature and unreliability in supply of some traded WSWFPs were also reported as a major drawback (70.4 ± 1.3%).

Table 6.7 Impediments to trade in WSWFPs in the Kingdom.

Market challenges	% response (±SEM)
High perishability (most can not be stored for long in fresh form).	88.6 (2.6)
Market dues.	81.1 (4.2)
Inaccurate consumers perceptions of WSWFPs such as poor mans' food, food for uncivilized.	73.0 (1.8)
Some are seasonal hence unreliable quantities for market.	70.4 (1.3)
Unorganized markets (WSWFPs sold in dirty places often on the ground, no established marketing groups).	68.5 (3.7)
Little or no value addition to improve on the demand and market prices.	52.9 (4.6)
Limited market information.	45.3 (6.4)
Few buyers and generally low demands.	43.9 (1.7)
Difficulty in setting the prices.	30.7 (3.1)
No market promotional activities.	25.5 (5.4)

Other challenges included unorganized markets (WSWFPs sold in dirty places often on the ground, no established marketing groups), little or no form of value addition to improve on the demand and market prices, limited market information, few buyers and generally low demands; difficulty in setting the prices, and the non existence market promotional activities (Table 6.7).

6.6.3.2 Market opportunities for trade in WSWFPs

Amidst the numerous marketing challenges, there were still some opportunities reported by traders that could potentially promote the trade in WSWFPs in their area (Table 6.8). Many (85.4 ± 1.5%) traders viewed growing market demand of most WSWFPs as a good opportunity for trade in WSWFPs. Similarly, the increasing focus of most service providers from local governments as well as civil society organizations such as community based organizations (CBOs), and faith based organizations (FBOs) in creating awareness about WSWFPs was considered by many (68.3 ± 7.4%) traders as an opportunity to increase the volume of traded WSWFPs.

Other recorded opportunities that could promote marketing of WSWFPs included the ever-changing perception about nutritional values of WSWFPs (57.3 ± 2.1%) by the general public, and current government emphasis on value addition (23.2 ± 5.5%) on traded agricultural products. Some traders (20.5 ± 4%) considered the fact that trade in WSWFPs required little or no need for start-up capital as equally an opportunity to trade in these resources. Others (15.5 ± 4.6%) said the absence of restrictive regulations on sale of WSWFPs unlike wild meat is an opportunity that should be exploited.

Table 6 8 Market-related opportunities for trade in WSWFPs.

Market opportunities for trade in WSWFPs	% response (±SEM)
Increasing market demands for WSWFPs	85.4 (1.5)
Increasing focus of service providers in WSWFPs	68.3 (7.4)
Changing perception about nutritional values of WSWFPs	57.3 (2.1)
Current government emphasis on value addition	23.2 (5.5)
Little or no need for start-up capital to trade in WSWFPs	20.5 (4.0)
No restriction to sell WSWFPs unlike wild meat	15.5 (4.6)

6.6.4 Strategies to improve the marketing of WSWFPs in the Kingdom

To improve the marketing of WSWFPs in the Kingdom, the following interventions were suggested by traders (Table 6.8) and some key informants: Training of gatherers and traders on how to add values to WSWFPs to increase their market demand (78.0 ± 3.5%); creation of market demands through promotional and awareness campaigns (74.4 ± 4.6%). There were suggestions from key informants that creation of market demand could be possible especially through deliberate radio broadcasts, local newspapers, posters, or erecting signposts in areas frequented by potential customers such as the markets, churches, mosques, and water collection points.

Many (67.1 ± 1.3%) respondents equally suggested scrapping the market dues paid by traders dealing in WSWFPs as an intervention that could improve on the market of WSWFPs in area. However, interviews with some local government officials about the traders' idea of scrapping market dues levied on WSWFPs were not welcomed. Other potential interventions suggested included the idea of helping gatherers and sellers to organise themselves by forming viable supply and market groups (51.2 ± 3.7%); linking gatherers and sellers to good markets, as well as providing them with available market information (Table 6.8). There were suggestions that the civil society organizations and local government production departments should take lead in these aspects.

Table 6.9 Strategies to improve the marketing of WSWFPs in the Kingdom.

Strategies/suggestions	% response (±SEM)
Training people on how to add values to WSWFPs before selling.	78.0 (3.5)
Creating market demands through promotions and awareness through radios, in the churches and mosques.	74.4 (4.6)
Scrapping off the market dues paid for selling WSWFPs.	67.1 (1.3)
Help gatherers and sellers to organise themselves by forming groups.	51.2 (3.7)
Linking gatherers and sellers to good markets.	30.5 (5.4)
Providing market information to gatherers and sellers.	22.0 (1.9)

6.7 Discussion

6.7.1 Market characteristics

6.7.1.1 Traders and their distribution by markets

Most traders of WSWFPs were elderly married people, particularly women with a basic primary education. It was clear that the selling of WSWFPs plants were not the primary occupation of some traders, as a number of traders were engaged chiefly in subsistence farming. The finding compares with other studies on wild food resources elsewhere. For instance in Zambia, Mkonda *et al.* (2003) found out that 81% of *Uapaca kirkiana* (sugar plum) wild fruit marketing was performed by women of which 92% were married. Similarly, in Northeast Thailand, women involvement in local marketing, movement and transformation of wild food plants into income-generating commodities have been reported (Moreno-Black and Price, 1993; Price, 2000).

In Uganda, women are the backbone of the household economy. On average, a Ugandan woman spends about 10 hours per day in specific tasks such as weeding, harvesting of crops, fetching water and firewood, cooking food, managing home sanitation, and selling some few items in the local markets, while men only work in the mornings and spend the rest of the afternoon and evening either resting or socializing with colleagues. Therefore, having more married traders in the marketing of WSWFPs may suggest that the trade in WFWFPs is an important livelihood coping strategy for income generation for poor households. The fact that most traders on average had a family size of seven persons, which is higher than the average national household size of five persons per household (Uganda Bureau of Statistics, 2002), implies a need for more income generating ventures such as trade in WSWFPs to cater for the pressing family basic needs such as health care.

The findings also indicated that trade in WSWFPs within the Kingdom, was still largely undeveloped with few traders (mainly women) scattered all over formal markets located both in trading centres and rural areas; home-based/roadside stalls market, and in mobile business inform of hawkers moving from place to place in search for potential buyers. Some women were reported to be specialized in home delivery systems, whereby they would carry plants mostly leafy wild vegetables on their head moving from house to house of their usual customers. The finding compare with observations made by Asfaw and Tadesse (2001), who noted that the few traders that were involved in selling wild food plants in Ethiopia were distributed all over town and village markets as well as the road stalls. It is therefore, clear from such findings that there is often no clear pattern of distribution of traders dealing in WSWFPs in both formal and informal markets although women traders tend to dominate in all these places.

6.7.1.2 WSWFPS traded in the locality

Out of 62 WSWFPs belonging 32 botanical families reported to be eaten in this locality, about 47% belonging to 12 botanical families were traded in the formal and informal markets in this area, which is a fairly high number considering that many species are consumed either at the household levels or at their collection sites only. About seven to ten WSWFPs species were always available in the markets, showing their high diversity in the markets. Compared to other places elsewhere, the number of WSWFPs traded in the present study is quite high. For instance in Sikkim Himalaya, Sundriyal and Sundriyal (2004) reported that out of 190 wild edible species that are consumed as food in the region, only about 24% are brought to the local markets. In nearly all instances, the findings of this study indicated that WSWFPs were not the primary product sold by traders that deal in WSWFPs. Many traders sold WSWFPs in combination with conventional farmed products such as tomatoes, okra, oranges, mangoes, lemons, banana of different types, cabbages, beans, and peas. Similar observation was also reported by Karaan *et al.* (2005) who noted traders of wild fruits such as *Vitex mombassae, Vitex doniana* and *Strychnos cocculoides* in Tanzania, Zimbabwe and Zambia were engaged primarily in selling farmed products such as tomatoes, pumpkins, lemons and even fish. Therefore, any attempt to promote trade in WSWFPs should perhaps, be integrated into those strategies aimed at promoting trade of conventional crops.

6.7.1.3 Processing and value addition prior to sale

Sundriyal and Sundriyal (2004) reported that processing of and value addition to wild edible plants especially wild fruits can increase income generated by their sales three to four times if products like pickles, jam, jelly and squash are made from them. Similarly, findings from Technology Transfer Series (DENR-CAR, 1993), indicates that processed wild food plants can have high market potentials both locally and abroad, and can enable a family to earn additional income aside from generating additional revenue for the government through taxes. However, in the present study, most traders sold WSWFPs in their generic forms without any form of processing or value addition. Those who attempted to process or add value to WSWFPs prior to sale, only engaged in preliminary activities such as washing the plants to remove dirt and soil particles, sorting bad or old ones away from the batches and grading into quality batches. Practices like parboiling, drying and crushing the plant to powder as well as processing to juice and wine were very limited. There is therefore, a need for deliberate encouragement and promotion of simple processing and value addition activities beyond mere preliminary processing activities reported in this study to increase the benefits or income generated from the sales of these WSWFPs.

6.7.1.4 Market chains, customers and relationship between traders and their suppliers

Kaaria (1998) reported that the market chain of most wild edible plants such as fruits normally starts with farmers or local community members who collect plants for home consumption and for sale at roadside to other community members or to traders who transport the plants to urban markets. These traders would either function as wholesalers and sell to retailers, or sell the fruits themselves as retailers. In addition, collectors would sometime sell their products directly to the public at markets, effectively eliminating all intermediaries. Besides Ham *et al.* (2008) and Agea *et al.* (2008) opined that longest chain in marketing of wild edible plants often consists of collectors, wholesalers, retailers, and consumers. However, in the present study market chains for WSWFPs were very short, simple and dominated by traders who double as gatherers, and selling directly to consumers at places such as trading centres, village markets, roadside stalls, or homesteads.

In fact most customers, who happened to be mainly elderly persons particularly women, coming from within or nearby villages, trading centres and towns. This is consistence with the general negative perception in the area that wild food plants are food for the lazy, handicapped, and elderly people. It is also important to note that most traders of WSWFPs who double as gatherers, were supported by family members in the gathering activities, sorting and cleaning of WSWFPs. Family members also helps in carrying the products to the market locations. There were few inter-trade activities between traders, whereby some traders buy some stocks to sell from their fellow traders. In Malawi, Kaaria (1998) reported a similar kind of inter-trade existing between the traders of indigenous fruits.

It should be noted that along the simplified market chain observed in the present study, there was little or no explicit division of marketing activities such as gathering, transportation, and value addition by actors. For instance, there were no specialised collectors, wholesalers, and retailers. Such short and simplified market chains without clear distinguishable roles of actors along the chain was as well reported by Ramadhani and Schmidt (2008) as a characteristic of marketing chain of most indigenous fruits in southern Africa. Similarly, traders of non-timber forest products (NTFPs) in Cameroon were reported (Ndoye, 1995) to often simultaneously act as an assembler/wholesaler or a wholesaler/retailer. Therefore, the marketing systems of WSWFPs in the present study comprising of short market chains are unorganized and do not enjoy the benefits of specialization along the market chains. Ham *et al.* (2008) asserted that such short market chain has however, the advantage of gatherers negotiating better price with the consumers by effectively eliminating all the intermediaries in the market process.

6.7.2 Market conduct and performance of the WSWFPs traded in the Kingdom

6.7.2.1 Transportation of WSWFPs to market location

In marketing, products have to undergo a series of transfers or exchanges from one hand to another before finally reaching the consumer. This movement is always facilitated by transport. Transportation thus plays an important role in market conduct and performance as it helps in assembling and dispersing the products to the market locations, thereby linking the producers/gatherers with the buyers who might be located at different places (Jain, 2009). Availability of cheap transport is therefore, a key factor that influences the market conduct and performance of most traded goods (Kotler and Armstrong, 1999). In the present study, walking was by far the most predominant mode of transport for traded WSWFPs to the market locations. Generally, women and girls carry the produce on the heads while walking and men especially the mobile hawkers largely carry them in polythene or locally made baskets bags by handles. Although, walking plays a considerable role in marketing of WSWFPs in this area, this mode of transport is often restricted by weight carried or distance to the market.

A few people also use bicycles to deliver the stocks to the markets. Bicycles are seldomly used for a number of reasons. The main reason is that most men who own bicycles cannot entrust them with the wives who are the main traders of WSWFPs. Besides, the 2005-2006 Uganda National and Housing Survey (Uganda Bureau of Statistics, 2006) showed that only 33.4% of the households in western Uganda possessed bicycles. Therefore, most women depend on the cheapest form of transport to the markets, which is walking. None of the traders in this locality reported using the public transport means such as taxis to deliver their stocks to the market. Similar findings were reported by Kadzere *et al.* (1998) who noted that delivery of wild fruits to the market in remote areas of southern Africa was predominantly by foot (walking) besides occasional use of ox-carts, bicycles and buses. Because of the meagre returns from the sale of wild food plants, gatherers would not want to rely on costly modes of transport to deliver their stocks to the market places.

6.7.2.2 Price setting and market information for WSWFPs

Pricing is one of the main elements of the marketing mix and is an important strategic issue in market conduct and performance because it affects products positioning and sales (Tomek and Robinson, 1990; Panigyrakis, 1997). There are generally three basic types of pricing strategies: pricing based on the total cost incurred, pricing based on demand and pricing based on competition (Panigyrakis, 1997). However, information garnered from this study shows that there are no definite or formal mechanisms of setting prices of WSWFPs traded by the vendors.

Most traders relied on daily market demands to determine the price upon which they sell their products. Others considered time and risks involved in gathering process, price information of the substitute food plant, price information on WSWFPs from other areas and markets, knowledge of the past season prices or the costs incurred from their suppliers. However, in all these cases, price fixing follows a sort of action-reaction sequence, generally beginning with the interested buyer asking for the price, followed by the naming of a price by the trader. Based on this, the bargaining process would begin until a final price, which the buyer is ready to pay is reached. So even after a trader has set a fair market price, negotiation with buyers would sometimes lower the price further.

These findings are similar to the situation in most southern African countries, where available information (Ham *et al.*, 2008) indicates that there is no defined mechanism for setting market prices of wild edible plants especially the indigenous fruits. Similarly, in west and central Africa, there is no consistent mechanism (Tchoundjeu *et al.*, 2008) upon which traders selling wild food plants determine the market price of their stocks; some traders, for instance, consider the customers affordability to buy the product. In that case, the prices are set depending on the sellers' assessment of the buying power of individual customers. A mere look at the customer would sometimes help sellers to gauge how much to charge them.

However, efforts to trade in WSWFPs can only thrive better in an environment where market information is freely available. As discussed by Shepherd (1997), market information can help traders, farmers and gatherers to decide whether they should sell their products immediately or whether storage is necessary or not; where and whom to sell; whether to add value to their products or not; and to know if there is more demand for one product or another. Such information can be used to check whether the prices the traders get are reasonable. Shortage of market information is disadvantageous for traders, farmers, and or gatherers in negotiating with buyers and therefore, weakens their bargaining power (Poole, 2001). Therefore, the selling price of traded wild food plants could be improved based on available and reliable price information. Unfortunately, in the present study, market information system for WSWFPs was largely rudimentary and undeveloped. Traders and gatherers rely mainly on information from fellow traders as well as their customers to make market decisions. There is very little market information passed on to traders and gatherers by public and private media as well as the service providers.

6.7.2.3 Estimated volumes, selling price and profit margins of traded WSWFPs

Generally, findings from the present study indicate that volumes of WSWFPs weekly traded in the markets are still low, compared to some conventionally cultivated food crops. The low weekly volumes of WSWFPs such as *Bidens pilosa* and *Vitex doniana* could perhaps, be attributed to low demand, low purchasing power, and general negative public perceptions of WSWFPs or lack of trade promotion in wild food plants (Sharma *et al.*, 1992). However, there is some light at the end of the tunnel. The volumes of some traded species such as *Hibiscus sabdariffa*, *Solanum nigrum*, *Amaranthus dubius*, *Cleome gynandra*, *Physalis peruviana*, *Basella alba*, *Tamarindus indica* and *Mondia whitei* traded weekly in the markets are reasonably high and are potential sources of cash incomes to the gatherers and traders alike. In Sikkim Himalaya, Sundriyal and Sundriyal (2004) also found that volumes of wild edible plants traded in three weekly markets of Gangtok, Singtam and Namchi were generally low with few exceptions of species such as *Spondias axillaris*, *Dendrocalamus hamiltonii*, *Urtica dioica*, *Diplazium esculentum*, *Eleagnus latifolia*, and *Machilus edulis* that had very high weekly and annual volumes marketed. Similarly, Shanley *et al.* (2002) reports low volumes of traded wild edible plants in Capim region of Brazil with exception of *Caryocar villosum*, *Platonia insignis* and *Endopleura uchi* fruits, which were found to be traded in sufficient quantities, and whose high volumes were attributed to their high demand for flavouring ice cream, yogurt, jams and juice by the natives. Therefore, one can deduce that WSWFPs sold in large quantities are those that command high demands, otherwise most traders prefer selling small quantities of different WSWFPs, as they are well aware of their low market demand.

Concerning market prices, the results of the present study revealed that the selling prices of the traded WSWFPs varied according to species marketed and unit of measurements. Compared to conventional food plants; the prices of most traded WSWFPs were generally alike. Some WSWFPs such as *Hibiscus acetosella*, *Basella alba*, *Hyptis spicigera* (seeds), *Phaseolus lunatus* (fresh seeds), *Aframomum* *alboviolaceum* and *Aframomum angustifolium*, *Borassus aethiopum* (fruits) had higher selling prices per unit measurement compared to the related conventional cultivated food plants traded in same locality. Their high market prices could perhaps, be attributed to their perceived nutritional and medicinal properties. Market demands of other traded WSWFPs, were noted to be rising either due to the same reason as above and other factors such as the repeated occurance of drought in the study area that often results in crop failure hence heavy reliance on wild resources by poor households. Elsewhere, there is a report that some traded wild edible food plants command higher market prices. For instance, in Sikkim Himalaya region of India, most traded wild food plants (e.g. *Tupistra nutans*, *Dendrocalamus hamiltonii*, *Diploknema butyracea* and *Eleagnus latifolia*) had very high market prices per unit measurement, accredited to mainly excessive labour costs involved in the marketing process, high demand as well as well as higher income of the people in the region (Sundriyal and sundriyal, 2004). Thus, increasing demand and prices of WSWFPs especially in the context of the present study could perhaps, be considered an opportunity to promote sustainable utilization and management of edible wild food plants.

Marketing margin is an indicator of the profitability of WSWFPs marketing. The finding from this study indicated that the average weekly profit yielded from the trade of various WSWFPs were moderate and ranged from UGX 764.5 to 6754.2 (USD 0.38–3.36). However, the highest return came from few species such *Hyptis spicigera, Hibiscus sabdariffa, Aframomum angustifolium, Borassus aethiopum, Basella alba, Solanum nigrum, Aframomum alboviolaceum* and *Canarium schweinfurthii.* According to most traders, profit from WSWFPs would be much higher, if it were not because they have to sell these plants at a low price. Very little costs ranging from UGX 115.5 to 1380.8 (USD 0.06–0.69) were incurred by the trader in the marketing process. These costs included mainly market dues and packing materials (polythene bags). Transport expenses were excluded in cost computation because only 4% of traders incurred it. Similar to Dixon *et al* (1989), it was not possible to compute time and labour costs involved in gathering process. In view of these costs, it is plausible to say that the profit margin would have been very low if the time and labour employed in gathering process were taken into account. However, given the very poor economic status of most traders of WSWFPs and the fact that majority of them survive on less than 1 USD a day, even a small amount of earnings, which may only be payment for the labour and time involved in the gathering processing, has a significant value, as it helps to fulfil some subsistence requirements.

6.7.3 Market opportunities and impediments to trade in WSWFPs in Kingdom

6.7.3.1 Impediments to trade

Although marketing WSWFPs can contribute to household income, it faces several challenges just like trade in conventional food crops. The fact that most traded WSWFPs are highly perishable posed a big challenge to most traders dealing in these categories of food plants. A problem often compounded by short shelf-life of most traded WSWFPs, thus making the trade in WSWFPs very risky and unattractive. Awono *et al.* (2002) also acknowledged this problem as a single greatest constraint that traders of safou (*dacryodes edulis*) in Cameroon face. Besides, most traders of WSWFPs in the present study complained about the market dues that market authorities in formal markets demand them to pay irrespective of what they are selling. To them, the market dues should be limited only to conventional food and cash crops not to the WSWFPs that has generally low demands and returns. Some traders reported sometimes spending the whole market day, with less than five customers buying their products. Similar claims has also been registered by the market vendors trading in non-wood forest products (NWFPs) in the humid forest zone of Cameroon (Ruiz Perez *et al.*, 1999), a case where vendors of NWFPs were not happy with the market taxes and number of other local regulations they were subjected to.

Inaccurate consumer perceptions about WSWFPs were also reported as a major drawback to their trade. Perceptions that WSWFPs are meant for the poor, uncivilized, and handicapped persons really affect their trade. Elsewhere, there is a report that similar perceptions have considerably affected trade of most wild fruits (e.g. *Uapaca kirkiana*) in Zambia because some communities believe that ancestral spirits own wild fruit trees, therefore it is a taboo to engage in commercial trade on these fruits as the spirits disapproves of such use (Kwesiga and Mwanza, 1994;

Mwanza and Kwesiga, 1994). Seasonal availability and unreliability in the supply of some traded WSWFPs were also some of the challenges traders are confronted with. Some of species such as *Aframomum alboviolaceum* and *Vitex doniana* were said to be very seasonal and have unpredictable supply, leading to supply-demand imbalances. Gondo *et al.* (2002) reports that such problems of seasonality and reliability in supply, makes the flow of income generated from the traded non-wood forest products inconsistent and at times even non-existence.

In addition, the present findings indicated that the market systems of traded WSWFPs are largely unorganized without any established marketing groups, and with most vendors often relegated to the dirty parts of the market. The majority of the vendors often display their products on the ground sometimes without mats underneath, a practice that can encourage contamination and spoilage. Kaaria (1998) also acknowledged such a problem as faced by traders of wild fruits in Malawi, where many traders sell their wares outside the markets because of limited space inside and basically put their produce on the floor, or lay down a piece of cloth to protect the goods from getting dirty. Aside from market disorganisation, trade in WSWFPs were characterised by very little form of value addition activities for improved demand and market prices with virtually no market promotional activities. The plants were generally offered in their generic form as and when available with little done to promote their trade other than mere art of display (arranging products in an interesting and persuasive manner) and persuasion (using familiar names, such as mother, father, uncle, sister, brother, auntie, even though he/she does not know who the customers are).

Other challenges faced by traders of WSWFPs included limited and sometimes completely no market information, low demands with few interested buyers and general difficulties in determining the market prices. Such challenges, however, are not restricted to traders of WSWFPs in Bunyoro-Kitara Kingdom. Ramadhani and Schmidt (2008) observed that some of these obstacles especially limited information is a major setback in marketing of indigenous fruits in southern Africa. They attributed some of these challenges to the limited growth and under-development of the sub-sector on the marketing of tree products, a feature that characterizes the trade systems of wild food resources in Bunyoro as well.

6.7.3.2 Market opportunities

Despite numerous challenges reported, there are still some opportunities that traders hoped could potentially enhance marketing of WSWFPs in Bunyoro-Kitara Kingdom. Many traders viewed growing market demands for WSWFPs as a good opportunity that could uplift and promote trade in WSWFPs. The current economic hardships within the study area and Uganda as a whole provide opportunities for even expanded demand for WSWFPs to satisfy the increasing food needs. Moreover, there is anecdotal evidence that there is a trend to revert to traditional foods. Osemeobo and Ujor (1999) in their study of non-wood forest products (NWFPs) in Nigeria pointed out that consumers' demands largely determine the market of most NWFPs. For instance, they reported that products such as chewsticks and wild vegetables that are often required on a daily basis have good markets in Nigeria.

Similarly, evidence from present study show that there is current increasing attention and focus by service providers from both local governments as well as civil society organizations (e.g. community based organizations and faith based organizations) in creating awareness about WSWFPs. This growing attention, coupled with the ever-changing perceptions on nutritional values of WSWFPs by the public is considered by most traders as an opportunity to increase the volume of traded WSWFPs. The role of service providers in fostering trade of agro-produce especially among traders in low-income areas has long been recognized. Hughes and Mattson (1995) opined that service providers help promote farmers' markets through the awareness creation and dissemination of "how-to" publications, which typically include tips about having a marketing, pricing, advertisement, and offering a sufficient product variety to ensure consumer satisfaction.

In addition, some traders view current Government of Uganda's emphasis on value addition on traded agricultural products as an opportunity that could enhance trade in WSWFPs as well. In Sikkim Himalaya, cost-benefit analysis of value addition activities to wild edible plants revealed that the income from trade of those plants can be increased by three to four times (Sundriyal and Sundriyal, 2004). However, just like in the present study, they noted that most wild edible plants of Sikkim Himalaya are mainly marketed in their generic forms. The other notable opportunity reported in this study was the fact that trade in WSWFPs required very little or no need for start-up capital and therefore, can be initiated without much difficulties. One only needs to scavenge the niches where these WSWFPs grow to get a start-up stock sometimes with or without the family labour. Gondo *et al.* (2002) also acknowledged that because of little capital requirements, most poor people often take up trade in non-wood forest products as a source of livelihood. Lastly, unlike the trade in wild game (meat) which is illegal and prohibited in Uganda, there are no such restrictions on the trade of WSWFPs in the area. Informal discussion with some traders revealed that much as most households in the study area eat bush meat on a weekly basis, its trade goes on undercover.

6.7.4 Strategies to improve the marketing of WSWFPs in the Kingdom

Improving marketing is often a long process and it is unlikely that marketing problems can be solved in one day and by the outsiders. Freedgood (1987) reported that there is no magic formula for improving local markets; feasible solutions to marketing problems should come from the local traders themselves, which can then be built upon by external actors. In the present study, there were many interventions suggested by traders that could help to improve on the markets of WSWFPs in the study area. Outstanding among these interventions, was the training need for gatherers and traders of WSWFPs on value addition activities. However, given the nature of most traded WSWFPs, and the little emphasis placed on their marketing and consumption by policy-makers in both at national and local governmental levels in favour of conventional crops, this strategy may not be very convincing and feasible at the moment.

Aside, from this, there were suggestions for concerted efforts especially by service providers and local governments to invest in promotional and awareness campaigns in order to expose the hidden benefits of WSWFPs. It is thought that with increased awareness about the hidden benefits of the WSWFPs, their demand will increase and hence many customers. There were suggestions that these promotional and awareness campaigns should deliberately be carried out on radios, local news papers, posters or sign posts in areas frequented by potential customers such as the markets, churches, mosques and water collection points. Agea *et al.* (2004*b*) tried similar promotional and awareness campaign strategy through radio broadcast programs and use of posters while promoting the use of indigenous fruits in Lira district of Northern Uganda, and today, there is anecdotal evidence that demand of indigenous fruits is on a rise in the district.

There was also a suggestion that market dues paid by traders selling WSWFPs could be scrapped. However, interviews with market officials and local government bureaucrats suggest that this intervention is not possible because market dues are sources of revenue for local governments, and therefore, scrapping off such taxes would encourage tax evasion by some traders dealing in conventional crops disguising to be selling WSWFPs. Some market officials already claimed to be getting resistance to collecting market dues from some traders especially those selling their products outside gazetted market areas. On the other hand, ideas of helping gatherers and sellers to organise themselves into viable supply and market groups, linking them to good markets, as well as providing them with available market information were all welcomed by local government and market officials. In fact there were suggestions that the civil society organizations and local government production departments should take lead in these aspects just like they are doing with the mainstream agricultural food and cash crops. Experiences from the trade of safou (*Dacryodes edulis*) in Cameroon have shown that if gatherers, who in most cases double as traders are organised into groups and helped to sell their produce to their neighbours, local markets, visiting traders or to wholesalers at the most remunerative prices (Awono *et al.*, 2002); they could substantially increase their income and improve on their livelihoods.

6.8 Conclusions

Trade in WSWFPs is still largely undeveloped with few traders who are mainly women, scattered all over formal markets in trading centres and rural areas; home-based/roadside stalls market, and in mobile business in the form of hawkers moving from place to place (sometimes from one home to another). Selling of WSWFPs plants were not the primary occupation of some traders. Most traders sold WSWFPs in combination with conventional farmed products such as tomatoes, okra, oranges, mangoes, lemons, bananas, cabbages, beans and peas.

Out of 62 WSWFPs belonging to 31 botanical families reported in the study, about 47% belonging to 12 botanical families were traded in formal and informal markets within the study area, which is a fairly high number considering that many species are consumed either at the household levels or at their collection sites only. Nearly all traders sold WSWFPs in their generic forms without any form of processing or value addition. Those who attempted to process or add value, were engaged only in preliminary activities such as washing to remove dirt and soil particles, sorting bad or old ones away from the batches and grading into quality batches.

Market chains for traded WSWFPs were very short, simple and dominated by traders who double as gatherers, and selling directly to customers (mainly elderly persons) at trading centres, village markets, roadside stalls, or homesteads. Traded WSWFPs were primarily delivered to markets on foot and using bicycles. Currently, there are no definite or formal mechanisms of setting prices of traded WSWFPs; most traders relied on the daily market demand, time and risks involved in gathering process, information of the price of substitute food and prices from other areas, knowledge of the past seasons' prices, and on the costs incurred from the suppliers.

Market information system for WSWFPs was largely rudimentary and undeveloped, and traders rely mainly on information from fellow traders as well as their customers to make market decisions. With exception of few species such as *Physalis peruviana* and *Basella alba*, weekly volumes of traded WSWFPs were low compared to most conventional food crops. On the other hand, prices of most traded WSWFPs were generally similar to those of alternative conventional food plants marketed in area. Some WSWFPs like *Hibiscus acetosella*, *Basella alba* and *Hyptis spicigera* (seeds), had higher market prices per unit measurement compared to the related conventional food plants.

Average weekly profits yielded from the trade of various WSWFPs were moderate and ranged from UGX 764.5 to 6754.2 (USD 0.38–3.36). The highest return came from species such *Hyptis spicigera, Hibiscus sabdariffa*, *Aframomum angustifolium, Borassus aethiopum, Basella alba*, *Solanum nigrum*, *Aframomum alboviolaceum* and *Canarium schweinfurthii.*

The main challenges faced in marketing of WSWFPs included high perishability, market dues, inaccurate consumers' perceptions of WSWFPs, seasonal shortfalls and unreliable supply, unorganized markets with products often sold in dirty places and often on the ground, little or no any form of value addition to improve on the demand and market prices, limited market information, few buyers and generally low demands, difficulty in setting the prices, and the inexistence of market promotional activities.

Opportunities to the trade in WSWFPs included the growing market demands for most WSWFPs, increasing focus of most service providers from local governments as well as civil society in creating awareness about WSWFPs, ever-changing perception on nutritional values of WSWFPs by the public, current government emphasis on value addition of traded agricultural products, little or no capital requirement for starting up trade in WSWFPs, and absence of restrictive regulations to sale WSWFPs.

Key strategies for improved marketing WSWFPs included training gatherers and traders on value adding activities prior to sale, deliberate investment in promotional and awareness campaigns to expose the hidden benefits of WSWFPs, scrapping market dues levied on traders selling WSWFPs, helping gatherers and sellers to organise themselves to form viable supply and market groups, linking gatherers and sellers to good markets, as well as providing them with available market information.

CHAPTER 7

NUTRITIONAL VALUES OF SOME SELECTED WILD AND SEMI-WILD FOOD PLANTS CONSUMED BY LOCAL PEOPLE IN BUNYORO-KITARA KINGDOM, UGANDA

7.1 Introduction

According to the United Nation Development Program's quality of life index (UNDP, 2008), most developing countries especially those in Africa were ranked the lowest. Uganda for example was ranked 154 (HDI of 0.505) out of 177 countries with data. The Human Development Index (HDI) provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and enrolment at the primary, secondary and tertiary level) and having a decent standard of living (measured by purchasing power parity (PPP) and income) (UNDP, 2008). These rankings, therefore, reflect the enormous challenges (e.g. food insecurity and illiteracy) of developing countries. Millions of people in the developing countries do not have enough food to meet their daily food requirements and a further more people are deficient in one or more micronutrients (FAO, 2004*a*).

Globally, Food and Agricultural Organisation reports that at least one billion people are thought to use wild foods in their diet (Burlingame, 2000). The diversity in wild species offers variety in family diet and contributes to household food security. Most of them are nutritionally rich and can supplement nutritional requirements, especially vitamins and micronutrients (Ali-Shtayeh, 2008). Numerous publications provide detailed knowledge of edible wild plants in specific locations in Africa (e.g. Becker, 1986; Campbell 1986; Zemede, 1997; Aberoumand, 2009). All showed that wild plants are essential components of many Africans' diets, especially in periods of seasonal food shortages. In Ghana alone, the leaves of over 300 species of wild plants and fruits are consumed (Aberoumand, 2009).

In Zimbabwe, poor households rely on wild fruits as an alternative to cultivated food for a quarter of all dry season's meals (Wilson, 1990). Similarly, in Northern Nigeria, leafy vegetables and other bush foods are collected as daily supplements to relishes and soups (Loghurst, 1986). In Swaziland, wild food plants are still of great importance and contribute a greater share to the annual diet than domestic cultivars (Ogle and Grivetti, 1985; Aberoumand, 2009). Various reports also noted that many wild edibles are nutritionally rich (FAO, 1985*a*, Ogle and Grivetti, 1985; IIED, 1995; Maundu *et al.*, 1999) and can supplement nutritional requirements, especially vitamins and micronutrients.

Whenever inadequate amounts of essential nutrients are provided, nutritional deficiency or inadequacy results and affects all developmental growth, efficiency of labour and the span of working life, which eventually influences the economic potential of a country (Rubaihayo *et al.*, 2003). Nutritional studies have shown that nutritional deficiency may also lead to very low haemoglobin levels in infants and pregnant women, the elderly and sick people in addition to increasing the prevalence of night blindness. The diet of average rural dwellers in Uganda is known to be deficient in proteins, iron, calcium, vitamins B and C, riboflavin and often iodine. All these nutrients can be obtained largely from locally available indigenous vegetables (Rubaihayo *et al.*, 2003). Nutritional analysis of some wild food plants demonstrates that in many cases the nutritional quality of wild plants is comparable and in some cases even superior to domesticated varieties (Kabuye, 1997).

Wild food plants can have even higher fat, protein, mineral and vitamin contents than cultivated species (Brand and Cherikoff, 1985; Ogle and Grivetti, 1985). Wild grains may also be more nutritious than cultivated varieties. The wild rice *Zizania aquatica* has for instance higher concentrations of protein, magnesium, phosphorus, potassium and vitamins B1 and B2 than the cultivated *Oryza sativa* (Murakami, 1988). The wild rice bean (*Vigna minima*) was also found to be of equal or greater nutritional value than the cultivated species (*Vigna umbellate*) (Scoones *et al.*, 1992). The present study was therefore, aimed at assessing the nutritional values of selected wild and semi-wild food plants (WSWFPs) consumed by local people in Bunyoro-Kitara Kingdom, Uganda.

7.2 Objectives

7.2.1 Overall objectives

The overall objective of the study was to assess the nutritional values of some selected wild and semi-wild food plants (WSWFPs) consumed by local people in Bunyoro-Kitara Kingdom, Uganda.

7.2.2 Specific objectives

i. To determine moisture, energy (calories), ash, protein, fat, total carbohydrates, dietary fibre and vitamins- ascorbic acid and β-carotene (provitamin A) contents of selected WSWFPs consumed by local people in the Kingdom.

ii. To assess the levels of nutritionally essential macro (Ca, K, Mg, Na, P) and micro (Fe, Mn, Cu, Zn) elements in the selected WSWFPs consumed by local people in Kingdom.

7.3 Hypothesis

Ho: There are no differences in moisture, energy (calories), ash, protein, fat, total carbohydrates, dietary fibre and vitamins- ascorbic acid and β-carotene (provitamin A) contents of the selected WSWFPs consumed by local people in Bunyoro-Kitara Kingdom compared to some selected well-known cultivated crops.

Ho: There are no differences in the levels of nutritionally essential macro (Ca, K, Mg, Na, P) and micro (Fe, Mn, Cu, Zn) elements in the selected WSWFPs consumed by local people in Bunyoro-Kitara Kingdom compared to some selected well-known cultivated crops.

7.4 Data collection and analysis

7.4.1 Sample collection

Field samples of the selected WSWFPs for nutritional analyses were collected from Mutunda and Kiryandongo sub-counties of Kibanda County in Bunyoro-Kitara Kingdom. The validity and usefulness of plant nutritional analysis depends largely on obtaining a reliable sample. If the samples taken are not representative, then all the careful and costly work put into subsequent analysis would be a wasted effort because the result would be less valid (Temminghoff and Houba, 2004). A minimum of 15-25 plants should be sampled in order to obtain a statistically significant number of plant tissues needed for analysis (A and L Eastern Labs, 2006). In this study, a field inventory (field walk) with key informants was undertaken to collect plant samples of 18 selected WSWFPs for laboratory analysis. The selection of these species for nutrient content analysis were undertaken on the basis of SWOT (Strength, Weakness, Opportunities and Threats) analysis (Appendix V) considering occurrence of the plant in natural habitats, market value, scanty information available on nutrient content, and finally extent of anthropogenic pressure on species.

In addition to the 18 selected WSWFPs, samples of three (3) conventional food plants namely the common cabbage (*Brassica oleracea var capitata*), sesame (*Sesamum indicum*), and Mangoes (*Mangifera indica*) were also analysed for comparison purposes. Each plant sample was taken from a minimum of 15 plants found within a radius of about 1 km, with the exception of *Hibiscus acetosella* where samples were collected from 13 plants and *Hyptis spicigera* where 1.5 kilograms of seeds was given by one of the key informants. Only the frequently harvested edible plant parts were collected in plastic bags labelled with sample numbers, date, code of locations, plant part, and analysis to be conducted (Appendix VI). About 500 grams of each plant material were collected in order to have an adequate amount of plant material for the analysis.

7.4.2 Laboratory and analytical procedures

7.4.2.1 Sample preparations

The laboratory and analytical procedures for nutritional analysis was limited to the portion of the plant normally consumed as prepared by local communities. Where appropriate, analyses included determination of moisture content, energy (calories), ash, protein, fat, total carbohydrates, dietary fibre, ascorbic acid, β-carotene and nutritionally essential macro and micro-elements (P, K, Na, Ca, Mg, Fe, Mn, Cu, Zn). All plant materials with exception of those used for determination of vitamin C and β-carotene, were dried in an oven with a fan at 65 °C for 24 hours using the AOAC (1980) air oven method No. 14.003 and then ground for chemical analysis (Plate 7.1). All samples were analysed in triplicate.

Plate 7.1 Sample preparation for determination for nitrogen content at Henfaes Research Facility, Abergwyngregyn, Gwynedd, UK.

7.4.2.1 Moisture content

Determination of moisture content (MC) of the samples was carried out following procedures described in Kirk and Sawyer (1991) and AOAC (1984). Aluminium dishes were washed, dried in the oven, removed and allowed to cool in a desiccator. About 3–4 g of the samples (in triplicates) were weighed into the dishes using analytical weight balance. The dishes containing the samples were placed in the oven (Gallenkamp hotbox oven fan size 2) and the oven temperature adjusted to 65 °C, and the samples dried to a constant weights. The samples were then removed, placed in a desiccator to cool and weighed and the MC of the sample was calculated as follows: MC (g) = (B − C)/A; where A is the weight of dry sample (C − weight of the dish) in grams (g); B is Wt. of dish and sample prior to drying in g; C is Wt. (g) of the dish and sample after drying; and B − C is the loss in Wt. (g) of sample after drying.

7.4.2.2 Total ash

Total ash content of the samples (in triplicates) were determined using the AOAC standard methods (1984). Five (5) g of the samples were weighed into a weighed porcelain dishes and dried for 3–4 hours in a Gallenkamp hotbox oven fan size 2 at 105 °C, until a constant weight was reached. The dishes and the contents were then weighed before being transferred to a muffle furnace and ignited at 550 °C for about 5 to 6 hours until the residues appeared greyish-white. The samples were then removed from the muffle furnace and placed in the desiccator to cool for 1 hour, after which time they were removed from the desiccator and weighed. Ash content of the samples were calculated as follows: Ash content (g) = (B − C)/A; where A is the Wt. of intial sample (g) after drying at 105 °C; B is Wt. (g) of dish and contents after the ignition process; C is Wt. of the empty dish.

7.4.2.3 Energy (calories)

Total energy (calories) of the plant samples were determined using a Gallenkamp Autobomb calorimeter (SG 96/02/536, Gallenkamp and Company Ltd, England UK). The method is based on combustion in a 'bomb' chamber, and when the sample is burned, the resulting heat is measured by the increase in temperature of water surrounding the bomb. One (1) gram of sample (in triplicate) was pelleted with a briquette press and weighed in a crucible. The pelleted sample was connected to the firing wire, which was fitted between the electrodes, by a cotton thread. The electrode assembly was placed into the bomb and the bomb was tightened. The circuit was tested and the bomb was filled with oxygen to a pressure of 3000 Pa (30 bar). The calorimeter vessel was filled with water (total weight 3 Kg) at 21- 23 °C, the prepared bomb was placed inside the calorimeter vessel, and then the calorimeter vessel was placed into the water jacket. The machine was switched on and left for a while (10-15 minutes) to warm up. Prior to firing, the initial temperature of the water was checked and recorded and 10-15 minutes after firing the final temperature was recorded. Benzoic acid was used as a standard. The energy value determined from such a standard of known energy was used to calibrate the system. Finally, the sample energy content was calculated according to the formula: Gross energy (kJ/g) = {[(Final temperature − Initial temperature) x 10.82] − 0.0896}/Wt. of the sample. Where, 10.82 = Heat capacity of the calorimeter in kJ/K; 0.0896 = Combined energy value of nickel wire and cotton in $kJ.g^{-1}$.

7.4.2.4 Protein

Protein contents of the samples were determined by the Kjeldahl method using Kjeltec Auto 1030 Analyzer (Tecator, Sweden), the most widely used method employed for the determination of protein in organic substances. This is because on digestion with concentrated sulphuric acid and catalysts, organic compounds are oxidized and the nitrogen is converted to ammonium sulphate. Upon making the reaction mixture alkaline, ammonia is liberated, removed by steam distillation, collected and titrated. Two hundred (200) mg samples were placed in a Kjeltec digestion tube. Two mercury Kjeltabs (Fisher K/0130/80) and 5 ml concentrate sulphuric acid (BDH 45006) were added to the sample. The sample was digested at 400°C (Digestion system 40 Tecator 1006 heating unit) for one hour. Twenty (20) ml of deionised water and 5 ml of 1.33N sodium thiosulphate were added to the sample after allowing it to cool. The sample was then distilled and the ammonia liberated, after adding of 25ml of 40% NaOH collected in standard boric acid and titrated against 0.2M hydrochloric acid. Both distillation and titration were automated. A blank was prepared and treated in the same manner except that the tube was free of sample. The titre values were read and later used to determine the protein content of the plant samples (Plate 7.2). Protein content was calculated according to the formula: Protein (g) = [(Sample titre – Blank titre) x 0.21 x 14.0072 x 6.25]/Wt. of the sample. Where, 0.21 is the normality of hydrochloric acid; 14.0072 is the molecular weight of nitrogen; and 6.25 is the nitrogen factor; since protein is assumed to be 16% nitrogen (Frank, 1975).

Plate 7.2 Determination of Nitrogen content of the plant samples at Henfaes Research Facility, Abergwyngregyn, Gwynedd, UK.

7.4.2.5 Total fat

Total fat content of the plant samples were determined using Tecator Soxtec System (HT 1043 Extraction Unit, Tecator Co USA). Metal receiving vessels of the unit, with three glass beads in each, were fired for 15 minutes, cooled and weighed. Five (5) g of sample was weighed into extraction thimble, which was plugged with cotton wool. Thimble was then fixed into the extraction unit and the fan switched on. Fifty (50) ml of petroleum ether (solvent) was put in each receiving vessel and placed under the thimbles. Cooling water was set at a flow rate of 1.5 litres per minute and extraction temperature was set at 80 °C. Initial heating to boiling was set at 10 minutes; refluxing time was set for 1 hour. Rinsing was also done for 1 hour after refluxing. Receiving vessels were removed after petroleum ether had stopped condensing, oven dried for 15 minutes at 100 °C, cooled for another 15 minutes in a desiccator, and weighed. Ether was drained off from all condensers before turning off the water and fan. Total fat content was calculated as follows: Total (g) = (Wt. of fat and the receiving vessel – Wt. of receiving vessel)/Wt. of the sample.

7.4.2.6 Total carbohydrates

The AOAC (1990) method was adopted for the analysis of total carbohydrate using the Manual Clegg Anthrone Method (Clegg, 1956). This method determines the total amount of carbohydrates, based on hydrolysable starch and soluble sugar content. One (1.0) g of grounded sample was weighed and transfer quantitatively to a stoppered 100 ml graduated cylinder, followed by addition of 10 ml of water and the mixture stirred with glass rod to disperse the sample. 13 ml of the perchloric acid solution was then added and the mixture stirred constantly with glass rod for 20 min. The glass rods were rinsed with distilled water and the volume of the mixture brought to 100 ml. The contents were mixed and filtered into a 250 ml volumetric flask. The graduated cylinders were rinsed with distilled water and added to the volumetric flask, after which the flasks were calibrated with distilled water and shaken.

Ten (10) ml of the extract were diluted to 100 ml with distilled water. Using a pipette, 1 ml of diluted filtrates was transferred in to test-tubes. Two 1 ml samples of distilled water for duplicate blanks were also pipetted and each one put in a separate test-tube. Two 1 ml duplicate standards were pipetted out using the dilute glucose solution. Rapidly 5 ml of freshly prepared anthrone reagent was pipetted to all the tubes, capped and mixed thoroughly. The tube were later placed in a water-bath and heated for 12 min, after which they were cooled rapidly to room temperature. The solutions were transferred to 1 cm spectrophometer cells. The green colour was stable for about 2 hours. The absorbance of the samples and the standards were read at 630 nm against the reagent blanks. Total available carbohydrates (TAC) were calculated as follows: TAC (as grams of glucose) = [(25 x b)/(a x W)] x 10^{-2}. Where W is the Wt. of the sample; a is the absorbance of the diluted standard (the graphs were straight lines in the range of 0.0 – 0.15 mg glucose); b is absorbance of diluted samples.

7.4.2.7 Dietary fibre

Dietary fibre was determined using Acid Detergent Fibre (ADF) solution following procedures described by Goering and Van Soest (1970). The solution was prepared as follows: Twenty-eight (28 ml) of 98% H_2SO4 were carefully added to and mixed with 600 ml of distilled water. Twenty (20 g) of Cetyl trimethyl ammonium bromide (CTAB), a detergent, were added and stirred until it dissolved. The acid detergent was made up to 1 litre with distilled water and mixed thoroughly. Into a clean one litre conical flask, was added 1.0 g of the sample; 100 ml of the acid detergent solution were added to the beaker followed by 2.0 ml of dekalin (decahydronaphthlene). The mixture was heated to boiling under reflux for 1 hour. Heating was controlled to minimise foaming by adjusting the control knob. The sample digest was filtered with a crucible previously dried in the oven at 100 °C. The beaker was washed with boiling distilled water filtering the content through the same crucible 3 times. The final washing was done with acetone and the residue was collected into a clean crucible dried at 100 °C for 8 hours in the oven. Dietary fibre (DF) of the sample was calculated as follows: DF (g) = [(Wt. of crucible and DF) – (Wt. of crucible)]/Wt. of the sample.

7.4.2.8 Vitamins (Ascorbic acid and β-carotene)

Ascorbic acid (Vitamic C) contents of the plant samples were determined according to the procedures given in Kirk and Sawyer (1991). Five (5) g of the fresh samples were weighed into a clean mortar. The sample were macerated in a mortar using a pestle with 5 ml portions of 5% trichloro acetic acid (TCA) being added at a time. The extracts were quantitatively transferred into a clean 50 ml volumetric flask and made up to volume with TCA. The flask was stoppered, shaken to ensure thorough mixing and the mixture was filtered using a filter paper (Watman no.1). The 2,6-dichlorophenolindophenol (DCPIP) solution was standardised using ascorbic acid standard solution of concentration 1.08 mg/ml. Five (5) ml of standardised ascorbic acid were titrated with DCPIP until a pink colour that persisted for 3-8 seconds was seen (blank). An equivalent five (5) ml of the extracts were pipetted into a clean conical flask and carefully titrated against the DCPIP solution until a pink colour that persisted for 3-8 seconds was observed. The volumes of DCPIP solution used were read from the burette and used to calculate the vitamin C content of the samples. The ascorbic acid content of the sample was calculated using the formula: Vitamin C content (mg/100g DM) = (Titre x VE x V_1 x 100 x 100)/(V_2 x S x 1000 x Y). Where VE = vitamin C equivalent of 1 ml of DCPIP (mg/ml); V_1 = total extract volume (ml); V_2 = titrated extract volume (ml); S = sample weight; Y = sample dry matter (%).

β-carotene was determined following procedures outlined by De Ritter and Purcell (1981). Samples were separately weighed out and placed in a mortar; 5-7 mls of hexane-acetone mixture in a ratio of 1:1 were added. A pestle was used to stir the sample-solvent mixture to facilitate extraction. The extract was transferred to a 50 ml volumetric flask and extraction was repeated 5 times with 5-7 ml portions of solvent mixture adding the extract of volumetric flask each time to the flask contents. When the sample was free of beta-carotene, the volume of the extract was made up to 50 mls with the solvent mixture. The volumetric flask was kept away from light by wrapping it with aluminium foil to prevent photo degradation of beta-carotene.

The extract was placed in a clean, dry 100 ml beaker and the beaker was heated gently on a hot plate in the fume cupboard with the fan on until all the solvent evaporated. The beaker was then removed and allowed to cool after which 2.0 ml of pure solvent mixture were added to dissolve the residue; 1.0 ml of the dissolved extract was pipetted and transferred to a packed column of magnesium oxide. Afresh solvent mixture was used to elute the extract from the column. The deep coloured band of beta-carotene was collected in a 50 ml volumetric flask until the eluate was colourless, the extract was made up to volume, with the extracting mixture, shaken to dissolve and put in the dark ready for absorbance reading. 15mg capsules of beta-carotene were dissolved in 100mls of hexane to make stock solutions. Using a spectrophotometer (SP20), the absorbencies of the stock solutions and the samples were read at 450 nm. A standard curve of absorbance Vs concentration (microgram/ml) were plotted. By using their absorbencies, the β-carotene concentrations of the samples were read off the previously prepared standard curves. The calculation of β-carotene was as follows: β-carotene content (μg/100g DM) = (observed β-carotene content (μg/ml) x V x D x 100 x 100)/(W x Y). Where V = total extract volume; D = dilution factor; W = sample weight; Y = dry matter content of the sample (%).

7.4.2.9 Essential macro (Ca, K, Mg, Na, P) and micro (Fe, Mn, Cu, Zn) elements

Potassium (K) and Sodium (Na)

Na and K concentrations were determined using the Flame Emission Photometer (Jenway, model PFP7, U.K.) using NaCl and KCl to prepare the standards (AOAC, 1984). 0.3 g of oven dried (65 ^{0}C) ground plant samples were weighed in to a labelled dry and clean digestion tubes and 4.4 ml of the digestion mixture (0.42 g of selenium (Se) powder, 14 g of $Li_2SO_4.H_2O$, 350 ml of 30% H_2O_2 and 420 ml of H_2SO_4) was added to each tube, and also to reagent blanks for each batch of the samples. These were digested at 360 °C for 3 hours until the solution were colourless. After cooling, the tubes were topped up with 25 ml of distilled water, filtered, and later made up 50 ml with distilled water. These were kept for analysis. 1000 mg/l (ppm) stock solutions of Na and K were prepared by weighing 2.541 g of NaCl and 1.907 g of KCl analytical grade reagents respectively. These were then dissolved in distilled water to make 1-litre solutions respectively. Working Na and K solutions (100 ppm each) were prepared by diluting 20 ml of the respective stock solutions to 200 ml.

A seven-step standard series (0.0, 0.5, 1.0, 2.0, 3.0, 4.0 and 5 ppm Na; and 0, 1, 2, 4, 6, 8, 10 ppm K) were prepared by pipetting respective ml of working solutions in 100 ml flasks and adding 3 ml of 1N H_2SO_4 to each flask before topping up to 100 ml level by distilled water. Two (2) ml of the wet-digested sample solutions were pipetted into a 50 ml volumetric flask and made to the mark with distilled water. The solutions were sprayed starting with the standards, followed by the samples and the blanks directly into the flame of flame emission photometer (wavelength at 766.5 nm). Respective amount of the K and Na present in the samples were read off from the calibration curves of absorbance against K and Na concentrations and calculated as follows: Concentration (mg/l) = [(a – b) x v x f]/(1000 x w x1000). Where a is the concentration of K or Na in the digest; b is the concentration of the blank digest; w is the Wt. of the sample; v is the vol. of the digest solution; and f is the dilution factor. The concentrations were later computed to mg/100g of edible plant portion.

Phosphorus (P)

P was determined spectrophotometrically (absorbance at a wavelength of 880nm) using Spectronic 20D+ Spectrophotometer model (USA). Twelve (12 g) of ammonium molybdate were dissolved in 100 ml of warm distilled water and then cooled. 0.291 g of antimony potassium tartrate was separately dissolved in 100 ml of distilled water. Both solutions were made to 2 litres with distilled water. The mixtures were shaken thoroughly to ensure proper mixing. Ascorbic acid reducing reagent was prepared by dissolving 2.108 g of ascorbic acid into 400 ml of ammonium molybdate/antimony potassium tartrate. Working standard solutions of 0.1, 0.2, 0.4, 0.6 and 0.8-ppm concentrations were prepared. 0.5 ml aliquots of the working standard solutions were transferred to a 25 ml volumetric flask and diluted with distilled water followed by 5 mls of the ascorbic acid reducing reagent. The mixture was made to the mark with distilled water and mixed thoroughly. The mixture was left to stand for 40 minutes prior to absorbance reading on a spectrophotometer. Similar procedures were followed to take absorbance reading of the samples. Calibration curves of absorbance against concentration were plotted using the working standard solutions. Phosphorus concentrations (ppm) in the samples were read from the calibration curve using the previously obtained sample absorbencies. The phosphorus concentrations in the samples were then computed to mg/100 g of the edible plant portion.

Calcium (Ca), Iron (Fe), Magnesium (Mg), Manganese (Mn), Copper (Cu) and Zinc (Zn)

Ca, Fe, Mg, Mn, Cu, and Zn were determined by Atomic Absorption Spectrometry (Perkin Elmer 2380 AA - auto wavelength scan model, USA and Varian SpectrAA 220 FS- A fully automated double beam system, Australia). 0.3 g of finely ground and oven dried (65 °C) plant samples were weighed into a clean digestion tubes and 2.5 ml of digestion mixtures (7.2 g salicyclic acid, 3.5 g selenium powder, 100 ml of conc. H_2SO_4) and allowed to react at room temperature for 2 hours. Two separate blanks included in each batch of measurement. The tubes were heated in the block digester for 1 hour at 110 °C, allowed to cool after which three successive portions of H_2O_2 were added, waiting at least 10 seconds between additions. The tubes were returned to the block digester and the temperature adjusted to 330 °C. The mixtures were heated until the colour turned colours (sometimes light-yellow for some samples), cooled to room temperature, and transferred to 50 ml volumetric flasks and made up to the mark with deionised water.

Working standard solutions were prepared for each element from the stock solutions. A seven-step standard series were prepared from respective standard working solution of each element. Air-acetylene flame was used for atomization of Ca, Mg, Cu, Fe, Mn and Zn). Standard series, diluted samples and the blanks were then aspirated into the Atomic Absorption Spectrometer (AAS) calibrated for each element measurement (Ca at 239.8 nm, Cu at 324.7 nm, Fe at 248.3 nm, Mg at 202.6 nm, Mn at 248.3 nm, Zn at 213.9 nm) and the absorbencies and the concentration of each element in the sample solutions was read directly from the machine in milligrams per litre (mg/l). The concentrations of these elements in the samples were later computed to mg/100g of edible plant portion.

7.5 Statistical data analysis

Nutritional contents of the analysed WSWFPs were compared to those of the three (3) conventional food plants namely the common cabbage (*Brassica oleracea var capitata*), sesame (*Sesamum indicum*), and Mangoes (*Mangifera indica*) using ANOVA (Steel and Torrie, 1980) at 5% level of significance in MINITAB statistical software.

7.6 Results

7.6.1 Leafy WSWFPS

7.6.1.1 Moisture, calories, ash, protein, fat, total carbohydrates, dietary fibre, vitamin C and β-carotene contents of the selected leafy WSWFPs compared to cabbage

Table 7.1 summarises the levels of moisture, calories, ash, protein, fat, total carbohydrates and dietary fibres while Table 7.2 presents vitamin C and β-carotene contents present in 15 leafy WSWFPs per 100 grams of edible portions compared to the commonly consumed cabbage (*Brassica oleracea var capitata*). With the exception of *Basella alba* (19.98 ± 0.83 Kcal), all of the leafy WSWFPs analysed had significantly ($P < 0.05$) higher calories compared to the common cabbage (25.32 ± 0.59 Kcal). *Senna obtusifolia* was the richest (71.56 + 1.15 Kcal) in calories, followed by *Vernonia amygdalina* and *Acalypha bipartite* respectively.

The moisture contents of the leafy WSWFPs ranged from 33.43 ± 0.99 g to 92.06 ± 0.25 g. Apart from *Basella alba* (92.06 ± 0.25 g), cabbage was significantly ($P < 0.05$) higher in moisture content (90.47 ± 0.52 g) compared to other leafy WSWFPs. Protein values ranged from as low as 1.94 ± 0.15 g in *Basella alba* to as high as 12.11 ± 0.61 g in *Vernonia amygdalina*. Compared with common cabbage, all the mean protein values of WSWFPs analysed were significantly ($P < 0.05$) higher than that of the cabbage. *Vernonia amygdalina* (7.76 ± 0.20 g), *Crotalaria ochroleuca* (4.78 ± 0.16 g), *Sonchus oleraceus* (3.57 ± 0.15), *Corchorus trilocularis* (3.50 ± 0.27 g), and *Bidens pilosa* (3.52 ± 0.13 g) had significantly ($P < 0.05$) higher contents of dietary fibre compared to the cabbage (2.04 ± 0.04 g). However, there were no significant differences in the mean dietary fibre contents of *Acalypha bipartite*, *Amaranthus spinosus*, *Cleome hirta*, and *Senna obtusifolia* from that of the cabbage.

Ash contents ranged from 1.54 ± 0.10 g as in *Hibiscus acetosella* to 5.58 ± 0.25 g as in *Solanum nigrum*. In all cases, the ash contents were significantly higher than those of cabbage. All the leafy WSWFPs had significantly ($P < 0.05$) higher fat contents compared to that of the cabbage (0.12 ± 0.01 g), with *Senna obtusifolia* (2.05 ± 0.07 g), and *Acalypha bipartite* (1.32 ± 0.10 g) being the richest in fat contents. Total carbohydrate contents of the leafy WSWFPs ranged from as low as 2.09 ± 0.12 g) in *Sonchus oleraceus* to as high as 38.62 ± 1.10 g recorded in *Vernonia amygdalina*. Means values of *Cleome hirta*, *Crotalaria ochroleuca*, and *Solanum nigrum* were not significantly different ($P < 0.05$) from that of cabbage (5.25 ± 0.18 g). The rest of the leafy WSWFPs except *Sonchus oleraceus*, *Basella alba*, and *Vigna unguiculata*, had significantly higher total carbohydrate contents compared to cabbage.

Vitamin C content of the leafy WSWFPs ranged from 35.01 ± 0.57 mg to 337.05 ± 1.50 mg per 100 grams of edible portions. With the exception of *Amaranthus spinosus*, *Asystasia gangetica*, *Asystasia mysorensis* and *Vigna unguiculata*, the rest of the leafy WSWFPs had significantly higher Vitamin C contents compared to that of the cabbage (57.41 ± 0.47 mg). *Cleome hirta* (337.05 ± 1.50 mg), *Vernonia amygdalina* (318.12 ± 1.00 mg), *Solanum nigrum* (141.01 ± 0.81 mg), *Acalypha bipartite* (138.89 ± 1.05 mg), and *Crotalaria ochroleuca* (126.00 ± 1.06 mg) were the richest in Vitamin C contents among the leafy WSWFPs. The β-carotene contents of the leafy WSWFPs ranged from 1100.13 ± 1.60 µg to 13411.63 ± 2.00 µg, and all were significantly ($P < 0.05$) higher than that of the cabbage (111.82 ± 1.26 µg). *Sonchus oleraceus* (13411.63 ± 2.00 µg), *Cleome hirta* (13170.05 ± 2.00 µg), *Solanum nigrum* (9047.31 ± 2.40 µg), *Senna obtusifolia* (7856.20 ± 3.70 µg); *Crotalaria ochroleuca* (6900.70 ± 3.10 µg) and *Vernonia amygdalina* (6115.40 ± 2.10 µg) were the richest in β-carotene contents.

Table 7.1 Moisture, calories, ash, protein, fat, total carbohydrates and dietary fibre contents of the selected leafy WSWFPs compared to cabbage.

Species	Nutrients (Mean composition per 100 gram edible portion ±SEM)						
	Energy (Kcal)	Moisture (g)	Protein (g)	Dietary fibre (g)	Ash (g)	Fat (g)	CHO (g)
Acalypha bipartite Müll. Arg.	52.36 (0.80)	75.26 (0.19)	6.19 (0.14)	1.93 (0.04)[a]	2.12 (0.11)	1.32 (0.10)	6.51 (0.30)
Amaranthus spinosus L.	30.73 (0.81)	84.67 (0.18)	3.57 (0.24)	2.29 (0.09)[a]	3.06 (0.10)	0.52 (0.04)	6.66 (0.25)
Asystasia gangetica (L.) T.Anders.	50.74 (0.53)	86.54 (0.82)	3.11 (0.37)	1.50 (0.07)	2.97 (0.10)	0.92 (0.06)	9.11 (0.42)
Asystasia mysorensis (Roth) T.Anders.	44.67 (0.99)	84.49 (0.51)	2.78 (0.16)	1.33 (0.12)	2.64 (0.21)	0.57 (0.04)	7.72 (0.16)
Basella alba L.	19.98 (0.83)	92.06 (0.25)	1.94 (0.15)	1.11 (0.07)	1.59 (0.16)	0.32 (0.02)	3.62 (0.25)
Bidens pilosa L.	45.18 (0.62)	85.48 (0.42)	4.29 (0.17)	3.52 (0.13)	3.52 (0.12)	0.66 (0.05)	7.31 (0.11)
Cleome hirta (Klotzsch) Oliv.	40.28 (0.84)	85.18 (0.18)	4.84 (0.42)	2.27 (0.11)[a]	2.93 (0.27)	0.64 (0.06)	4.52 (0.22)[b]
Corchorus trilocularis L.	48.49 (0.89)	81.61 (0.47)	5.77 (0.11)	3.50 (0.27)	1.92 (0.11)	0.26 (0.03)	8.51 (0.26)
Crotalaria ochroleuca G.Don	49.62 (0.68)	76.68 (0.36)	7.46 (0.33)	4.78 (0.16)	2.13 (0.11)	0.69 (0.06)	5.29 (0.18)[b]
Hibiscus acetosella Welw. *ex* Hiern	42.10 (0.89)	80.95 (0.93)	2.88 (0.12)	1.45 (0.06)	1.54 (0.10)	0.46 (0.04)	7.49 (0.18)
Senna obtusifolia (L.) Irwin & Barneby	71.56 (1.15)	79.47 (0.48)	6.72 (0.16)	2.33 (0.19)[a]	4.12 (0.15)	2.05 (0.07)	8.50 (0.26)
Solanum nigrum L.	41.13 (0.69)	85.66 (0.37)	5.20 (0.19)	1.25 (0.12)	5.58 (0.25)	0.66 (0.05)	5.44 (0.14)[b]
Sonchus oleraceus L.	28.81 (0.08)	86.32 (0.92)	3.45 (0.07)	3.57 (0.15)	3.26 (0.26)	0.72 (0.01)	2.09 (0.12)
Vernonia amygdalina Del.	54.38 (1.11)	33.43 (0.99)	12.11 (0.61)	7.76 (0.20)	3.69 (0.14)	0.56 (0.04)	38.62 (1.10)
Vigna unguiculata (L.) Walp.	31.22 (0.70)	83.66 (0.93)	4.54 (0.27)	1.60 (0.14)	2.42 (0.11)	0.43 (0.01)	4.40 (0.25)
Brassica oleracea var capitata. L. (Alef.) (Common cabbage)	25.32 (0.59)	90.47 (0.52)	1.45 (0.04)	2.04 (0.04)[a]	0.67 (0.02)	0.12 (0.01)	5.25 (0.18)[b]

Means are of three measurements. Bracketed are the standard errors of the mean. Means in the same column followed by the same superscript letter are not significantly different from those of the corresponding cabbage (P > 0.05).

Table 7.2 Vitamin C and β-carotene contents of the selected leafy WSWFPs compared to cabbage.

Species	Nutrients (Mean composition per 100 gram edible portion ±SEM)	
	Vit. C (mg)	β-carotene (μg)
Acalypha bipartite Müll. Arg.	138.89 (1.05)	1100.13 (1.60)
Amaranthus spinosus L.	35.01 (0.57)	5387.30 (2.60)
Asystasia gangetica (L.) T.Anders.	48.51 (0.91)	5937.21 (1.50)
Asystasia mysorensis (Roth) T.Anders.	45.75 (1.17)	5783.50 (2.40)
Basella alba L.	81.39 (0.69)	3319.90 (2.80)
Bidens pilosa L.	74.00 (0.91)	1908.90 (4.00)
Cleome hirta (Klotzsch) Oliv.	337.05 (1.50)	13170.05 (2.00)
Corchorus trilocularis L.	98.03 (0.88)	5443.10 (2.10)
Crotalaria ochroleuca G.Don	126.00 (1.06)	6900.70 (3.10)
Hibiscus acetosella Welw. *ex* Hiern	67.01 (1.23)	3409.04 (1.70)
Senna obtusifolia (L.) Irwin & Barneby	78.02 (1.03)	7856.20 (3.70)
Solanum nigrum L.	141.01 (0.81)	9047.31 (2.40)
Sonchus oleraceus L.	69.81 (1.01)	13411.63 (2.00)
Vernonia amygdalina Del.	318.12 (1.00)	6115.40 (2.10)
Vigna unguiculata (L.) Walp.	47.00 (1.28)	5880.80 (2.50)
Brassica oleracea var capitata. L. (Alef.) (Common cabbage)	57.41 (0.47)	111.82 (1.26)

Means are of three measurements. Bracketed are the standard errors of the mean. All means in the columns are significantly different from those of the corresponding cabbage in that column ($P < 0.05$).

7.6.1.2 Essential macro and micro mineral contents of the selected leafy WSWFPs compared to cabbage

Macro (Ca, K, Mg, Na, P) mineral contents

The nutritionally essential macro (Ca, K, Mg, Na, P) mineral contents of the 15 selected leafy WSWFPs are summarized in Table 7.3. All the mean values of the triplicate analyses were significantly ($P < 0.05$) different from those of the corresponding cabbage. Calcium (Ca) content ranged from as low as 35.28 ± 1.28 mg (*Sonchus oleraceus*) to as a high as 518.43 ± 1.10 mg (*Asystasia mysorensis*). Apart from *Sonchus oleraceus*, all other leafy WSWFPs had significantly ($P < 0.05$) higher Ca content compared to cabbage (52.17 ± 1.06 mg). In addition to *Asystasia mysorensis*, other richest sources of Ca were the leaves of *Asystasia gangetica* (502.70 ± 1.71 mg), *Acalypha bipartite* (499.44 ± 1.96 mg), *Amaranthus spinosus*

(410.40 ± 0.54 mg), *Bidens pilosa* (408.73 ± 0.66 mg) and *Senna obtusifolia* (406.50 ±1.10 mg).

Potassium (K) contents varied from 5.23 ± 0.33 mg (*Vernonia amygdalina*) to 714.14 ± 0.46 mg (*Amaranthus spinosus*). Most of the leafy WSWFPs had significantly (P < 0.05) higher mean K values compared to common cabbage (241.6 ± 1.52 mg). The richest sources of K were *Sonchus oleraceus* (576.68 ± 0.69 mg), *Basella alba* (494.27 ± 0.70 mg), *Asystasia gangetica* (466.08 ± 0.40 mg), and *Asystasia mysorensis* (423.72 ± 0.22 mg). Apart from *Vigna unguiculata* (13.48 ± 0.30 mg), all the other leafy WSWFPs had significantly (P < 0.05) higher P contents compared to the cabbage (36.83 ± 0.54 mg). The richest sources of P were *Asystasia gangetica* (505.38 ±1.34 mg), *Bidens pilosa* (492.92 ± 1.53 mg), *Asystasia mysorensis* (477.88 ± 0.64 mg) and *Senna obtusifolia* (237.78 ± 3.11 mg).

Sodium (Na) contents of the leafy WSWFPs ranged from 3.27 ± 0.44 mg (*Solanum nigrum*) to 355.75 ± 1.81 (*Senna obtusifolia*). With exceptions of *Solanum nigrum* and *Acalypha bipartite* (13.70 ± 0.46 mg), all the other leafy WSWFPs had significantly (P < 0.05) higher Na contents compared to the cabbage (16.20 ± 0.41 mg). In addition to *Senna obtusifolia*, other rich sources of Na included *Bidens pilosa* (279.97 ± 2.03 mg), *Vernonia amygdalina* (236.60 ± 1.07 mg) and *Sonchus oleraceus* (234.15 ± 1.58 mg). All the leafy WSWFPs except *Crotalaria ochroleuca* (3.63 ± 0.15 mg) had significantly (P < 0.05) higher Magnesium (Mg) contents compared to the cabbage (16.91 ± 0.39 mg). *Asystasia gangetica* (421.70 ± 1.07 mg), *Asystasia mysorensis* (393.70 ± 0.23 mg), *Bidens pilosa* (313.33 ± 1.39 mg), *Senna obtusifolia* (253.74 ± 0.89 mg), *Solanum nigrum* (235.90 ± 1.53 mg) were the richest sources of Mg.

Micro (Fe, Mn, Cu, Zn) mineral contents

Like in macro minerals, the mean values of the micro (Fe, Mn, Cu, Zn) mineral contents of the 15 analysed leafy WSWFPs were generally different and in most case significantly (P < 0.05) higher than those of the corresponding cabbage (Table 7.4). All the leafy WSWFPs had significantly (P < 0.05) higher iron (Fe) contents compared to the common cabbage (0.61 ± 0.02 mg). *Acalypha bipartite* (30.03 ±

0.55 mg), *Corchorus trilocularis* (18.92 ± 0.51 mg), *Asystasia gangetica* (18.34 ± 0.99 mg), *Bidens pilosa* (17.44 ± 0.26 mg), *Asystasia mysorensis* (13.40 ± 0.32 mg), and *Senna obtusifolia* (13.33 ± 1.39 mg) were the richest in Fe contents.

Zinc (Zn) contents of the leafy WSWFPs varied from 0.08 ± 0.01 mg (*Solanum nigrum*) to 11.43 ± 0.37 mg (*Senna obtusifolia*). Apart from *Solanum nigrum*, all other leafy WSWFPs had significantly ($P < 0.05$) higher Zn contents compared to common cabbage (0.21 ± 0.02 mg). The richest sources of zinc were *Senna obtusifolia* (11.43 ± 0.37 mg), *Bidens pilosa* L (10.50 ± 0.40 mg), *Vernonia amygdalina* (9.4 ± 0.40 mg), and *Asystasia gangetica* (8.23 ± 0.18 mg).

Copper (Cu) contents of the leafy WSWFPs varied from 0.08 ± 0.01 mg (*Vigna unguiculata*) to 8.81 ± 0.16 mg (*Bidens pilosa*). Nine of the leafy WSWFPs had significantly ($P < 0.05$) lower Cu contents compared to that of the cabbage (2.04 ± 0.04 mg). Aside from *Bidens pilosa*, the richest sources of copper were *Vernonia amygdalina* (5.33 ± 0.37 mg), *Asystasia mysorensis* (4.20 ± 0.32 mg), *Asystasia gangetica* (3.72 ± 0.19 mg), and *Senna obtusifolia* (2.32 ± 0.16 mg) whose mean Cu content was not significantly ($P < 0.05$) different from that of common cabbage.

Manganese (Mn) contents of the leafy WSWFPs ranged from as low as 0.64 ± 0.03 mg (*Basella alba*) to as high as 32.75 ± 1.25 mg (*Vernonia amygdalina*), with all mean values significantly higher than that of common cabbage (0.19 ± 0.03 mg). In addition to *Vernonia amygdalina*, other good leafy sources of Mn included *Asystasia mysorensis* (11.37 ± 0.35 mg), *Asystasia gangetica* (10.63 ± 0.43 mg), *Bidens pilosa* (9.62 ± 0.22 mg), *Cleome hirta* (6.27 ± 0.26mg), and *Senna obtusifolia* (5.74 ± 0.18 mg).

Table 7.3 Essential macro mineral contents of leafy WSWFPs compared to cabbage.

Species	Macro-mineral elements (Mean composition per 100 gram edible portion ±SEM)				
	Ca (mg)	K (mg)	P (mg)	Na (mg)	Mg (mg)
Acalypha bipartite Müll. Arg.	499.44 (1.96)	272.37 (1.34)	103.85 (1.23)	13.70 (0.46)	58.37 (0.38)
Amaranthus spinosus L.	410.40 (0.54)	714.14 (0.46)	88.22 (1.00)	27.26 (0.77)	65.44 (1.38)
Asystasia gangetica (L.) T.Anders.	502.70 (1.71)	466.08 (0.40)	505.38 (1.34)	43.10 (0.40)	421.70 (1.07)
Asystasia mysorensis (Roth) T.Anders.	518.43 (1.10)	423.72 (0.22)	477.88 (0.64)	39.77 (0.96)	393.70 (0.23)
Basella alba L.	119.60 (1.10)	494.27 (0.70)	55.67 (0.65)	18.33 (0.64)	59.37 (2.04)
Bidens pilosa L.	408.73 (0.66)	278.98 (0.48)	492.92 (1.53)	279.97 (2.03)	313.33 (1.39)
Cleome hirta (Klotzsch) Oliv.	373.50 (1.04)	390.62 (0.80)	15.83 (0.32)	27.37 (0.96)	79.74 (1.20)
Corchorus trilocularis L.	311.37 (1.04)	132.77 (0.71)	83.82 (0.84)	34.33 (0.46)	53.00 (1.40)
Crotalaria ochroleuca G.Don	243.57 (0.52)	166.94 (0.18)	69.44 (0.53)	29.30 (0.82)	3.63 (0.15)
Hibiscus acetosella Welw. *ex* Hiern	239.60 (0.53)	204.30 (0.32)	101.30 (1.00)	53.78 (0.19)	73.33 (1.30)
Senna obtusifolia (L.) Irwin & Barneby	406.50 (1.10)	101.67 (0.76)	237.78 (3.11)	355.75 (1.81)	253.74 (0.89)
Solanum nigrum L.	397.07 (1.70)	53.58 (0.31)	77.34 (0.96)	3.27 (0.44)	235.90 (1.53)
Sonchus oleraceus L.	35.28 (1.28)	576.68 (0.69)	63.64 (0.98)	234.15 (1.58)	72.00 (0.70)
Vernonia amygdalina Del.	163.63 (1.71)	5.23 (0.33)	75.78 (0.67)	236.60 (1.07)	25.18 (1.63)
Vigna unguiculata (L.) Walp.	127.54 (0.29)	98.63 (0.31)	13.48 (0.30)	23.34 (0.38)	57.08 (0.79)
Brassica oleracea var capitata. L. (Alef.) (Common cabbage)	52.17 (1.06)	241.6 (1.52)	36.83 (0.54)	16.20 (0.41)	16.91 (0.39)

Means are of three measurements. Bracketed are the standard errors of the mean. All means in column are significantly different from those of the corresponding cabbage in that column ($P < 0.05$). All measurements in mg/100 gram of edible portion.

Table 7.4 Nutritionally essential micro (Fe, Mn, Cu, Zn) mineral contents of selected leafy WSWFPs compared to cabbage.

Species	Micro-mineral elements (Mean composition per 100 gram edible portion ±SEM)			
	Fe (mg)	Zn (mg)	Cu (mg)	Mn (mg)
Acalypha bipartite Müll. Arg.	30.03 (0.55)	1.20 (0.27)	1.42 (1.14)	2.48 (0.06)
Amaranthus spinosus L.	4.25 (0.13)	7.51 (0.26)	1.58 (0.16)	1.14 (0.01)
Asystasia gangetica (L.) T.Anders.	18.34 (0.99)	8.23 (0.18)	3.72 (0.19)	10.63 (0.43)
Asystasia mysorensis (Roth) T.Anders.	13.40 (0.32)	6.48 (0.22)	4.20 (0.32)	11.37 (0.35)
Basella alba L.	2.13 (0.20)	0.93 (0.15)	1.17 (0.92)	0.64 (0.03)
Bidens pilosa L.	17.44 (0.26)	10.50 (0.40)	8.81 (0.16)	9.62 (0.22)
Cleome hirta (Klotzsch) Oliv.	8.67 (0.61)	1.77 (0.09)	1.15 (0.13)	6.27 (0.26)
Corchorus trilocularis L.	18.92 (0.51)	5.74 (0.18)	0.52 (0.05)	1.75 (0.05)
Crotalaria ochroleuca G.Don	3.47 (0.50)	3.33 (0.26)	ND	1.02 (0.14)
Hibiscus acetosella Welw. *ex* Hiern	5.28 (0.74)	0.62 (0.04)	0.41 (0.27)	ND
Senna obtusifolia (L.) Irwin & Barneby	13.33 (1.39)	11.43 (0.37)	2.32 (0.16)[a]	5.74 (0.18)
Solanum nigrum L.	8.68 (0.25)	0.08 (0.01)	0.13 (0.01)	1.64 (0.17)
Sonchus oleraceus L.	4.35 (0.42)	0.70 (0.03)	0.45 (0.03)	1.33 (0.07)
Vernonia amygdalina Del.	10.77 (0.87)	9.4 (0.40)	5.33 (0.37)	32.75 (1.25)
Vigna unguiculata (L.) Walp.	3.47 (0.15)	0.72 (0.04)	0.08 (0.01)	ND
Brassica oleracea var capitata. L. (Alef.) (Common cabbage)	0.61 (0.02)	0.21 (0.02)	2.04 (0.04)[a]	0.19 (0.03)

Means are of three measurements. Bracketed are the standard errors of the mean. Means in the same column followed by the same superscript letter are not significantly different from those of the corresponding cabbage ($P > 0.05$). All measurements in mg/100 gram of edible portion. ND = Not Detected.

7.6.2 Edible fruits

7.6.2.1 Moisture, calories, ash, protein, fat, total carbohydrates, dietary fibre, vitamin C and β-carotene contents of two selected edible wild fruits compared to *Mangifera indica*

Table 7.5 presents the levels of moisture, calories, ash, protein, fat, total carbohydrates, dietary fibres, vitamin C and β-carotene contents of the two edible wild fruits (*Aframomum angustifolium*, and *Physalis peruviana*) per 100 grams of edible portions compared to the commonly consumed mangoes (*Mangifera indica*). The two wild fruits had significantly ($P < 0.05$) lower calories compared to the common mangoes (57.73 ± 0.53 Kcal) with *Aframomum angustifolium* and *Physalis peruviana* having mean calories values of 42.17 ± 0.79 Kcal and 50.45 ± 0.84 Kcal respectively.

Aframomum angustifolium (87.51 ± 0.80 mg) had significantly ($P < 0.05$) higher moisture content compared to the common mangoes (83.87 ± 0.23 g). The two wild fruits were all significantly ($P < 0.05$) richer in protein contents than the common mangoes. *Physalis peruviana* had the highest protein values (1.59 ± 0.16 g) compared to the common mangoes (0.84 ± 0.04 g). *Physalis peruviana* (3.93 ± 0.17 g) was very rich in dietary fibres compared to the common mangoes. Dietary fibre contents of *Aframomum angustifolium* (0.33 ± 0.03 g) was significantly ($P < 0.05$) lower than that of common mangoes (1.25 ± 0.09 g).

There was no significant ($P < 0.05$) difference in the mean ash contents of *Aframomum angustifolium* and that of common mangoes. However, *Physalis peruviana* (2.14 ± 0.13 mg) had significantly higher ($P < 0.05$) ash contents compared to that of common mangoes. *Aframomum angustifolium* fruits (0.65 ± 0.06 g) had significantly ($P < 0.05$) higher fat content compared to common mangoes. Conversely, *Physalis peruviana* fruits had significantly ($P < 0.05$) lower fat content compared to that of the common mangoes. Total carbohydrate contents of the two wild fruits were significantly ($P < 0.05$) lower than that of common mangoes (13.35 ± 0.28 mg), with *Aframomum angustifolium* and *Physalis peruviana* having carbohydrates contents of 10.32 ± 0.45 g and 9.89 ± 0.31 g respectively.

There was no significant ($P < 0.05$) difference between Vitamin C contents of *Physalis peruviana* and that of common mangoes. Although *Aframomum angustifolium* had high Vitamin C contents (32.44 ± 0.46 mg), this value was significantly ($P < 0.05$) lower than that of common mangoes (37.98 ± 0.67 mg). Compared to the mangoes (786.65 ± 3.44 μg), *Physalis peruviana* (1704.20 ± 4.50 μg) was significantly ($P < 0.05$) higher in β-carotene contents. On the other hand, *Aframomum angustifolium* was found to have β-carotene contents compared to the common mangoes.

Table 7.5 Moisture, calories, ash, protein, fat, total carbohydrates, dietary fibre, vitamin C and β-carotene contents of two selected wild fruits compared to *Mangifera indica* L. (Mean composition per 100 gram edible portion ±SEM).

Nutrients	Species		
	Aframomum angustifolium (Sonnerat) K.Schum.	*Physalis peruviana L.*	*Mangifera indica L. (Mangoes)*
Energy (Kcal)	42.17 (0.79)	50.45 (0.84)	57.73 (0.53)
Moisture (g)	87.51 (0.80)	81.34 (0.32)	83.87 (0.23)
Protein (g)	1.14 (0.09)	1.59 (0.16)	0.84 (0.04)
Dietary fibre (g)	0.33 (0.03)	3.93 (0.17)	1.25 (0.09)
Ash (g)	0.72 (0.09)[a]	2.14 (0.13)	0.70 (0.03)[a]
Fat (g)	0.65 (0.06)	0.12 (0.02)	0.30 (0.03)
Carbohydrates (g)	10.32 (0.45)	9.89 (0.31)	13.35 (0.28)
Vit. C (mg)	32.44 (0.46)	38.31 (0.39)[a]	37.98 (0.67)[a]
β-carotene (μg)	732.96 (2.68)	1704.20 (4.50)	786.65 (3.44)

Means are of three measurements. Bracketed are the standard errors of the mean. Means in the same row followed by the same superscript letter are not significantly different from those of the corresponding mangoes ($P > 0.05$).

7.6.2.2 Essential macro and micro mineral contents of selected edible wild fruits compared to *Mangifera indica* L.

Macro (Ca, K, Mg, Na, P) minerals

The nutritionally essential macro (Ca, K, Mg, Na, P) elements contents of the selected two wild fruits (*Physalis peruviana* and *Aframomum angustifolium*) are summarized in Table 7.6. The two fruits had significantly ($P < 0.05$) low calcium (Ca) contents compared to the common mangoes (20.72 ± 0.74 mg). *Aframomum angustifolium* was extremely high in potassium (K) contents (365.64 ± 0.44 mg) than

Physalis peruviana and common mangoes. However, the two wild fruits had significantly (P < 0.05) higher phosphorus (P) contents compared to common mangoes (24.07 ± 0.65 mg). *Aframomum angustifolium* contained 73.81 ± 0.43 mg while *Physalis peruviana* had 51.07 ± 0.38 mg.

As with P content, *Aframomum angustifolium* (11.47 ± 0.46 mg) and *Physalis peruviana* (8.57 ± 0.91 mg) were richer sources of sodium (Na) compared to common mangoes. Similarly, magnesium (Mg) contents of the two wild fruits were significantly (P < 0.05) higher compared to common mangoes, with *Aframomum angustifolium* (37.72 ± 0.46 mg) being richer in Mg content than *Physalis peruviana* had (27.43 ± 0.66 mg).

Micro (Fe, Mn, Cu, Zn) minerals

The nutritionally essential micro (Fe, Mn, Cu, Zn) elements contents of the two wild fruits (*Aframomum angustifolium* and *Physalis peruviana*) are presented in Table 7.6. *Physalis peruviana* contained significantly (P < 0.05) higher iron (Fe) contents (4.60 ± 0.17 mg) compared to the common mangoes (1.01 ± 0.02 mg). However, there was no significant (P < 0.05) difference in the mean Fe contents of *Aframomum angustifolium* and that of the common mangoes.

Both wild fruits were significantly (P < 0.05) richer in zinc (Zn) contents compared to common mangoes, with *Aframomum angustifolium* containing the highest (2.20 ± 0.47 mg) amount of Zn. Compared to common mangoes (0.16 ± 0.01 mg), the two wild fruits had significantly (P < 0.05) lower copper (Cu) contents. *Aframomum angustifolium* had the lowest (0.03 ± 0.01 mg) contents of Cu. *Physalis peruviana* (0.26 ± 0.02 mg) was richer in Manganese (Mn) contents compared to common cabbage (0.04 ± 0.002 mg).

Table 7.6 Essential macro and micro mineral contents of selected edible wild fruits compared to *Mangifera indica* L. (Mean composition per 100 gram edible portion ±SEM).

Elements	Species		
	Aframomum angustifolium (Sonnerat) K.Schum.	*Physalis peruviana L.*	*Mangifera indica L. (Mangoes)*
Ca	17.91 (0.64)	13.67 (0.64)	20.72 (0.74)
K	365.64 (0.44)	117.85 (0.18)	168.03 (1.31)
P	73.81 (0.43)	51.07 (0.38)	24.07 (0.65)
Na	11.47 (0.46)	8.57 (0.91)	1.88 (0.12)
Mg	37.72 0.46)	27.43 (0.66)	8.73 (0.454)
Fe	1.63 (0.35)[a]	4.60 (0.17)	1.01 (0.02)[a]
Zn	2.20 (0.47)	1.30 (0.12)	0.05 (0.01)
Cu	0.03 (0.01)	0.09 (0.01)	0.16 (0.01)
Mn	0.01 (0.003)	0.26 (0.02)	0.04 (0.002)

Means are of three measurements. Bracketed are the standard errors of the mean. Means in the same row followed by the same superscript letter are not significantly different from those of the corresponding mangoes ($P > 0.05$). All measurements in mg/100 gram of edible portion.

7.6.3 Edible wild seeds (*Hyptis spicigera* Lam.)

7.6.3.1 Moisture, calories, ash, protein, fat, total carbohydrates, dietary fibre, vitamin C and β-carotene contents of *Hyptis spicigera* Lam compared to *Sesamum indicum* Linn.

Table 7.7 presents the levels of moisture, calories, ash, protein, fat, total carbohydrates, dietary fibres, vitamin C and β-carotene contents in *Hyptis spicigera* per 100 grams of seeds compared to the conventional sesame (*Sesamum indicum*) seeds. There was no significant ($P < 0.05$) difference in the mean calorie contents of *Hyptis spicigera* (544.31 ± 1.74 Kcal) from that of sesame (546.17 ± 10.45 Kcal). Similarly the mean moisture content of the seeds *Hyptis spicigera* (5.89 ± 0.03 g) was not significantly ($P < 0.05$) from that of sesame (6.06 ± 0.07 g). However, *Hyptis spicigera* had higher mean protein seed contents (20.01 ± 0.54 g) than sesame (18.59 ± 0.34 g) although the difference in their mean values was not significant.

Dietary fibre contents of *Hyptis spicigera* seeds (5.35 ± 0.26 g) was significantly ($P < 0.05$) higher than that of sesame. However, the mean ash contents of two edible seeds were not significantly ($P < 0.05$) different from each other. Although *Hyptis spicigera* seeds was found to be very rich in fat contents (40.64 ± 1.06 g), its mean fat contents was significantly ($P < 0.05$) lower compared to that of ($P < 0.05$). Both Carbohydrates (20.68 ± 0.54 g) and β-carotene (27.39 ± 1.53 μg)) contents of *Hyptis spicigera* seeds were not significantly ($P < 0.05$) different from that of sesame.

Table 7.7 Moisture, calories, ash, protein, fat, total carbohydrates, dietary fibre, vitamin C and β-carotene contents of *Hyptis spicigera* Lam compared to *Sesamum indicum* Linn. (Mean composition per 100 gram edible portion ±SEM).

Elements	Species	
	Hyptis spicigera Lam.	*Sesamum indicum Linn. (Sesame)*
Energy (Kcal)	544.31(1.74)[a]	546.17 (0.45)[a]
Water (g)	5.89 (0.03)[a]	6.06 (0.07)[a]
Protein (g)	20.01(0.54)[a]	18.59 (0.34)[a]
Dietary fibre (g)	5.35(0.26)	4.03 (0.04)
Ash (g)	6.54(0.32)[a]	6.43 (0.07)[a]
Fat (g)	40.64(1.06)	45.26 (0.40)
Carbohydrates (g)	20.68(0.54)[a]	19.63 (0.33)[a]
Vit. C (mg)	-	-
β-carotene (μg)	27.39(1.53)[a]	28.25 (0.48)[a]

Means are of three measurements. Bracketed are the standard errors of the mean. Means in the same row followed by the same superscript letter are not significantly different from those of the corresponding sesame ($P > 0.05$).

7.6.3.2 Essential macro and micro mineral contents of *Hyptis spicigera* Lam compared to *Sesamum indicum* Linn.

Macro (Ca, K, Mg, Na, P) minerals

The nutritionally essential macro (Ca, K, Mg, Na, P) elements contents of *Hyptis spicigera* seeds per 100 grams of the edible seed compared to that of sesame (*Sesamum indicum*) are presented in Table 7.8. From the analysis, the seeds of this wild plant (*Hyptis spicigera*) contained significantly ($P < 0.05$) higher (857.94 ± 1.22 mg) calcium (Ca) contents compared to that of sesame (827.01 ± 1.3 mg). However, the potassium (K) contents though substantially high (365.64 ± 0.44 mg) in *Hyptis spicigera*, was significantly ($P < 0.05$) lower compared to that of sesame. Mean phosphorus (P) content was very high (702.27 ± 1.53 mg) in *Hyptis spicigera* seeds compared to that of sesame. However, sodium (Na) and magnesium (Mg) contents of

Hyptis spicigera seeds were all significantly ($P < 0.05$) lower compared to those of sesame seeds.

Micro (Fe, Mn, Cu, Zn) minerals

The nutritionally essential micro (Fe, Mn, Cu, Zn) elements contents of *Hyptis spicigera* seeds per 100 grams of the edible seed compared to that of *Sesamum indicum* are summarised in Table 7.8. There was no significant ($P < 0.05$) difference in the mean iron (Fe) content of *Hyptis spicigera* (9.87 ± 0.33 mg) compared to that of the *Sesamum indicum* seeds (10.49 ± 0.33 mg). Although *Hyptis spicigera* contained higher amount of zinc (Zn), there was no apparently significant ($P < 0.05$) difference in the mean Zn content compared to that of *Sesamum indicum* seeds. Similar to Zn contents, *Hyptis spicigera* contained higher amount of copper (Cu) (4.45 ± 0.25) than *Sesamum indicum* (3.92 ± 0.05), although the difference of its mean Cu content from that of *Sesamum indicum* was significant ($P < 0.05$).Mean contents of Manganese (Mn) in both seeds were also not significant ($P < 0.05$) different from each other.

Table 7.8 Essential macro and micro mineral contents of *Hyptis spicigera* Lam compared to *Sesamum indicum* Linn. (Mean composition per 100 gram edible portion ±SEM).

Elements	Species	
	Hyptis spicigera Lam.	*Sesamum indicum Linn.*
Ca	857.94 (1.22)	827.01 (1.3)
K	383.64 (0.37)	447.94 (1.47)
P	702.27 (1.53)	652.28 (1.89)
Na	77.28 (0.74)	114.1 (0.91)
Mg	315.76 (1.53)	457.25 (1.49)
Fe	9.87 (0.33)[a]	10.49 (0.33)[a]
Zn	8.23 (0.23)[a]	8.13 (0.34)[a]
Cu	4.45(0.25)[a]	3.92 (0.05)[a]
Mn	2.85 (0.05)[a]	2.9 (0.17)[a]

Means are of three measurements. Bracketed are the standard errors of the mean. Means in the same row followed by the same superscript letter are not significantly different from those of the corresponding sesame. ($P > 0.05$). All measurements in mg/100 gram of edible portion.

7.7 Discussion

7.7.1 Moisture, energy (calories), ash, protein, fat, total carbohydrates, dietary fibre, vitamin C and β-carotene contents of the selected WSWFPs consumed

Moisture

Moisture is one of the most commonly measured properties of food materials. It is important to know because there are legal limits of the maximum or minimum amount of water that must be present in certain types of food. Besides, the propensity of microorganisms to grow in foods depends on their water content (Nollet, 2004). In the present study, the moisture content of most WSWFPs except *Acalypha bipartite, Crotalaria ochroleuca, Corchorus trilocularis, Senna obtusifolia, Physalis peruviana* and *Vernonia amygdalina* were found to be higher than the usual range (60-83g/100g) of moisture content for fruits and vegetables (FAO, 1968). However, compared to the conventionally cultivated cabbage (*Brassica oleracea var capitata*), all the leafy WSWFPs analysed in the present study except *Basella alba* had significantly lower moisture contents. The fruits of *Aframomum angustifolium* had higher moisture content than that *Mangifera indica*. The high moisture contents of WSWFPs often above normal range will encourage microbial growth, increase the rate of enzymatic reaction and hence deterioration. The implication of this is that the harvested food plant cannot be stored fresh for more than 24 hours before it starts to deteriorate. The low moisture contents as in *Vernonia amygdalina* and the seeds of *Hyptis spicigera* are indicative of their high dry matter content and possible long shelf-life.

Food energy (calories)

Energy obtained from food is used to support physical activities and to maintain life supporting metabolic processes such as regulation of body temperature, maintenance of breathing, control of heartbeat, breaking up molecules and building muscle tissues (Garrison and Somer, 1997). Analyses from present study show that most leafy WSWFPs like *Senna obtusifolia*, *Vernonia amygdalina* and *Acalypha bipartite* are rich sources of food energy compared to conventionally cultivated cabbage (*Brassica oleracea var capitata*). Furthermore, the calorie content of most of the WSWFPs were within the range of other conventional food crops reported in literature (FAO, 1968; Farrell and Houtkooper, 2009). *Aframomum angustifolium* and *Physalis peruviana* had lower calories than common mangoes but the nevertheless they are still good sources of food energy. The seeds of *Hyptis spicigera* was the richest in calories and there was no significant different in its mean energy content from that of the cultivated sesame.

Ash

Ash is the inorganic residue that remained after the water and organic matter have been removed after heating the food plant. It is a measure of the total amount of minerals within a food (Nielsen, 2003). The findings from the present study show that ash contents were significantly high in most WSWFPs compared to the conventional food crops. In fact, all leafy WSWFPs had significantly higher ash contents compared to the common cabbage. Notably high in ash contents were leaves of *Solanum nigrum* (5.58 ± 0.25 g/100g), *Senna obtusifolia* (4.12 ± 0.15 g/100g) and the seeds of *Hyptis spicigera* (6.54 ± 0.32 g/100g), all indicating their richness with mineral elements. Elsewhere, Handique (2002) reported that most non-conventional cultivated food plants like the tender shoot of wild banana (*Musa bulbisiana*) and *Paederia foetida* have remarkably higher ash contents often in the range of 8.3-20.4% compared to some conventional food crops.

Protein

Protein is the building material for all body parts, such as muscle, brain, blood, skin, hair, nails, bones and body fluids. It is essential for growth, repair of worn-out tissues, replacement of used-up blood and resistance against infections. One gram of protein is known to supply the body with about 4 Kcal (Garrison and Somer, 1997). Findings from the present study indicated that most WSWFPs were rich sources of protein compared to the three conventional food plants (*Brassica oleracea var capitata*, sesame and *mangifera indica*) that were analysed in this study. In fact, the tender leaves of *Vernonia amygdalina*, *Crotalaria ochroleuca, Senna obtusifolia, Acalypha bipartite*, *Corchorus trilocularis*, *Solanum nigrum* were significantly richer in protein contents compared to the common cabbage. Similarly, the fruits of

Aframomum angustifolium and that of *Physalis peruviana* are higher in protein contents compared to the common mangoes.

Likewise, the protein content of seeds of *Hyptis spicigera* is comparable to that of sesame. In the same vein, Handique (2002) opined that many non-conventional leafy vegetables are either at par or even superior to many conventional and cultivated leafy vegetables as far as protein content is concerned. Species such as Diplazium (Fern), wild Amaranths like *A. viridis* that occur as garden weed, *Momordica*, and *Moringa* which are of limited occurrence as backyard crop have protein content in the range of 12-27% as against about 23% protein in case of well known cultivated and conventional leafy vegetables like Spinach (Handique, 2002).

Fats

Fats perform life-supporting functions in every human cell, including cell membrane structure, enzyme reactions, blood and tissue structure, in memory and nervous system operations, and in the manufacture and utilization of the sterol hormones and the hormone-like prostaglandins (Nollet, 2004). Fats are also required for healthy skin, the transport and absorption of the fat-soluble vitamins A, D, E and K, and the regulation of cholesterol metabolism. Besides, they are concentrated sources of energy needed by the body- 1 g of fat provides 9 kcal, more than double the energy given by carbohydrate or protein per unit weight (Garrison and Somer, 1997). The findings from the present study indicate that seeds of *Hyptis spicigera* are very rich in fat contents (40.64 ± 1.06 g/100g) although not superior to that of sesame (45.26 ± 0.40 g/100g). This however, implies that *Hyptis spicigera* can all the same be used as an alternative substitute to sesame as an oil crop.

Although vegetables naturally have low fat contents, most of the leafy WSWFPs and edible wild fruits analysed in the present study had higher fat contents compared to the commonly grown cabbage and mangoes respectively. For instance, edible fruit pulp of *Aframomum angustifolium* (0.65 ± 0.06 g/100g) was richer in fat contents compared to common mangoes (0.30 ± 0.03 g/100g). Similarly, tender leaves of *Senna obtusifolia* (2.05 ± 0.07 g/100g) and *Acalypha bipartite* (1.32 ± 0.10 g) were notably richer in fat contents compared to the cabbage plant (0.12 ± 0.01 g/100g).

However, these values are still very low compared to the fat contents of *Hyptis spicigera*, implying that leafy and fruity WSWFPs analysed in this study should not be relied upon as the primary sources of fats.

Total carbohydrates

Carbohydrates are the primary source of energy for the body and are often referred to as 'fuel of life' (WHO and FAO, 1998). Each gram of carbohydrate yields 4 calories in the process of its metabolism. They help to provide energy for muscular work and nutritive processes, maintenance of body temperature, besides their role in oxidation of fats, and as spare protein for growth and repair (WHO and FAO, 1998). Most WSWFPs analysed in this study were found to contain significantly higher total carbohydrate contents compared to the conventional food crops used for comparison. For instance, *Hyptis spicigera* was very rich in carbohydrate contents than sesame. Similarly, the tender leaves of *Vernonia amygdalina*, *Asystasia gangetica*, *Corchorus trilocularis*, *Senna obtusifolia*, *Asystasia mysorensis*, and *Hibiscus acetosella* were found to be good sources of carbohydrates. *Aframomum angustifolium* (10.32 ± 0.45 g/100g) and *Physalis peruviana* (9.89 ± 0.31 g/100g) fruits are equally good sources of carbohydrates although their mean carbohydrates were all lower than that of *Mangifera indica* (13.35 ± 0.28 g/100g). Therefore, daily consumption of such WSWFPs can significantly contribute to the recommended daily intake of total carbohydrate, which is about 130 g (Institute of Medicine, Food and Nutrition Board, 2005).

Dietary fibre

Dietary fibre plays an important role in decreasing the risks of many disorders such as constipation, colon cancer, cardiovascular diseases (CVD), diverticulosis and obesity (Spiller, 2001). Besides, they inhibit absorption of glucose and cholesterol from the gastrointestinal tract, thus are helpful in diabetes and heart disease control (Ensminger, 1993). In the present study, apart from *Aframomum angustifolium*, *Acalypha bipartite*, *Asystasia gangetica*, *Asystasia mysorensis*, *Basella alba*, *Hibiscus acetosella*, *Solanum nigrum*, and *Vigna unguiculata*, all other WSWFPs analysed were rich in dietary fibre contents often ranging from 2.27–7.76 g/100g. In most cases, their dietary contents were significantly higher than the corresponding conventional cultivated food crops that were analysed for comparison. Elsewhere Tukan *et al.* (1998) reported large numbers of wild edible plants in Jordanian diet also being richer in fibre contents compared to cultivated food crops. In the present study, therefore, daily consumption of some WSWFPs such as *Vernonia amygdalina*, *Hyptis spicigera*, Crotalaria *ochroleuca*, *Physalis peruviana*, and *Sonchus oleraceus* could contribute to the much-needed daily dietary fibre (30 g) for our normal wellbeing (Institute of Medicine, Food and Nutrition Board, 2005).

Vitamin C

Vitamin C also known as ascorbic acid helps in the formation of protein, collagen, bone, teeth, gums, cartilage, blood vessels, skin and scar tissue (Gaby and Singh, 1991); facilitates the absorption of iron and calcium from the gastrointestinal tract, involved in fats and amino acid metabolisms, increases resistance to infection and contributes to brain functioning (Schectman *et al.,* 1991). Findings from the present study show that a number of leafy WSWFPs are rich sources of Vitamin C compared to the conventionally cultivated cabbage plant. Likewise, the fruits of *Aframomum angustifolium* and *Physalis peruviana* were rich in vitamin C contents, with that of *Physalis peruviana* being nearly at par to vitamin C contents of *Mangifera indica.* The recommended daily allowance (RDA) of vitamin C for a normal adult is 65 to 90 mg (Institute of Medicine, Food and Nutrition Board, 2000), implying that consumption of most leafy WSWFPs such as such as *Cleome hirta* (337.05 ± 1.50 mg/100g), *Vernonia amygdalina* (318.12 ± 1.00 mg/100g), *Acalypha bipartite* (138.89 ± 1.05 mg/100g), *Solanum nigrum* (141.01 ± 0.81 mg/100g), *Crotalaria ochroleuca* (126.00 ± 1.06 mg), and *Corchorus trilocularis* (98.03 ± 0.88 mg/100g) could more than meet the RDA for an adult compared to the consumption of the cabbage (57.41 ± 0.47 mg/100g).

β-carotene contents

β-Carotene is the major precursor of vitamin A (retinol). Its cleavage yields retinal - the first and requisite step to produce retinoids, which are involved in many essential biological functions, including vision, reproduction, cell differentiation, gene expression, and general body maintenance (Napoli, 1996). Compared to the cultivated cabbage plant, leafy WSWFPs analysed in this study are much superior sources of β-Carotenes. Similarly, β-Carotene contents of *Hyptis spicigera* seeds of are comparable to that of sesame. Fruits of *Physalis peruviana* are also rich sources of β-Carotene than those of *Mangifera indica.* The recommended daily allowance (RDA) of β-carotene for a normal adult is in the range of 6000 μg for men, 4800 μg for women and between 2400 and 4200 μg for children (National Research Council of USA, 1989; Ndawula *et al.*, 2004). This implies consumption of 100 grams of WSWFPs such as *Sonchus oleraceus, Cleome hirta, Solanum nigrum, Senna obtusifolia, Crotalaria ochroleuca, Vernonia amygdalina, Asystasia gangetica, Vigna unguiculata, Asystasia mysorensis Corchorus trilocularis* and *Amaranthus spinosus* would supply all the RDA for adult men, women and children. Mean while the consumption of about 100 g of *Basella alba* and *Hibiscus acetosella* would meet RDA of β-Carotene for children.

7.7.2 Essential macro (Ca, K, Mg, Na, P) mineral contents the WSWFPs consumed

The concentration of macro minerals (Ca, K, Mg, Na and P) in WSWFPs from the present study are in the range of 3.27–857.94 mg/100 g, with most WSWFPs at either par or even superior to the related conventional and cultivated food crops compared with. Calcium (Ca) is essential for healthy bones, muscles, nerves, teeth and blood (Charles, 1992). It also required for the absorption of dietary vitamin B, synthesis of the neurotransmitter acetylcholine, and activation of enzymes such as the pancreatic lipase (Charles, 1992). The recommended daily allowance of Ca for children is between 500 and 1000 mg and for adults 800 mg. To achieve a Ca level of nearly one percent of the total diet would be rather difficult. Concentrations of Ca in the analysed WSWFPs are in the range of 17.91–857.94 mg/100 g. Seeds of *Hyptis spicigera* and the leaves of *Asystasia mysorensis, Asystasia gangetica, Acalypha bipartite, Amaranthus spinosus, Bidens pilosa, Senna obtusifolia, Solanum nigrum* and *Cleome hirta* are rich in Ca (373.50–857.94 mg/100g) and their consumption can contribute greatly to the RDA.

Concentration of potassium (K) in the WSWFPs analysed ranged from 5.23 to 714.14 mg/100g. K is one of the most abundant elements in WSWFPs. Potassium is accumulated within human cells by the action of the Na^+, K^+-ATPase (sodium pump). The regulation of such metal ion flows, especially of K and Na, is crucial to life and is most clearly exemplified by the ionic movements that occur in nerve cells during excitation and transmission of the action potential (Naidu *et al.,* 1999). K is an activator of some enzymes, in particular co-enzyme for normal growth and muscle function (Birch and Padgham, 1994). Our data indicate that most WSWFPs are not deficient in potassium. Consumption of *Amaranthus spinosus*, *Sonchus oleraceus*, *Basella alba*, *Asystasia gangetica*, *Asystasia mysorensis*, *Cleome hirta*, *Hyptis spicigera* and fruits of *Aframomum angustifolium*, which are rich in K (365.64–714.14 mg/100g), might help in the case of potassium deficiency.

Magnesium (Mg) is an important electrolyte also responsible for proper nerve and muscle function. It plays an important role in regulating the neuromuscular activity of the heart. Where Ca stimulates the muscles, Mg is used to relax the muscles. It also works as co-factor in more than 300 metabolic reactions (Berdanier, 1994). It aids the formation of bone and teeth and assists the absorption of Ca and K. It assists the parathyroid gland to process vitamin D, and a shortage here can cause absorption problems with calcium. With exception of *Crotalaria ochroleuca* and *Hyptis spicigera*, all other WSWFPs analysed in this study presented higher levels of Mg compared to the corresponding conventionally cultivated food crops. The concentration of Mg ranges from 3.63 to 421.70 mg/100g. Mg has an RDA of 420 mg for men, 320 mg for women and 240 mg for children (Institute of Medicine, Food and Nutrition Board, 1997). Incorporation of *Asystasia gangetica*, *Asystasia mysorensis*, *Hyptis spicigera*, *Bidens pilosa*, *Senna obtusifolia*, *Solanum nigrum*, which are rich in Mg (235.90–421.70 mg/100g), could contribute substantially to RDA.

Sodium (Na) plays an important role in the maintenance of acid–base equilibrium and of osmotic pressure of body fluids (Martin *et al.,* 1985). It also assists nerve impulse initiation and muscle contraction. WSWFPs were more superior in sodium contents than corresponding the three conventional food plants analysed in the present study. The concentration of Na ranged from 3.27 to 355.75 mg/100g. Na has an RDA of 1500 mg for a healthy living (Institute of Medicine, Food and Nutrition Board (1997). Therefore, consumption of WSWFPs such as *Senna obtusifolia*, *Bidens pilosa, Vernonia amygdalina* and *Sonchus oleraceus*, which are richer in Na contents (234.15–355.75 mg/100g), could nonetheless help supplement the dietary intake of Na.

Phosphorus (P) is involved in bone and teeth formation as well as metabolism, kidney function, cell growth and heart muscle contraction. It does not only help in conversion of food to energy but also in vitamin utilisation particularly with the B-vitamins (Turan *et al.,* 2003). P concentrations in most of the analysed WSWFPs were superior to those of the cabbage, sesame and mangoes that were analysed as well. Given that the recommended daily allowance for P is 700 mg for normal adult life, consumption of *Hyptis spicigera* (702.27 mg/100g), would adequate provide the needed RDA. In addition, inclusion of other WSWFPs like *Asystasia gangetica, Bidens pilosa, Asystasia mysorensis,* and *Senna obtusifolia,* which are rich in P contents (237.78–505.38 mg/100g) compared to the cultivated cabbage plant, could help supplement RDA of P intake.

7.7.3 Essential micro (Fe, Mn, Cu, Zn) mineral contents of WSWFPs consumed

Iron (Fe) is an essential microelement for haemoglobin formation, normal functioning of the central nervous system, and oxidation of carbohydrate, protein and fats (Adeyeye and Otokiti, 1999). It is also a cofactor bound to several non-heme iron enzymes required for the proper functioning of cells (Martin *et al.,* 1985). Its deficiency, according to World Health Organisation (WHO) report in 2005, affects about 3.7 billion people out of which about 2 billion people are anaemic (Meng *et al.,* 2005). Like other minerals, the concentration of Fe in many WSWFPs analysed in this study are much higher compared those in conventional food crops used for comparison. Given that RDA for Fe is 18 mg (Institute of Medicine, Food and Nutrition Board, 2002), consumption of WSWFPs such as *Acalypha bipartite, Corchorus trilocularis,* and *Asystasia gangetica,* which are very rich in Fe contents (18.34–30.03 mg/100g) could meet the daily Fe requirements of an adult. Similarly, use of the species like *Bidens pilosa, Asystasia mysorensis,* and *Senna obtusifolia, Vernonia amygdalina* that are considerably high in Fe contents (10.77–17.44 mg/100g) could substantially contribute to Fe recommended daily intake.

Manganese (Mn) plays important role in metabolism of vitamin B1 and vitamin E, activation of various enzymes such as decarboxylases, hydrolases, kinases, and transferases; which are important for proper digestion and utilization of foods (Hurley and Keen, 1987). Mn also acts as a catalyst in the breakdown of fats and cholesterol, and it is necessary for normal skeletal development and maintains sex hormone production (Hurley and Keen, 1987). Its deficiency can cause poor reproductive performance, growth retardation, congenital malformations in the offspring, abnormal formation of bone and cartilage, and impaired glucose (Hurley and Keen, 1987). The present study shows that many WSWFPs are important sources of Mn compared to conventional crops (e.g. cabbage and mangoes) that were also analysed for comparison. When compared with 2–4 mg set as RDA for Mn (Uganda National Drug Authority, 2009), consumption of most WSWFPs such as *Vernonia amygdalina*, *Asystasia mysorensis*, *Asystasia gangetica*, *Bidens pilosa*, *Cleome hirta* and *Senna obtusifolia*, which are very rich in Mn content (5.74–32.75 mg/100g) would supply all the recommended daily intake of Mn. Additionally, utilization of *Hyptis spicigera* seeds (2.48 ± 0.06 mg/100g) and tender leaves of *Acalypha bipartite* (2.85 ± 0.05 mg/100g) in the diet could also substantially meet part of the required daily intake of Mn.

Copper (Cu) is an essential nutrient involved in the absorption, storage and metabolism of iron. It helps in the oxidation of vitamin C and works with vitamin C to form elastin, a chief component of the elastin muscle fibres throughout the body (Davis and Mertz, 1987). It aids in the formation of red blood cells, transport of oxygen in the blood stream, supply of the body's tissues with oxygen, bone formation and its maintenance. Besides, it assists the thyroid gland in balancing and secreting hormones (Davis and Mertz, 1987). Findings from this study show that most WSWFPs are valuable sources of Cu compared to conventional food plants analysed for comparison. The RDA for Cu is 2–4 mg (Uganda National Drug Authority, 2009), implying that consumption of WSWFPs such as *Bidens pilosa*, *Vernonia amygdalina*, *Hyptis spicigera*, *Asystasia mysorensis*, *Asystasia gangetica*, and *Senna obtusifolia*, which are quite rich in Cu contents (2.32–8.81 mg/100g) could meet the recommended daily intake of Cu for a healthy life.

Zinc (Zn) is an antioxidant nutrient necessary for protein synthesis, wound healing and vital for the development of the reproductive organs, prostate functions and male hormone activity (Hambidge, 2000). It is necessary for a healthy immune system, and is useful in fighting skin problems such as acne, boils and sore throats. It maintains the body's alkaline balance, helps in normal tissue function and aids in the digestion and metabolism of phosphorus (Hambidge, 2000). Compared to cabbage, sesame and the common mangoes, all WSWFPs analysed in this study are better sources of Zn. RDA for Zn is 11 mg for adult life (Institute of Medicine, Food and Nutrition Board, 2002), so most WSWFPs like *Senna obtusifolia*, *Bidens pilosa*, *Vernonia amygdalina*, *Asystasia gangetica*, *Hyptis spicigera*, *Amaranthus spinosus* and *Asystasia mysorensis* which are rich in Zn contents (6.48–11.43 mg/100g) would greatly supplement the recommended daily intake of Zn.

7.8 Conclusions

In light of the objectives of this study and the results described above, the following conclusions can be drawn about the nutritional values of WSWFPs in study area:

Compared to the conventionally planted cabbage, mangoes and sesame crops, most WSWFPs were generally richer sources of macro and micronutrients, right from protein, vitamin C, beta-carotene, calories, carbohydrates, dietary fibres, ash, moisture, potassium, phosphorus, magnesium, calcium, sodium to iron, manganese, copper and zinc, and therefore they can help improve household nutrition especially during the months preceding the harvest of cultivated crops and also during periods of social unrests, military conflicts, droughts, famine, and other natural catastrophes. A diet of comprising of WSWFPs can definitely assure a relief from some of the major and minor nutrient deficiencies often faced by the poor people in Uganda.

Hyptis spicigera, *Senna obtusifolia*, *Vernonia amygdalina, Acalypha bipartite*, *Asystasia gangetica* and *Physalis peruviana* were the richest sources of calories (50.45–544.31 kcal/100g). Ash content was highest (3.69–6.54 g/100g) in *Vernonia amygdalina*, *Solanum nigrum*, *Senna obtusifolia*, *Hyptis spicigera*, while protein was more abundant (5.20–12.11 g/100g) in *Vernonia amygdalina*, *Crotalaria ochroleuca,* *Senna obtusifolia, Acalypha bipartite, Corchorus trilocularis* and in *Solanum nigrum.*

Total fat content (40.64 g/100g) was highest in seeds of *Hyptis spicigera* while tender leaves of *Vernonia amygdalina, Asystasia gangetica, Corchorus trilocularis, Senna obtusifolia, Asystasia mysorensis, Hibiscus acetosella,* also seeds of *Hyptis spicigera, Aframomum angustifolium* and *Physalis peruviana* fruits were highest (7.49–38.62g/100g) in carbohydrates contents. Good sources (3.50–7.76 g/100g) of dietary fibres were *Vernonia amygdalina, Hyptis spicigera, Crotalaria ochroleuca, Physalis peruviana,* and *Sonchus oleraceus.*

Vitamin C was highest (98.03–337.05 mg/100g) in *Cleome hirta, Vernonia amygdalina, Acalypha bipartite, Solanum nigrum, Crotalaria ochroleuca,* and *Corchorus trilocularis* more than RDA for an adult (65–90 mg). While β-Carotene contents beyond the RDA were found in *Sonchus oleraceus, Cleome hirta, Solanum nigrum, Senna obtusifolia, Crotalaria ochroleuca, Vernonia amygdalina, Asystasia gangetica, Vigna unguiculata, Asystasia mysorensis, Corchorus trilocularis* and *Amaranthus spinosus.*

Ca contents were richer (373.50–857.94 mg/100g) in seeds of *Hyptis spicigera* and leaves of *Asystasia mysorensis, Asystasia gangetica, Acalypha bipartite, Amaranthus spinosus, Bidens pilosa, Senna obtusifolia, Solanum nigrum,* and *Cleome hirta.* While K concentrations were highest (365.64–714.14 mg/100g) in *Amaranthus spinosus, Sonchus oleraceus, Basella alba, Asystasia gangetica, Asystasia mysorensis, Cleome hirta, Hyptis spicigera* and fruits of *Aframomum angustifolium.*

Mg content was more abundant (235.90–421.70 mg/100g) in *Asystasia gangetica, Asystasia mysorensis, Hyptis spicigera, Bidens pilosa, Senna obtusifolia* and *Solanum nigrum.* Na content was highest (234.15–355.75 mg/100g) in *Senna obtusifolia, Bidens pilosa, Vernonia amygdalina* and *Sonchus oleraceus.* P was more abound (237.78–702.27 mg/100g) in *Hyptis spicigera* seeds, *Asystasia gangetica, Bidens pilosa, Asystasia mysorensis,* and *Senna obtusifolia.*

Fe content was highest (10.77–30.03 mg/100g) in *Acalypha bipartite*, *Corchorus trilocularis*, *Asystasia gangetica*, *Bidens pilosa*, *Asystasia mysorensis*, *Senna obtusifolia* and *Vernonia amygdalina*. Mn was more plentiful (5.74–32.75 mg/100g) in *Vernonia amygdalina*, *Asystasia mysorensis*, *Asystasia gangetica*, *Bidens pilosa*, *Cleome hirta* and *Senna obtusifolia*.

Cu content was more concentrated (2.32–8.81 mg/100g) in *Bidens pilosa*, *Vernonia amygdalina*, *Hyptis spicigera*, *Asystasia mysorensis*, *Asystasia gangetica* and *Senna obtusifolia*. Zn was more abundant (6.48–11.43 mg/100g) in *Senna obtusifolia*, *Bidens pilosa*, *Vernonia amygdalina*, *Asystasia gangetica*, *Hyptis spicigera* *Amaranthus spinosus* and *Asystasia mysorensis*.

CHAPTER 8

MANAGEMENT OF WILD AND SEMI-WILD FOOD PLANTS BY LOCAL PEOPLE IN BUNYORO-KITARA KINGDOM, UGANDA

8.1 Introduction

Plant management has been defined as the set of actions or practices directly or indirectly performed by humans to favour availability of populations or individual within populations of useful plant species (Gonza′lez-Insuasti and Caballero, 2007). Plant management enhances the maintenance of culturally and locally valued species within the communities. Many studies (e.g. Stoffle, 1990; Cunningham, 1995; Price 1997; Gonza′lez-Insuasti and Caballero, 2007) in different world regions have revealed a series of management strategies for what had previously been considered just wild plants. These studies indicate that most wild and semi-wild food plants (WSWFPs) are often managed under anthropogenic systems. These systems, according to Caballero *et al* (1998), and Gonza′lez-Insuasti and Caballero (2007) involve such practices as systematic gathering, 'let standing', encouraged growing, and protection. Systematic gathering consists of harvesting useful products from wild and weedy plant populations (Caballero *et al.,* 1998). Traditional gathering may include incipient forms of systematic management such as selective harvesting of particular phenotypes, rotation of gathering areas, temporary restrictions to exploitation of particular resources, among others, which may have more consequences that are important on plant communities (Casas *et al.*, 1996; Gonza′lez-Insuasti and Caballero, 2007).

'Let standing' includes practices directed to maintain within human-made environments useful plants that occurred in those areas before the environments were transformed by humans (Casas *et al.,* 2007). This type of management practices, has been documented in some perennial plants such as palms (Caballero, 1994). It has also been documented in the management of weedy species such as *Amaranthus hybridus*, *Chenopodium* spp., *Crotalaria pumila*, *Porophyllum* spp., and *Portulaca oleracea* and in other weeds with edible fruits such as *Jaltomata* spp., *Solanum* *nigrum*, *Physalis philadelphica* and *Lycopersicon lycopersicum* (Davis and Bye, 1982; Caballero and Mapes, 1985; Casas *et al.*, 1996).

Encouraged growing includes strategies directed at increasing density of populations of useful species within a plant community. Such strategies may include burning and taming of vegetation, which favour particular plant species, or through sowing seeds or planting vegetative propagules of favoured plants within wild or weedy areas. An example of this management type is the management of the palm *Brahea dulcis* by the Mixtec of Guerrero (Casas *et al.,* 1994, 1996). This palm propagates vegetatively and is resistant to fire. People remove trees and burn the remaining vegetation in order to eliminate competitors and to enhance the growth of palm populations. In addition, it is a common practice to deliberately scatter seeds of useful weedy plants within agricultural fields to increase their abundance (Casas *et al.,* 1996; Gonza'lez-Insuasti and Caballero, 2007).

Protection includes the deliberate elimination of competitors and predators of useful plants. It also involves their pruning, protection against frosts, and addition of fertilizers, to ensure their availability for special value (González-Insuasti *et al.,* 2008). For instance, Bye (1985) found that during the gathering of wild onions, the Tarahumara disperse bulbils of the plants gathered and remove roots of perennial plants near the onions in order to ensure the further availability of onions and to reduce competition, respectively, increasing in this way the numbers of onions in the populations gathered. However, local knowledge on selection criteria, propagation and management of WSWFPs in Uganda as elsewhere in many developing countries are neglected areas of inquiry as are the constraints, opportunities, and strategies to utilisation and promotion of WSWFPs. In this study therefore, local management practices, farmers' selection criteria, constraints, opportunities, and strategies to utilisation and promotion of WSWFPs in Bunyoro-Kitara Kingdom, Western Uganda were assessed and documented.

8.2 Objectives

8.2.1 Overall objectives

The overall objective of this study was to document local management practices, farmers' selection criteria for occasional cultivated WSWFPs, constraints, opportunities and strategies to their use, management and promotion of WSWFPs in Bunyoro-Kitara Kingdom, Western Uganda.

8.2.2 Specific objectives

The specific objectives of this particular study were three-fold:

i. Assses and document the local management practices of WSWFPs in the Kingdom.
ii. Document WSWFPs that are occasionally cultivated and local selection criteria for their incorporation into the farming systems.
iii. Determine the constraints, opportunities, and strategies to utilisation and promotion of WSWFPs in the Kingdom.

8.3 Research questions

The following research questions were sought:

Are gathered WSWFPs managed by the local people within the Kingdom? If managed, how are they locally managed? Who manages them? What criteria do local people use to select the occasionally cultivated WSWFPs within the Kingdom? What are the limiting factors to the use and promotion of WSWFPs in the Kingdom? What are the opportunities and strategies for enhanced use and promotion of WSWFPs in the Kingdom?

8.4 Data collection

In this study, 385 households from the two sub-counties (Kiryandongo and Mutunda) of Kibanda country in Bunyoro-Kitara Kingdom, were chosen for household survey following the method described by Krejcie and Morgan (1970). Fifty-five (55) households each from parishes of Kakwokwo, Diima, Nyamahasa, Kitwara, Kyankende, Kichwabugingo, and Kikube that make two sub-counties were then randomly selected. According to Krejcie and Morgan (1970), if one wished to know a representative sample size of a population of 9,000 people, then one looks in to the table at level N = 9,000 (see chapter 3). The sample size in this example is 368. The table, which is applicable to any population of a defined (finite) size is based on a formula:

$$Sample\ size = \frac{X^2NP(1-P)}{C^2(N-1)+X^2P(1-P)}).$$

Where, X^2 is a constant value of 3.841 (the square of the Z value of 1.96 for 95% confidence level); N represents the population size; P is the population parameter of 0.5; C is a 95% confidence interval (0.05)- a probability that the samples represent the population. No calculations are required to use the table.

Using this method and the table based on a survey system sample size culculator, 364 households were chosen for household survey because the documents gathered from sub-counties and county headquarter indicated that Kiryadongo and Mutunda had a total household number of 6788. However, 21 extra households were added to make a total of 385 samples for household survey. Krejcie and Morgan (1970) state that, using this calculation, as the population increases the sample size increases at a diminishing rate (plateau) and remains, eventually constant at slightly more than 380 cases. There is little to be gained to warrant the expense and energy to sample beyond about 380 cases. Alreck and Settle (1995) provide similar evidence.

The selected households were administered with semi-structured questionnaires (Appendix I). Respondents were asked how they managed WSWFPs, which they gather; to list WSWFPs that are occasionally cultivated in their area and how these plants are selected for cultivation. The questionnaire also covered the perceived challenges, opportunities, and strategies for promoting the use and management of WSWFPs by the local people. Data from the questionnaires were corroborated using eight focus group discussions (FGDs) with selected key informants that were identified during the course of household survey. Only participants who had time and were willing to participate in the discussions were selected. Each FGDs that lasted for about 3 to 4 hours, had 8 to 12 participants. Discussions were held at venues identified by and convenient to the participants. Where there was scoring, participants used, dry lima beans for such purposes. Probing was done to clarify of conflicting issues and ideas among the group participants. Participants were served soft drinks and with snacks, and their transport costs were reimbursed.

8.5 Data analysis

Responses from household questionnaires were coded, entered and analysed descriptively, and inferentially using Excel spread sheets and MINITAB statistical package. Mean frequency responses of management practices, selection criteria, constraints, opportunities, and strategies were computed and presented in form of tables, figures, and charts. Data from focus group discussions (FGDs) were analysed and reported qualitatively. They were subjected to in-depth content analysis, coding, and analytic comparisons (Miles and Huberman, 1994). Flip-charted notes were read several times to identify the key emerging issues, commonalities, variations, and disagreements. Disagreements or issues needing further clarification were resolved through further discussions. Mean scores from scoring exercises were also computed.

8.6 Results

8.6.1 Local management practices for WSWFPs in the Kingdom

Figure 8.1 indicates that most (55.2 ± 2.6%) households do not manage WSWFPs in Bunyoro-Kitara Kingdom. Only a few (44.4 ± 2.6%) households are engaged in some form of local management practices such as occasional cultivation and caring for some WSWFPs (58.1 ± 2.4%), and scattering seeds to encourage greater availability of certain preferred species (50.6 ± 6.7%). Other households tolerated or spared certain WSWFPs in the gardens (46.5 ± 4.8%), transplanted wildlings, and or seedlings of some WSWFPs (26.2 ± 2.6%). Some few households also protected and cared for certain WSWFPs (such as *Tamarindus indicus* and *Canarium schweinfurthii*) in the wild (Figure 8.2).

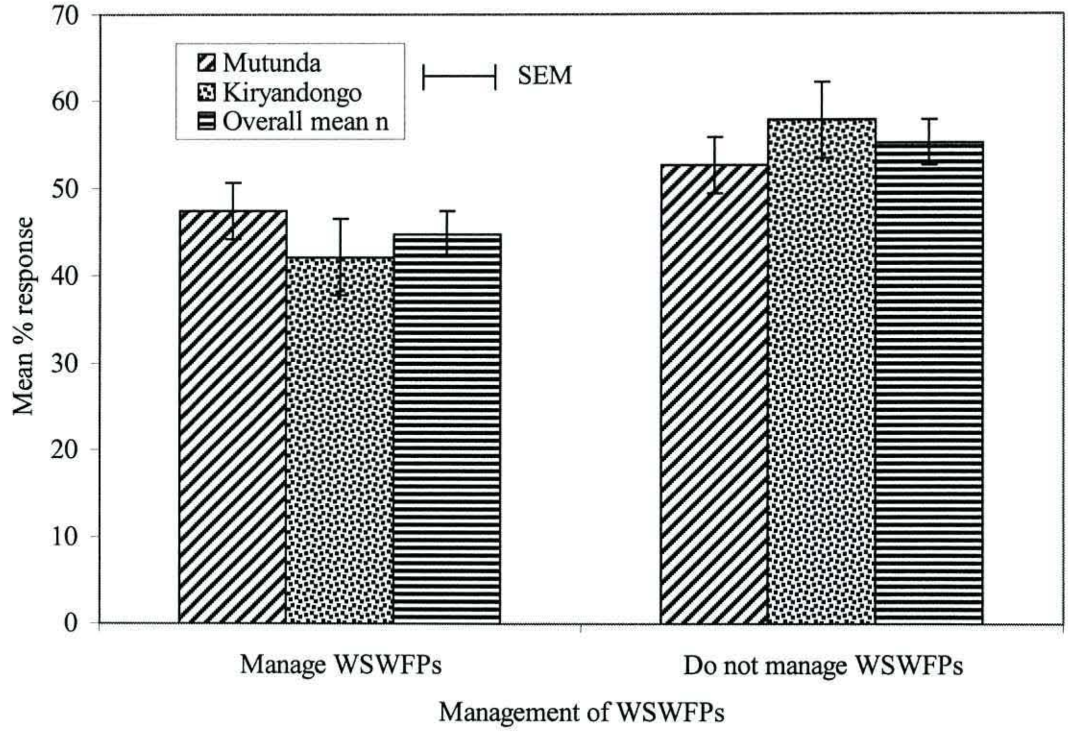


Figure 8.1 Response as to whether household members manage WSWFPs in their locality.

Findings from the FGDs (scoring using 30 lima beans); indicated that women were primarily engaged in: scattering of seeds of most WSWFPs to encourage their more availability (24.3 ± 0.7); protection and caring of WSWFPs in their wild habitats (14.3 ± 2.3), occasional cultivation and caring of WSWFPs on farms (18.3 ± 1.7), and tolerating or sparing of certain WSWFPs in the gardens (21.7 ± 1.7). Men were only active in transplanting wildlings and or seedlings of some WSWFPs (mainly fruits) (14.0 ± 2.1) although the mean score of this very action was not significantly different ($P > 0.05$) from that of their women counterparts. Men were also more involved in managing and caring of WSWFPs in their wild habitats (11.7 ± 1.7). Children were generally less involved in the management and caring of WSWFPs (Table 8.1).

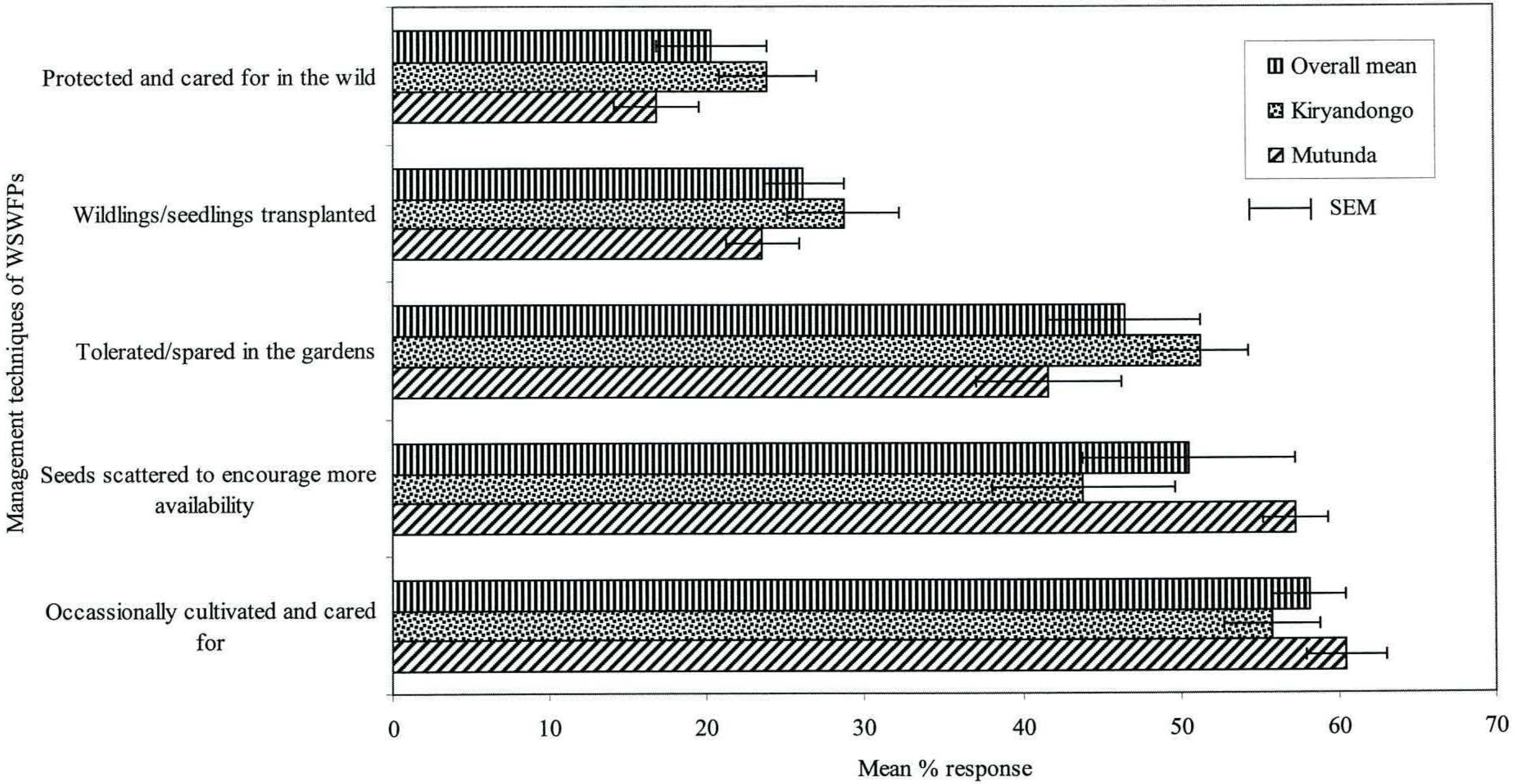


Figure 8.2 Management practices for WSWFPs in Bunyoro-Kitara Kingdom, Uganda.

Table 8.1 Who in the household is mainly involved in the management of WSWFPs; scores from three focus group discussions (FGDs).

Management practices	Who in the household is mainly involved in the management of WSWFPs											
	FGDs in Diima			FGDs in Kichwabugingo			FGDs in Kitwara			Mean (±SEM) score*		
	W	M	C	W	M	C	W	M	C	W	M	C
Scattering seeds to encourage more availability of the WSWFPs	23	2	5	25	3	2	25	1	4	24.3 (0.7)	2.0 (0.6)[d]	3.7 (0.9)[d]
Protection and caring for WSWFPs in their wild habitats	15	10	5	10	15	5	18	10	2	14.3 (2.3)[a]	11.7 (1.7)[a]	4.0 (1.0)
Occasional cultivation and caring for WSWFPs on farms	20	5	5	15	10	5	20	8	2	18.3 (1.7)	7.7 (1.5)[e]	4.0 (1.0)[e]
Transplanting the wildlings/seedlings	10	15	5	10	17	3	18	10	2	12.7 (2.7)[b]	14.0 (2.1)[b]	3.3 (0.9)
Tolerance/sparing of WSWFPs in the gardens	20	8	2	25	3	2	20	10	0	21.7 (1.7)	7.0 (2.1)	1.3 (0.7)

C = Children, M = Men, W = Women. Scores were made using 30 dry lima bean seeds. *High scores imply the principle responsibility. Mean scores in the same row followed by the same superscript letter are not significantly different from each other ($P > 0.05$).

8.6.2 Occasionally cultivated WSWFPs and farmers' selection criteria

8.6.2.1 Occasionally cultivated WSWFPs

Thirteen (13) of the 62 documented WSWFPs were reported to be occasionally cultivated by some households in the study area (Figure 8.3). Key among them was *Hibiscus sabdariffa* (68.9 ± 5.3%), *Amaranthus dubius* (65.1 ± 2.4%), *Solanum nigrum* (55.2 ± 4.4%), *Amaranthus hybridus* subsp. *cruentus* (41 ± 3.3%), *Cleome gynandra* (38.2 ± 2.2%), *Capsicum frutescens* (33 ± 1.2%), and *Crotalaria ochroleuca* (29.9 ± 10.9%). Others included *Corchorus tridens*, *Solanum lycopersicum*, *Amaranthus lividus*, *Phaseolus lunatus*, *Solanum macrocarpon,* and *Canarium schweinfurthii.*

Findings from the FGDs sessions based on a scoring system using 30 dry lima bean seeds (Table 8.2) indicated a total of seven caring practices often used by some households in management of occasionally cultivated WSWFPs. Principle among this caring practices included occasional weeding while weeding the main crop grown (12.3 ± 1.5), keeping off domestic livestock especially goats, and sheep from the cultivated plants (8.0 ± 1.2), mixed-cropping of the preferred WSWFPs most especially with tobacco plants to repel insect pests that may attack them (3.3 ± 0.9), uprooting and burning plants showing symptoms of diseases (3.0 ± 1.2).

Other uncommon practices included occasional dusting of some plants such as *Hibiscus sabdariffa, Solanum nigrum* and *Solanum lycopersicum* with kitchen ash to repel insect pests, occasional spraying of the cultivated plants with a water solution made from local materials such as cow dung, crushed leaves of neem trees (*Azadirachta indica*), tephrosia (*Tephrosia vogelii*) and red pepper fruits (*Capsicum frutescens*) to repel insect pests, and staking of some plants like as *Solanum lycopersicum* (wild tomatoes) and wild beans (*Phaseolus lunatus*).

Table 8.2 Caring practices for occasionally cultivated WSWFPs. Scores from three FGDs held in Diima, Kichwabugingo, and Kitwara parishes.

Caring practices	Scores from FGDs held in three parishes			
	Diima	Kichwabugingo	Kitwara	Mean(±SEM) score*
Occasionally weeded while weeding the main crop.	12	10	15	12.3 (1.5)
Keeping off domestic livestock especially goats, sheep and from the cultivated plants.	8	10	6	8.0 (1.2)
Mixed-cropping especially with tobacco plants to repel insect pests.	3	2	5	3.3 (0.9)
Uprooting and burning plants showing symptoms of diseases.	3	5	1	3.0 (1.2)
Occasionally dusting some plants such as *Hibiscus sabdariffa, Solanum nigrum,* and *Solanum lycopersicum* with kitchen ash to repel insect pests.	1	2	0	1.0 (0.6)
Occasionally spraying plants with a water solution made from local materials such as cow dung, crushed leaves of neem trees, tephrosia, and red pepper fruits to repel insect pests.	2	0	1	1.0 (0.6)
Staking some plants like as wild tomatoes and wild beans.	1	1	2	1.3 (0.3)

*High scores imply the popularity of the practice whereas low scores imply it is less popular. Scores were made using 30 dry lima bean seeds.

8.6.2.2 .Local selection criteria

Households who occasionally cultivated and cared for some WSWFPs in their gardens reportedly used different criteria as a basis of their choices for selecting which WSWFPs to cultivate (Table 8.3). High market demands of the plant (80.7 ± 3.1%), good tastability when being consumed (73.1 ± 2.5%), ability of the plant to grow fast and produce harvestable parts in a short time period (66 ± 4.6%), cultural and social acceptability (55.2 ± 4.2%) and easiness of growing and managing the plant with minimal inputs (50 ± 3.8%) were the most commonly used criteria. Other criteria used for selection included high yielding ability of the plant, non-weedy characteristic, growth compatibility with other crops, good tolerance to drought condition and ability to withstand or resist pests and diseases (Table 8.3).

Table 8.3 Local criteria for selection of WSWFPs occasionally cultivated on farms.

Local selection criteria of occasionally cultivated WSWFPs	Frequency of mention (%)		
	Mutunda (±SEM)	Kiryandongo (±SEM)	Overall mean (±SEM)
High market demands.	77.6 (5.7)	83.7 (4)	80.7 (3.1)
Good tastability when being consumed.	75.6 (4.5)	70.6 (3.7)	73.1 (2.5)
Ability to grow fast and produce harvestable parts in a short time period.	61.5 (4.4)	70.6 (3.1)	66.0 (4.6)
Cultural and social acceptability.	59.4 (2.3)	51.0 (3.6)	55.2 (4.2)
Ease of growing and managment with minimal inputs.	53.8 (4.2)	46.2 (2.9)	50.0 (3.8)
High yielding ability.	35.8 (5.1)	42.5 (4.3)	39.2 (3.4)
Non-weedy characteristics.	30.5 (3.9)	21.4 (2.5)	25.9 (4.6)
Growth compatibility with other crops.	20.5 (1.8)	24.8 (2.5)	22.6 (2.2)
Good tolerance to drought.	15 (3.3)	22.7 (2)	18.9 (3.9)
Ability to resist pests and diseases.	15.9 (2)	11.5 (1.4)	13.7 (2.2)

8.6.3 Constraints, opportunities and strategies in promoting the use and management of WSWFPs

8.6.3.1 Constraints

A number of constraints hampering the promotion of WSWFPs were reported (Figure 8.4). Key among these constraints were the weak market competitiveness of many WSWFPs compared to most conventional crops (75.8 ± 2.6%), weedy nature of some of WSWFPs (73.2 ± 3.7%), scarce knowledge on preparation procedures of most WSWFPs (68.3 ± 2.6%), negative public perceptions about consumption of WSWFPs (61.6 ± 3.1%), little support from the government in promoting the use and management of WSWFPs (55.1 ± 3%), and difficulty in accessing some of the WSWFPs because of increasing habitat loss (41.3 ± 5.6%). Other constraints hindering the promotion of WSWFPs included little research work and dissemination efforts on locally important species, scarce and dwindling knowledge on the general management of WSWFPs, special preparation methods which often discourages use and wide adaptation of some WSWFPs, and lastly lack of good planting seeds (Figure 8.4). Plate 8.1 depicts *Senna obtusifolia* - one of the weedy WSWFPs, which is very invasive on farms.

Plate 8.1 *Senna obtusifolia* (L.) Irwin & Barneby - one of the aggressive weedy WSWFPs.

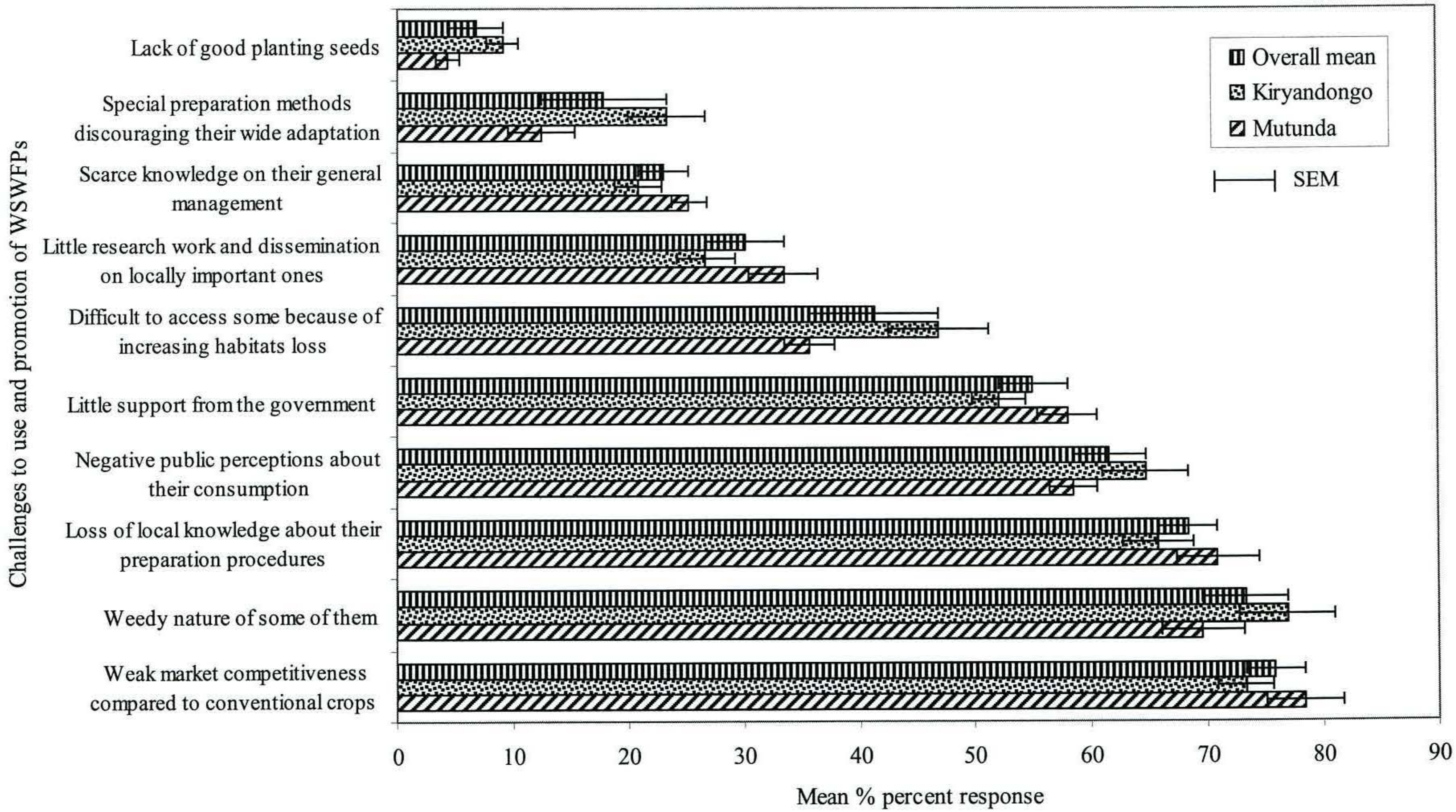


Figure 8.4 Constraints in promoting the use and management of WSWFPs in Bunyoro-Kitara Kingdom.

Findings from the FGD sessions based on a scoring system using 30 dry lima bean seeds (Table 8.4) indicated that human activities mainly responsible for habitat loss of most WSWFPs in the study area were: opening and clearing more land for agriculture activities (11.7 ± 1.7), bushfires from charcoal burning activities, hunters and cattle grazers (7.0 ± 1.5), and opening and clearing more land to settle the ever increasing number of people (6.3 ± 0.9). Others included indiscriminate cutting of trees including edible fruit bearing trees for charcoal, firewood, craft and building materials; and overgrazing by livestock especially cattle.

Table 8.4 Human activities responsible for the loss of habitat of WSWFPs in the study locality, scores from three focus group discussions.

Human activities responsible for the loss of habitat of WSWFPs	Scores from FGDs held in three parishes			
	Dii	Kic	Kit	Mean (±SEM) score*
Opening and clearing more land for agricultural activities	10	15	10	11.7 (1.7)
Bushfires from charcoal burning activities, hunters and cattle grazers	5	6	10	7.0 (1.5)
Opening and clearing more land for settlement to accommodate ever increasing number of people	8	5	6	6.3 (0.9)
Indiscriminate cutting of trees including edible fruit bearing trees to supply charcoal, firewood, craft and building materials	5	3	2	3.3 (0.9)
Overgrazing by livestock (especially cattle).	2	1	2	1.7 (0.3)

Dii: Diima, Kic: Kichwabugingo, Kit: Kitwara. Scores were made using 30 dry lima bean seeds. *Higher the mean score, the more important is the activity in causing habitat loss of WSWFPs.

8.6.3.2 Opportunities

Asked as to what they perceived as the opportunities in promoting the use and management of WSWFPs in their area, many (75.3 ± 1.8%) respondents said that the increasing awareness of the nutritional importance of WSWFPs in the local diet presents a good opportunity (Table 8.5). Similarly, increasing demand and market value of some WSWFPs in face of local, national and global food problems (66.2 ± 4.8%); existing policies that govern the management of wild resources (60.3 ± 2.9%), and the fact that most WSWFPs are already an integral part of local cultures and present in many traditional food preparation systems (57.9 ± 2.4%) were considered important opportunities. Plate 8.2 shows *Tamarindus indica* - one of the popular WSWFPs that is eaten across many local cultures in Uganda.

Other opportunities included increasing campaigns and awareness creation about WSWFPs by service providers mainly from community based organisations (CBOs), quick adaption of most WSWFPs to different habitats, potential of many recipes from WSWFPs, increasing awareness of medicinal significances of most WSWFPs especially in boosting the body immunities to fight diseases, and the perception that WSWFPs are nearly clean foods- not much contaminated with inorganic chemicals (Table 8.5).

Plate 8.2 *Tamarindus indica* L - one of the popular WSWFPs that are eaten a across many local cultures in Uganda.

Table 8.5 Opportunities for promoting the use of WSWFPs in Bunyoro-Kitara Kingdom

Opportunities in promoting the use of WSWFPs.	Frequency of mention (%)		
	Mutunda (±SEM)	Kiryandongo (±SEM)	Overall mean (±SEM)
Increasing awareness of the nutritional importance of WSWFPs in the local diet.	77.1 (3.1)	73.5 (2.5)	75.3 (1.8)
Growing demand and market value of some WSWFPs in face of local and national food problems.	61.5 (4.4)	71.0 (3.9)	66.2 (4.8)
Existing policies and laws that governs the management of wild resources.	63.1 (3.6)	57.4 (3.0)	60.3 (2.9)
WSWFPs are already integral part of many local cultures and are present in many traditional food preparation systems.	60.3 (3.3)	55.5 (3.6)	57.9 (2.4)
Increasing campaigns and attention by service providers towards WSWFPs.	52.5 (3.5)	44.6 (2.9)	48.6 (4.0)
Most WSWFPs quickly adapt to different habitats/agro ecological niches.	19.2 (3.8)	31.2 (4.3)	25.2 (6.0)
Potential of many recipes from WSWFPs.	20.5 (1.8)	25.2 (2.6)	22.9 (2.4)
Increasing awareness of medicinal significance of most WSWFPs especially in boosting the body immunities to fight diseases.	22.0 (2.7)	13.8 (2.0)	17.9 (4.1)
WSWFPs are all nearly clean foods- not much contaminated with inorganic chemicals.	15.8 (2.2)	6.5 (1.5)	11.2 (4.7)

8.6.3.3 Strategies

A number of strategies to promote use and management of WSWFPs in Bunyoro-Kitara Kingdom were suggested (Table 8.6). Prominent among them were: setting up local community seed centres of WSWFPs to maintain and supply planting materials (71.9 ± 2.5%); scaling-up public awareness campaigns about nutritional benefits of WSWFPs (60.8 ± 3.4%); creating and enforcing supportive legal frameworks on protection, use and management of WSWFPs (56.1 ± 4.1%); promoting deliberate cultivation and marketing of WSWFPs (47.3 ± 3.4%); documenting and disseminating local knowledge on the use and preparation of the WSWFPs (40 ± 5.5%). Other suggested strategies included incorporating WSWFPs into any government framework for alleviating food insecurity like Plan for Modernisation of Agriculture (PMA), empowering service providers to train people on value adding aspects of WSWFPs, and undertaking participatory research on locally important WSWFPs (Table 8.6).

Scoring of the strategies during FGD, sessions using 40 dry lima bean seeds (Table 8.7) revealed similar order of importance with some few displacements. Setting up local community seed centres for WSWFPs to maintain and supply planting materials (11.7 ± 2.0), and scaling-up public awareness campaigns about nutritional benefits of WSWFPs (7.7 ± 1.5) were still considered the best strategies. However, promoting deliberate cultivation and marketing of WSWFPs (5.0 ± 0.6), documenting as well as disseminating local knowledge on the use and preparation of the WSWFPs (4.3 ± 0.7) were considered the third and fourth best strategies. While creating and enforcing the supportive legal framework on protection, use, and management of WSWFPs (4.0 ± 0.6) was considered the fifth best strategy.

Table 8.6 Strategies to promote use of WSWFPs.

Strategies to promote use and management of WSWFPs	Frequency of mention (%)		
	Mutunda (±SEM)	Kiryandongo (±SEM)	Overall mean (±SEM)
Setting up local community seed centres for WSWFPs to maintain and supply planting materials.	74.4 (4.3)	69.5 (5.0)	71.9 (2.5)
Scaling-up public awareness campaigns about nutritional benefits of WSWFPs.	57.4 (2.7)	64.2 (3.0)	60.8 (3.4)
Creating and enforcing supportive legal framework on protection, use, and management of WSWFPs.	52 (2.9)	60.2 (3.8)	56.1 (4.1)
Promoting deliberate cultivation and marketing of WSWFPs.	50.6 (3.2)	43.9 (2.6)	47.3 (3.4)
Documenting and disseminating local knowledge on the use and preparation of WSWFPs.	45.5 (2.5)	34.5 (2.2)	40.0 (5.5)
Incorporating WSWFPs into any government framework for alleviating food insecurity like PMA.	26.7 (2.4)	32.0 (3.3)	29.4 (2.7)
Empowering service providers to train people on value adding aspects of WSWFPs.	20.5 (1.6)	15.9 (1.9)	18.2 (2.3)
Undertaking participatory research on locally important WSWFPs together with local people.	6.8 (1.1)	14.0 (2.0)	10.4 (3.6)

Table 8.7 Relative importance of the strategies to promote use of WSWFPs (scores from three FGDs).

Strategies in promoting use of WSWFPs	Scores from FGDs held in three parishes			
	Diima	Kichwabugingo	Kitwara	Mean(±SEM) score*
Setting up local community seed centres for WSWFPs to maintain and supply planting materials.	8	12	15	11.7 (2.0)
Scaling-up public awareness campaigns about nutritional benefits of WSWFPs.	10	8	5	7.7 (1.5)
Encourage deliberate cultivation and marketing of WSWFPs.	4	6	5	5.0 (0.6)
Documenting and disseminating local knowledge on the use and preparation of WSWFPs.	5	3	5	4.3 (0.7)
Creating and enforcing supportive legal framework on protection, use, and management of WSWFPs.	5	3	4	4.0 (0.6)
Incorporating WSWFPs into any government framework for alleviating food insecurity like PMA.	3	2	3	2.7 (0.3)
Empowering service providers to train people on value adding aspects of WSWFPs.	3	2	2	2.3 (0.3)
Undertaking participatory research on locally important WSWFPs together with local people.	2	4	1	2.3 (0.9)

Scores were made using 40 dry lima bean seeds. *Higher the mean score, the more important is the proposed strategy considered in promoting use of WSWFPs.

8.7 Discussion

8.7.1 Local management practices for WSWFPs in the Kingdom

More than half of the households studied do not manage WSWFPs they use in their area. Fewer households engaged in some forms of local management (e.g. occasional cultivation) to protect some WSWFPs. Agea *et al.* (2010) reported that most people in Uganda still regard wild food plant resources as God given and therefore, should not be managed. The commonest management practice was occasional cultivation and caring for certain WSWFPs especially in homegardens, and sometimes together with the mainstream conventional crops on the farms. Equally, important and common practice was scattering of seeds of favoured WSWFPs (e.g. *Cleome gynandra*) to encourage their continued availability. Evidence from key informant interviews indicated that seeds of most favoured species are scattered mainly in homegardens (homesteads), farm borders (boundaries) and along the footpaths. Such practices were also documented by Katende *et al.* (1999), Musinguzi *et al.* (2006) and Tabuti *et al* 2007 in Uganda. Similarly, in southern Ethiopia, some wild-food plants (e.g. Arisaema and Huernia species) were reported as occasionally being cultivated on farm fields to increase their availability and use at times of food shortages (Guinand and Dechassa, 2000). Huernia is cultivated on the stonewalls forming the terraces in the midlands, thereby preventing competition with conventional crops.

Other households in the present study tolerated (spared) some WSWFPs (e.g. *Capsicum frutescens*) in their gardens, transplanted wildlings and or seedlings of favoured WSWFPs, while others simply protected and cared for some WSWFPs in their wild habitats (*in situ*). These practices are, however not new in Uganda. Katende *et al.* (1999) reported such practices while documenting wild food plants and mushrooms of Uganda. Agea *et al* (2007) also reported that some farmers in Lira district of northern Uganda spared on their farms, transplanted the wildlings or protected in the wild some indigenous fruit trees. Elsewhere, Van den Eynden (2004) reported that some households in southern Ecuador tolerated while others actively transplanted some edible non-crop plants, thus ensuring their continued availability.

Findings from the present study showed that women were more actively involved in managing WSWFPs than men and children. For example, women participated more in seeds scattering of most favoured WSWFPs to increase their availability, *in situ* protection and caring for certain WSWFPs in their natural habitats, occasional cultivation, and tolerance of certain WSWFPs in the gardens. This is consistence with the widely held views that women generally have the primary responsibility for maintenance of agrobiodiversity (FAO, 1999; Torkelsson, 2003; FAO, 2004*b*). Women have also been reported to be primarily involved in the selection, improvement, and adaptation of plant varieties and as such, they often have more specialized knowledge of wild plants used for food than men and children (Synnevag, 1997; Guinand and Lemessa, 2000).

8.7.2 Occasionally cultivated WSWFPs and local selection criteria

8.7.2.1 Occasionally cultivated WSWFPs

Thirteen of the 62 documented WSWFPs in the present study were occasionally cultivated by some households in the area. The number is considerably low, compared to total number of WSWFPs documented. This perhaps could be due to the fact that most households are only interested in the cultivation of crops from which they can earn a good income and because no one has cultivated these WSWFPs with the intention of earning an income from them, they are considered not worth investing labour in growing. However, the few that are occasionally cultivated have been reported in some parts of Uganda to have gradually been incorporated into the mainstream farming systems perhaps implying a changing trend in the perception by the farming households. *Hibiscus sabdariffa* and *Cleome gynandra* for example have gradually become some of the mainstream food crops grown among the northern tribes of Uganda notably Langi and Acholi tribal communities (Katende *et al.*, 1999). Similarly, there are several reports that show *Amaranthus dubius*, *Solanum nigrum*, *Amaranthus hybridus* subsp. *cruentus*, *Capsicum frutescens*, *Crotalaria ochroleuca*, *Corchorus tridens* becoming regular food crops under cultivation in some parts of Uganda (Rubaihayo *et al.*, 2003; Musinguzi *et al.*, 2006; Tabuti *et al* 2007; NARO, 2008).

Results from FGD revealed that farming households occasionally weed some of these cultivated WSWFPs. However those that are intercropped with the conventional crops, benefits from regularly weeding of these crops. Other farming households protected these plants from the roaming livestock, deliberately intercropped them with other crops to offer protection from insect pests, uprooted, and burned plants showing symptoms of diseases. Others occasionally dusted the plant with kitchen ash and or sprayed them with a water solution made from local materials such as cow dung, crushed leaves of neem trees, tephrosia, and red pepper fruits to repel insect pests. Such caring practices especially scattered intercropping to repel pests have been reported by Rubaihayo *et al.* (2003), however, it is not clear how effective intercropping and dusting the plants with kitchen or spraying them with locally made concoctions are in controlling pests compared to purchased pesticides, an area that requires research. Similarly, Agea *et al.* (2008) reported similar use of locally made pesticides (mixture of red pepper, human and animal urine, neem tree, tobacco and Tephrosia leaves) as being employed by resource poor farmers in Masaka district, central Uganda to control field crop pests.

8.7.2.2 Local selection criteria

A number of criteria were reportedly used in the selection of WSWFPs that are occasionally cultivated. One such criterion was the market demand. During the FGDs, most people argued that there is no incentive for cultivating WSWFPs, which do not have market value, and appealing tastes. Although, market value was recognized as a relevant factor, its applicability as a criterion is limited only to a few of the WSWFPs especially those that are used in virtually all curries to enhance the taste of the dish (e.g. *Capsicum frutescens* and *Corchorus tridens*). Most other WSWFPs do not currently have a good monetary value. Taste was considered as an important criterion. WSWFPs such as *Hibiscus sabdariffa* and *Cleome gynandra* have often been occasional cultivated by many households in the study area because they are considered by many people to be among the tastiest of leafy greens. However, selection of some WSWFPs such as *Basella alba* ('Enderema') and *Urtica massaica* ('Orugenyi or Ekicuraganyi') for cultivation are constrained by cultural and social beliefs associated with them.

For instance, among people of Ganda origin, Enderema is only eaten by women because it is believed that any man who dares eat it will lose his sexual potential forever. The superstition may have grown up because women wanted the vegetable for themselves. It is believed further that some men will not even eat food cooked in the same pot as Enderema (Goode, 1989). Similarly it is believed that women who are picking the young tender shoots and leaves of Orugenyi (Ekicuraganyi) remain very quiet except if greeted by someone passing by. If in the process of greeting the name of the plant is mentioned then the plant will never be cooked properly and the leaves will remain hard and tough (Goode, 1989). Such cultural and social notions would limit their chances of selection. On the other hand, WSWFPs such as *Solanum anguivi* were preferred for cultivation especially by women who believe its consumption increases milk production in lactating mothers, however, as farm households tend to use multiple criteria in making the choices, their chances of selection is not definite.

Self-regeneration, fast growth and ease of management are qualities for which most WSWFPs have to stand the test as they are not expressly planted and managed by human beings (Mazhar *et al.*, 2007). In the present study, it was noted that some farmers typically based their choices on these criteria. Species (e.g. *Hibiscus sabdariffa*) that germinate easily and grow fast to produce harvestable parts in a short time duration with minimum management requirements were favoured. Some WSWFPs (e.g. *Tamarindus indica*) were simply relegated because they grow slowly or require special care and attention at different stages of growth. Others criteria that are used by farm households in selecting which WSWFPs to incorporate in farming systems are high yielding ability, non-weedy characteristics, growth compatibility with other crops, tolerance to drought condition and ability to withstand pests and diseases. Some of these criteria were also reported to be used by farmers in Adwari sub-county of Lira district in northern Uganda as a basis for selecting indigenous fruit trees (IFTs) for on-farm management (Agea *et al.,* 2007). Minae *et al.* (1994) also reports the use of the similar criteria by farmers in Central Malawi to make their choices of IFTs for on-farm cultivation.

8.7.3 Constraints, opportunities and strategies in promoting use of WSWFPs

8.7.3.1 Constraints

WSWFPs are increasingly becoming important among poor households, where they play a critical role in food security and nutrition, especially during seasonal food shortages. However, a number of challenges hinder their full exploitation and promotion. One of the key challenges is their weak market competitiveness compared to conventional crops. There are few accounts where WSWFPs were found to compete favourably with conventional food crops during the market survey. Farm household generally believed that it is not worthwhile to rely much on WSWFPs for income generation. Whether they are nutritious and may have other virtues, the pecuniary incentive is one of the overriding factors in motivating farmers to produce. However, with the increasing awareness, it is hoped that some WSWFPs such as *Hibiscus acetosella*, *Basella alba* and *Hyptis spicigera* (seeds) would in future compete fairly with conventional food crops. In Sikkim state of Himalaya, Sundriyal and Sundriyal (2004) too notes that WSWFPs generally have low market competiveness compared to mainstream cultivated food crops.

The weedy nature of some WSWFPS was noted to be restricting their promotion especially incorporating them on-farm. In fact some farm households were eradicating them in favour of introduced and conventional food crops, yet most WSWFPS (e.g. *Amaranthus spinosus*) perceived as weedy are in most cases nutritious than their cultivated counterparts. This finding concurred with that of Della (2006) who reported that some wild edible plants which were very much appreciated and frequently consumed in the past are now considered as weeds by farmers in Paphos and Larnaca countryside of Cyprus, hence their neglect. The other challenge to promotion of the use WSWFPs in the study area was the loss of local knowledge about their preparation. Due to changing lifestyles and social attitudes, diets for most people in study area like elsewhere in Uganda and Africa consist increasingly of introduced and conventional food crops often with a less strenuous preparation procedures. A worrying trend now, is that only a few elderly people are left with undocumented local knowledge about preparation and preservation of most WSWFPs in the area. Information about WSWFPs is no longer systematically transferred from one generation to the next so the knowledge gap between the older generations and young people is widening. FAO (2005) calls for urgent need to document such knowledge before it is lost forever.

Another barrier to the widespread use of WSWFPs is negative public perceptions about their consumption. While there is increasing demand for introduced and conventional food crops, WSWFPs are considered by some people as out of fashion. They thus enjoy less social prestige, with their continued consumption associated to poverty and low status. As the poor seek to imitate the eating habits of the relatively wealth-off people who despise the consumption of WSWFPs in preference of conventional food crops, most WSWFPS become neglected. In Ethiopia, Guinand and Lemessa (2000) too reported that people consuming WSWFPs are perceived as poor, a sentiment which makes many people to shy away from its consumption. These public prejudices about WSWFPs could perhaps be due to a lack of proper knowledge, especially of the nutritive and medicinal values of WSWFPs.

Little support from the government in promoting use and management of WSWFPs was also a concern. Much as it is known by government (local and national) that WSWFPs are of great importance to local communities in many ways, very little in terms of policy and investment support is done, to promote their consumption and incorporation into the current farming systems. Policy makers and service providers remain transfixed by the goal of promoting and increasing yields of the mainstream conventional food crops at the expense of locally adaptable WSWFPs that has been used for generations by humans. Further, agricultural curricula in schools, colleges and universities have not addressed WSWFPs to any appreciable extent and the local food systems of most town dwellers do not include much local recipes in their menu. The danger of little or no institutional support from the governments has also been underscored by Jaenicke and Hoschle-Zeledon (2006) who noted very little progress can be achieved in promoting underutilized plant species without the strategic support.

Currently, accessibility of some WSWFPs were said to be difficult. Increasing habitat loss caused mainly by human activities such as opening and clearing more land for agriculture and settlement; bushfires from charcoal burning activities, hunters and cattle grazers; indiscriminate cutting of trees including edible fruit bearing trees to supply charcoal, firewood, craft and building materials; and overgrazing by livestock were held responsible for the increasing inaccessibility of some WSWFPs within the study area. Scoones *et al* (1992) reported that as cultivated areas expand and traditional agroecosystems are simplified, the availability of wild resources diminishes and knowledge on their use diminishes too overtime. Similar, Balemie and Kebebew (2006) also reports that human activities such as over grazing, agricultural land expansion, fuel wood collection and uncontrolled fires are major threats to wild edible plants in Derashe and Kucha Districts of South Ethiopia.

There was also concern about the little research and dissemination efforts on locally important WSWFPs in the present study. Most researchers generally find it unattractive to work on wild food resources. Senior researchers from the universities and research institutions often prefer their comfort zones. This has resulted into little published information available on WSWFPs in the country. Besides, there is little or no policy direction by our government to focus research activities on WSWFPs. This has made it even difficult to find an entry point for the few people interested to research on WSWFPs. These problems coupled with lack of social marketing of WSWFPs meant their usefulness is waning away. The lack of public awareness and little research on WSWFPs in Uganda has also been echoed by NARO (2008). Lastly, lack of good planting germplasm mainly seeds was reported by some people. Some seeds of certain WSWFPs such as *Hyptis spicigera* were said to difficult to get. In other instances, seeds, which they procure mostly from wild, were of poor quality. This coupled with lack of knowledge on cultivation and subsequent management discourages some households from their widespread use.

8.7.3.2 Opportunities

The present study documented a number of opportunities that could be exploited in promoting the use and management of WSWFPs in Bunyoro-Kitara Kingdom. Increasing awareness of the nutritional importance of most WSWFPs in the local diet as well as the growing demand and market value of some WSWFPs (e.g. *Amaranthus* spp.) in face of local and national food problems were viewed as good opportunities to promote the use and management of WSWFPs in the Kingdom. In fact, there is an anecdotal evidence suggesting a trend of reverting to wild and neglected food plants to reduce dependence on conventional food crops. Such a trend of course, creates a potential to promote some of the WSWFPs, especially those that are already under semi-cultivation. In this respect, Gündel *et al.* (2003) observed that the growing demand and market potential of many underutilized food plants is an important incentive for their conservation.

Furthermore, existing policies and laws related to management of wild genetic resources was too considered an opportunity. Although, Uganda currently does not have a specific policy or legislation on wild plant genetic resources for food and agriculture, it has a number of legal frameworks that have been passed and or amended which have a bearing on plant genetic resources. Some of these legal frameworks include the 1995 Constitution of the Republic of Uganda, the Land Act of 1998, the National Agricultural Advisory Services Act 2001, the National Forestry and Tree Planting Act 2003, the National Agriculture Research Act 2005, the Seeds and Plant Act 2006, National Environment Regulations, 2005 (NARO, 2008). Besides, most WSWFPs (e.g. *Capsicum frutescens*, *Cleome gynandra*, *Amaranthus* sp. and *Solanum nigrum*) are already an integral part of local food cultures and traditional food preparation systems for most communities in Uganda. This is therefore, an added incentive in promoting the use and management of these plants. Similarly, increasing awareness of medicinal significances of most WSWFPs (e.g *Vernonia amygdalina* and *Senna obtusifolia*) was considered as an opportunity. For instance, liquid extract from boiled leaves and roots of Kibirizi (*Vernonia amygdalina*) is used in the treatment of malaria (fever), stomachache, intestinal worms, hypertension, diarrhoea, skin eruptions while decoction from the leaves, seeds and roots of Luge (*Senna obtusifolia*) is used to treat fevers, wounds, snakebites, stomach-ache, cough and chest pains. Other WSWFPs like *Mondia whytei* (Omurondwa) is popular because of its local use as sexual stimulant, appetiser, de-wormer and stimulant of milk production in lactating mothers (Agea *et al.*, 2008).

Other opportunities for promoting the use and management of WSWFPs in the Bunyoro-Kitara Kingdom include the growing campaigns by service providers mainly from civil society organisations; easy adaption of most WSWFPs to varying habitats; many recipes from WSWFPs, and the general belief that most WSWFPs are clean foods (not much contaminated with inorganic chemicals). As noted by Chweya (1997), such opportunities could be used as an incentive to lure many people in using and managing WSWFPs on their farmlands.

8.7.3.3 Strategies

Several strategies for promoting use and management of WSWFPs in Bunyoro-Kitara Kingdom were documented. Most people suggested setting up local community seed centres to maintain and supply planting materials of WSWFPs to farmers. With community seed banks managed at village level, community members would able to gain access to good seeds at the right time for planting. Besides, some of the species that have been lost within area, their seeds would be sourced from other areas, multiplied and supplied to interested farmers. However, as pointed by Cooper *et al.* (1992), this would require initial investment in training community groups on seed selection, bulking, seed harvesting and processing, post-harvest management of seed, including treatment against pest damage. There was also, a suggestion for scaling-up public awareness campaigns on nutritional benefits of WSWFPs within the Kingdom; and that promotional campaigns could be designed to target specific WSWFPs starting with those that are already under semi-cultivation.

Besides, there was a call for documentation and dissemination of local knowledge on preparation procedures of the commonly consumed WSWFPs in the Kingdom. During FGDs, there was a suggestion that researchers in collaboration with local governments (e.g. sub-county, parish and village councils) should lead in the documentation of knowledge on WSWFPs. Awareness campaigns and information dissemination was to be spear-headed by extension agencies, private sector and civil society organisations (NGOs, CBOs and FBOs). The importance of awareness campaigns and information dissemination towards promoting the exploitation of underutilised plant species for poverty alleviation have also been underscored by Gündel *et al.* (2003). Other people called for concerted effort by government and other stakeholders to encourage deliberate cultivation and marketing of WSWFPs by the local people as livelihood means. As noted by FAO (1985*b*), an appropriate measure to increase both production and consumption of WSWFPs is vital because it would be pointless to try to promote consumptive use without ensuring adequate supply. In the same vein, sufficient availability without market demand will create gluts and thus act as a disincentive to further production. Success of promotion programmes, therefore, will depend on how these factors can be synchronized.

In addition, there was a suggestion that the government (local and national) should put in place measures that would incorporate the use of WSWFPs into any of its developmental framework for alleviating household food insecurity such Plan for Modernisation of Agriculture (PMA). However, such attempts would require a strong advocacy and lobby to obtain political commitment and support. There was also a call for participatory research undertaking on locally important WSWFPs. It is a well known fact that local communities often have a profound understanding of their environment and its ecology. Harris *et al.* (2008) echoed that farmers' own research and holistic assessments of technologies and practices can make a vital contribution to knowledge production even though their approach might be different from the formal scientific method. Huvio (1999) also noted that some members of local communities (e.g. women and elderly people) often ignored by research scientists, are quite knowledgeable about their environment, best informed regarding traditional practices and recent trends.

Some people called for the empowerment and retooling of service providers in the emerging area of value addition. Service providers have an essential role to play in training farmers or gatherers on how to add values to some of the WSWFPs that are occasional cultivated or gathered. It was echoed that any future training on value adding activities should first target those WSWFPs, which have a good marketing potential at local and national levels; and that priority should be given to the development of new recipes that will increase market value and competitiveness of these plants against conventional food crops. On the other hand, there was a call for the modification and enforcement of the legal frameworks related to management of wild genetic resources. Policies and regulations that particularly favour use and management of WSWFPs should be formulated and those that favour their waste and destruction should be modified. Gündel *et al.* (2003) noted that lack of supportive and enabling policies and legislation is one of the major constraints to wide scale exploitation of underutilized plant species.

8.8 Conclusions

In light of the objectives, research questions and the results described above, the following conclusions can be drawn about the management of WSWFPS by local people in Bunyoro-Kitara Kingdom:

A few households were involved in the management of WSWFPs in Buyoro-Kitara Kingdom. Common management practices included occasional cultivation and caring, seeds scattering to encourage more availability, and sparing some WSWFPs in the gardens. Women were primarily responsible for the management of WSWFPs than men and children. Only 13 of the 62 documented WSWFPs were occasionally cultivated in the area by some households. Common ones were *Hibiscus sabdariffa, Amaranthus dubius, Solanum nigrum*, *Amaranthus hybridus* subsp. *Cruentus,* and *Cleome gynandra*.

Selections of the occasional cultivated WSWFPs were based on a number of criteria. Common ones were high market demands, good taste, fast growth to produce harvestable parts in a short period, cultural and social acceptability, and ease of management. Main challenges to use and promotion of WSWFPs in the Kingdom were their weak market competitiveness compared to conventional crops, their general weedy nature, scarce knowledge on their preparation procedures, negative public perceptions, little promotional support from the government, and the increasing inaccessibility of some of the WSWFPs because of habitat loss.

Main opportunities in promoting WSWFPs in the Kingdom included increasing awareness of the nutritional values of WSWFPs, growing demand and market value of some the WSWFPs in face of local and national food problems, existing policies that governs the management of wild genetic resources, and the fact that most WSWFPs are already an integral part of local cultures and present in many traditional food preparation systems.

Key documented strategies for promoting use and management of WSWFPs in the Kingdom were: setting up local community seed centres to maintain and supply planting materials of WSWFPs for interested farmers; scaling-up public awareness campaigns on their nutritional benefits; creating and enforcing supportive legal frameworks on protection, use and management of WSWFPs; promoting their deliberate cultivation and marketing; documenting and disseminating local knowledge on their preparation.

CHAPTER 9

GENERAL SYNTHESIS OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

In this chapter, findings and discussions presented in the previous chapters (4, 5, 6, 7 and 8), are re-examined in a general perspective and in relation to the food-based approach (Figure 1.1) (Clendon, 2001) that encompasses amongst others food availability, dependability, food diversity, nutritional and economic values, the cultural importance, and local knowledge about WSWFPs. The chapter also summarises the conclusions and recommendations made from the findings presented and discussed in the preceding chapters. Some of the recommendations are of policy and development nature while others are recommendations for further research. Being aware that science is the 'relation of the old to the new things as a process of logical reconstruction by which out of expectations new things may arise' (Smith and Manning, 1982); and that the role of science is to extend and enrich our knowledge base (Ehrenberg, 1982), this chapter therefore, synthesizes the general findings, highlighting the key contributions that have been made. Cognisant of the limitations of this study, the author acknowledges that it would be ambitious to claim that this research has discovered some elemental truth of science or that it provides a solution to household poverty and food insecurity. This study, however, does shed light on the use and potential of wild and semi-wild food plants (WSWFPs) in alleviating household poverty and food insecurity in Bunyoro-Kitara Kingdom that have not been examined in this depth before.

9. 2 General synthesis

WSWFPs have long provided poor households a 'hidden harvest', as they have used these plants often gathered from within and around their communities to supplement their foods and earnings (Scoones *et al.*, 1992; Grivetti and Ogle, 2000). Many of these plants are important sources of micronutrients and play an important role in nutrition, especially for poor and low-income households who are often more vulnerable to nutritional deficiencies where the food budget is limited and the diet restricted. Diversifying the family diet through the use of these plants enables the poor households to improve their nutrient intake at little or no additional cost. Compared to the conventional food plants such as cabbage, mangoes and sesame, findings from the present study indicated these often neglected WSWFPs were generally richer sources of macro and micronutrients, including protein, vitamin C, beta-carotene, calories, total carbohydrates, dietary fibres, ash, moisture, potassium, phosphorus, magnesium, calcium, sodium to iron, manganese, copper and zinc. Therefore, their daily inclusion in the diet may help improve household nutrition especially during the months preceding the harvest of cultivated crops and also during periods of social unrests, droughts, famine, and other natural catastrophes. Elsewhere, Handique (2002) reported that most uncultivated food plants (e.g. tender shoot of wild banana (*Musa bulbisiana*) and *Paederia foetida*) have remarkably higher nutrients compared to some conventional food crops. A diet comprising of WSWFPs can definitely assure a relief from some of the major and minor nutrient deficiencies often faced by the poor households.

A total of 62 species belonging to 31 botanical families were reportedly sought after from such places as forest gaps and margins, bushes, farmlands, home gardens and farm-borders by poor people for either household consumption or sale. Members of botanical families of Solanaceae, Fabaceae, Amaranthaceace, Malvaceae, Asteraceae and Brassicaceae were the most targeted. Their relevance as emergency and supplementary food sources and buffer against hunger is considerable in the study area. This is evidently clear by the fact that their consumption was found to comprise a major part (7 to 9 months) of the dietary intake of poor households where the tender leaves, shoots and fruits were predominantly harvested. Besides, the mean per capita harvest, which is a statistical measure of the amounts of WSWFPs harvested annually by households for subsistence use, expressed on a per person basis (g/day) (Wolfe and Utermohle, 2000) were considerably high for many species. For instance *Amaranthus dubius* and *Amaranthus spinosus* had very high mean per capita harvests of 31.59 and 27.23 g day^{-1} respectively.

Similarly, the mean per capita use, which is a statistical measure of the amounts of wild foods used annually within households that reported using wild foods, expressed on a per person basis (g/day) (Wolfe and Utermohle, 2000) was also high for many of the documented species. In fact the mean per capita consumption of some the plants such as *Hyptis spicigera* (107.02 g day^{-1}) and *Borassus aethiopum* (91.82 g day^{-1}) were even higher than the reported vegetable and fruit per capita consumption of 79.45 g day^{-1} in sub Saharan Africa, although much although much lower than the world average of 205.48 g consumed per person per day (Ruel *et al.*, 2005). The same note, most of the reported WSWFPs had moderately high (CFSI 20–99) to very high (CFSI $\geq$ 300) cultural food significance indices, indicating their cultural values to the local people.

The techniques for gathering these plants has indicated in Chapter 5, were largely dependant on the plant parts harvested. Some of the methods included the plucking of edible parts (e.g. leaves, shoots and fruits); collecting fruits that have fallen to the ground; pulling (up-rooting) the whole plant from the soil; cutting off the tender aerial plant parts; digging out the tubers and roots; knocking down fruits from the tree crowns using objects such as stones; climbing and shaking of tree branches (e.g. *Vitex doniana*) to dislodge the fruits. Some of these practices like the last two, are often discouraged and sometimes not tolerated by elders because they causes fruit wastes, damage to the tree, and may also injure or dislodge non-target plant parts. On the contrary, plucking the tender leaves and shoot of leafy WSWFPs (e.g. *Hibiscus acetosella*) is reported to stimulate growth of more leaves and shoots of some plants (Moss, 1988; Ken, 2007). Gathering of the fruits from the ground floor was said to be a common practice by mainly by women and girls because the culture restricts them from climbing the trees. For girls, prohibition on climbing trees has its origin in the belief that a girl's chance of marriage could be ruined by a fall from a tree (Byaruhanga and Opedum (2008).

Like in the case of the gathering techniques, preparation procedures for gathered WSWFPs varied from one species to another. However, some procedures such as sorting, wilting, washing, and chopping of the plants into smaller pieces prior to cooking were common among many leafy plants that are normally cooked before consumption. Actual cooking procedures (e.g. boiling, stir-frying, steaming, addition to other cooking foods) as well as the added ingredients (e.g. tomatoes, curry powder, ghee, groundnut or sesame paste) and cooking time depended on each plant species. Nevertheless, most leafy WSWFPs were boiled or fried for a shorter period of time with a few exceptions (e.g. *Cleome gynandra* and *Cleome hirta*), which are often boiled for longer time before serving. Small quantity of 'magadi' (bi-carbonate of soda) or potash made from ashes of some amaranthus species (e.g. *Amaranthus spinosus*), is often added to some cooking vegetables (e.g. *Vigna unguiculata*) to soften them. In other cases, some plants (e.g. *Corchorus* spp.) are added to other cooking foods to improve the texture, taste and flavour. Ogle and Grivetti (1985) also reported the use of bi-carbonate of soda for cooking 'igushe' and other leafy vegetables by the Swazi women. They noted that instead of ashes made from *amaranthus* spp. like in the present study, Swazi women preferred the traditional aloe ash to make the potash. Previous work in Uganda (Katende *et al.*, 1999; Tabuti *et al.*, 2004; Musinguzi *et al.*, 2006) indicates that some WSWFPs (especially fruits) are eaten snacks immediately. Similarly, in the present study, most fruits (*Annona senegalensis, Vitex doniana, Ximenia americana*) and few leafy plants such as *Abrus precatorius*, *Oxalis corniculata* and *Oxalis latifolia* were generally eaten as snacks without any special preparation procedures.

Direct sun-drying was generally the most popular preservation method for the majority of the gathered plants that are often stored for future use. Drying duration was reported to depend on the targeted plant species as well as on the brightness of the sun. The colour and weight changes were used as a "gauge" to determine whether the leafy vegetables are perfectly dry and ready for storage. Because drying removes moisture, the food becomes smaller and lighter in weight accompanied with colour changes (green to brown). Other people simply crush the leaves between the fingers and when the leaves crumble to a fine powder, means it is perfectly dry and therefore ready for storage. Sun drying technique is not only cheap but has also received much emphasis in the tropics (Musinguzi *et al.*, 2006; Osunde and Musa-Makama, 2007; Oladele and Aborisade, 2009) compared to other methods of food preservation described in the literature. Some also people parboiled or blanched gathered vegetables for about 2 to 8 minutes prior to sun-drying. Others used hot chilli (*Capsicum frutescens*) powder or common salt (sodium chloride) to preserve dried products. It was a common belief that parboiling and blanching helps to soften vegetables and being slightly cooked, the dried food would require less cooking time in future. Others believed that that blanching WSWFPs prior to sun drying helps to prevent the stored products from discolouring or developing an off flavour or strong odour. Therefore, blanching of vegetables before drying should be promoted.

Most freshly harveted leafy vegetables and fruits were reported to have shelf life of less than 5 days. However, under special conditions like wrapping the vegetable or the fruits in fresh banana leaves, the shelf life could be extended up to ten days. On the contrary, most properly dried leafy WSWFPs accompanied by proper storage requirements were reported to have shelf life of between 4 to 6 months. Likewise, dried seeds, fruits and rootstocks of some gathered plants had storage shelf life of ranging from 8 to 12 months. The dried food materials were in many cases packed in airtight and waterproof containers/packages (e.g. clay pots, tins, and plastic bags) and, stored in a dry cool and dark place away from direct sunlight. Dauthy (1995) reported that low storage temperatures extends the shelf-life of dried products and that all dried vegetables deteriorate to some extent during storage when exposed to direct light, losing flavour, colour and aroma. As potrayed in (Figure 1.1) food-based framework (Clendon, 2001), any attempt that is aimed at promoting the preservation (especially sun-drying) of the gathered WSWFPs will not only increase their availability to other people in places where the plant is not available but will also offer the poor households opportunity for off-seasonal use of the plants.

The need for a greater focus on market prospects for WSWFPs are repeatedly stressed by many people (e.g. Moreno-Black, 1993; Price, 2000; Karaan *et al.*, 2005) as one way of promoting use and management as well as justification for continued gathering of WSWFPs by local people. Clendon (2001) in his food-based framework (Figure 1.1) for analysing the roles of wild food plants opined that incomes from trade of wild food plants, however small it may be can contribute to household economy of the poor people. In the present study, the average weekly profits yielded from the sales of WSWFPs were moderate and ranged from UGX 764.5 to 6754.2 (USD 0.38–3.36). Very little costs ranging from UGX 115.5 to 1380.8 (US$ 0.06–0.69) were incurred by traders in form of market dues and purchase of packaging polythene bags. Transport expenses were excluded from cost computation because only 4% of traders incurred it. Similar to Dixon *et al* (1989), it was not possible to compute time and labour costs involved in gathering process. In view of these costs, it is plausible to say that the profit margins would have been rather low if the time and labour employed in gathering process were taken into account. However, given the very poor economic status of most traders of WSWFPs interviewed and the fact that majority of them survive on less than 1 US$ a day, even a small amount of earnings, which may only be payment for the labour and time involved in the gathering processing, has a significant value to them.

Trade in these plants was largely undeveloped with very short and simple market chains, and a few traders (mainly women) that were often selling WSWFPs in combination with conventional food crops such as tomatoes, okra and cabbages. Ham *et al.* (2008) asserted that such short market chain nevertheless, gives the gatherers a chance for negotiating a better price with the consumers by effectively eliminating all other intermediaries in the market process. Weekly volumes of traded WSWFPs in the markets were low compared to alternative conventional food crops. The low weekly volumes could perhaps, be attributed to low demand, low purchasing power, general negative public perceptions about WSWFPs or lack of trade promotion in wild food plants (Sharma *et al.*, 1992). Almost all traders who also doubled as gatherers sold WSWFPs in their generic forms without any form of processing or value addition. Those who attempted to process or add value were engaged only in preliminary activities such as sorting bad or old plants away from the batches; washing the plants to remove dirt and soil particles, and grading into quality batches. There is therefore, a need for deliberate promotion of simple processing and value addition activities beyond mere preliminary processing activities reported in this study to increase the benefits or income generated from the sales of WSWFPs.

Aside from being sold in their generic forms, there were no definite or formal mechanisms of setting market prices of the traded WSWFPs. Most traders relied on the daily market demand, time and risks involved in gathering process, past seasons' prices, and price information of substitute foods. In all these cases, price fixing followed a sort of action-reaction sequence, generally beginning with the interested buyer asking for the price, followed by the naming of a price by the trader. Based on this, the bargaining process would begin until a final price, which the buyer was ready to pay was reached. So even after a trader has set a fair market price, negotiation with buyers would sometimes lower the price further. In west and central

Africa, similar pricing mechanisms for traded wild edible plants has been reported (Tchoundjeu *et al.,* 2008). Therefore, it is plausible to say, that the weekly volumes of the traded WSWFPs and the profit generated from their sales, would have been reasonable higher if their markets were developed as those of the conventional food crops. Efforts geared towards developing such markets would therefore be much appreciated by the traders.

During the household survey, all respondants interviewed reported that their household do eat WSWFPs. On sad note, however, only a few (44.4 ± 2.6%) households were involved in the management of these plants mainly through occasional cultivation, seeds scattering to encourage more availability, and sparing or tolerating some of the preferred WSWFPs in their gardens. Only 13 of the 62 documented WSWFPs were occasionally cultivated in the area, and this is not quite surprising because many people in Uganda still regard wild food plants as God given and therefore, there is no need for one to invest his/her time and energy in managing them (Agea *et al.*, 2010). For those who occasionally cultivated some of these plants, they often base their choices on market demands, tastes, ability of the plant to produce harvestable parts in a short time period, cultural and social acceptability, and the ease of management. Species such as *Hibiscus sabdariffa* and *Cleome gynandra* have often occasionally been cultivated by many households because they are considered to be among the tastiest of leafy greens of all time.

There were a lot of challenges reported that are hindering use, management and promotion of these plants by the local people. The main ones included weak market competitiveness of WSWFPs compared to conventional crops, their general weedy characteristics, scarce knowledge on preparation procedures, negative public perceptions and little promotional support from the government. Results from market survey indicated that there were only few accounts where WSWFPs were found to compete favourably in the market with alternative conventional food crops and yet market demand was reported as one of the main creteria used by farmers while selecting those occasionally cultivated WSWFPs. Increasing habitats loss due to human activities (e.g. clearing of more land for agricultural use and settlement) was also reported as one the major challenges to accessibility of some the WSWFPs (especially fruits trees). Besides, there was a concern about increasing difficulty in accessing of planting germplasm mainly seeds of certain plant such as *Hyptis spicigera*. Some of these challenges coupled with lack of social marketing has also been echoed by (NARO, 2008) as the major threats to use and management of wild plant genetic resources in Uganda.

Notwithstanding these numerous challenges, there are a number of opportunities that were reported in this study, which could be exploited for promoting widescale use and management of WSWFPs. Some of these opportunities included the growing awareness of the nutritional values of often neglected plants, increasing demand and market value of some species (e.g. *Hibiscus acetosella* and *Hyptis spicigera*) in face of local and national food problems, and the fact that most of these plants (e.g. *Amaranthus* spp. and *Tamarindus indica*) are already an integral part of local cultures and are present in many traditional food preparation systems. As noted by Chweya (1997) and Gündel *et al.* (2003), such opportunities should be exploited to promote wide scale use and management of WSWFPs especially on farming landscapes. Alongside the these opportunities, several strategies for promoting the use and management of WSWFPs in the Kingdom were suggested. Setting up local community seed centres to maintain and supply planting materials of commonly consumed WSWFPs to the people interested in their cultivation was prominent.

However, as pointed out by Cooper *et al.* (1992), setting up these community seed centres would require adequate training of community members on amongst other things, seed selection and seed crop husbandry. Scaling-up public awareness campaigns on nutritional and medicinal benefits as well as supporting deliberate cultivation and marketing of these plants by relevant authorities (e.g. local governments and civil society organisations) were also suggested. Gündel *et al.* (2003) too underscored the importance of awareness campaigns towards promoting the use and management of underutilised plant species for poverty alleviation. Other people called for the incorporation of WSWFPs into any government development framework aimed at alleviating household poverty and food insecurity. Such attempts, however, would require a strong advocacy and lobby to obtain political commitment and government support. There were also calls for participatory research undertaking on locally important WSWFPs with full involvement of local communities. It is a known fact that local communities often have a profound understanding of their environment and its ecology. They know numerous ways of using wild plants and animals, for example as food, medicine and dyes (Huvio, 1999).

Other suggested strategies included empowerment of service providers on value addition aspects of these undervalued plants; creation, modification and enforcement of legal frameworks to specifically address the use and management of WSWFPs. As noted by Gündel *et al.* (2003), lack of supportive and enabling policies is a major obstacle to any reasonably effort geared towards promoting widespread use of underutilized plant species. The findings from this studt are therefore, expected to be a major step towards formulating policies, programmes and by-laws that may increase the availability, sustainability, use, management and or on-farm cultivation of WSWFPs within the study area and Uganda at large. Currently, on-farm management of wild genetic resources in Uganda forms a very small component of farming practices. Yet, the country's Plan for Modernisation of Agriculture and Poverty Eradication Action Plan emphasises commercialisation of agriculture and the sustainable use of natural resources for poverty alleviation.

9.3 Conclusions

9.2.1 WSWFPs consumed by local people in Bunyoro-Kitara Kingdom (Chapter 4)

Sixty (62) WSWFPs belonging to 31 botanical families were reported as being consumed in the study area. Most of these WSWFPs comprise a major part of the dietary intake of poor households for most part of the year (7 to 9 months). Many are almost available throughout the year for gathering, with the exception of some that are gathered mainly in the rainy or dry seasons. The findings also showed that local knowledge of WSWFPs increases with the age of the respondents. Younger people have less knowledge of WSWFPs than their elderly counterparts. Irrespective of their ages, women on average knew and reported more WSWFPs than their male counterparts.

Fresh leaves and shoots, and fruits were the most predominantly consumed plant parts in the study area. Most WSWFPs were largely consumed as the main sauce and side dishes after cooking, raw as snacks, and as condiments (spices or appetizers). Their consumption as wine and porridge component, beverages, raw in salads, potash salts in other foods, and as relishes were infrequent. WSWFPs were found almost exclusively consumed by entire household members. Women and children were found to be the primary gatherers. Men only occasionally collected wild fruits.

Most gathered WSWFPs were collected from a variety of habitats including the forests gaps and margins, grasslands, woodlands, wetlands, roadsides, around kraals, homegardens, cultivated or abandoned farmlands, wastelands and farm borders, were predominantly herbs and shrubs. Trees, vines (climbers), and graminoids were few.

Mean per capita harvests of WSWFPs varied substantially by species, as high as 31.59 g day^{-1} in *Amaranthus dubius* to about 0.04 g day^{-1} as in *Lantana camara*. Mean per capita consumption of some WSWFPs such as *Hyptis spicigera*, *Borassus aethiopum* and *Dioscorea minutiflora* were higher than the reported vegetable and fruit per capita consumption of 79.45 g day^{-1} in sub Saharan Africa. Most WSWFPs documented had very high to moderate cultural food significance indices (CFSI). The majority people perceived WSWFPs as medicinal, nutritious, sources of income; emergency and supplementary foods. Others perceived some WSWFPs as weeds; toxic and harmful if their preparations are not taken with adequate care.

9.2.2 Harvesting, preparation and preservation of commonly consumed WSWFPs (Chapter 5)

This case study was geared at improving the understanding of the use of WSWFPs by exploring local methods of their harvesting, processing and preservation in Bunyoro-Kitara Kingdom, Uganda. It was apparent that the gathering processes for WSWFPs involves various harvesting techniques, which are determined to a great, extend by the plant parts that are collected for consumption or sale. These techniques included hand plucking of edible parts (e.g. leaves and shoots); picking or collecting fallen fruits from the ground; hand pulling the whole plant; cutting off the tender aerial plant parts; digging out the tubers and roots, knocking down fruits from the tree crowns with objects such as stones; climbing and shaking of tree branches to dislodge the fruits.

There were also varied procedures of preparing WSWFPs. However, for many leafy WSWFPs that are cooked, some preparation procedures including sorting, wilting, washing, and chopping of the plants into smaller pieces prior to cooking were common. Actual procedure such as boiling, stir-frying, steaming or adding them to other cooking foods, as well as cooking time, and ingredients (like rock salt, ghee, groundnut or sesame paste) were dependant on each food plant. Some WSWFPs (especially fruits) were eaten as snacks without any special preparation procedures.

The majority of the gathered WSWFPs were preserved by direct sun drying. Other preservation techniques included boiling/parboiling or blanching of the plant materials prior to sun drying; sprinkling of hot chilli (*Capsicum frutescens*) powder or common salt (sodium chloride) to dried vegetables before storage; smoking in the kitchen roof ceiling over fireplace; keeping in moist cool place, and wrapping in fresh banana leaves.

Shelf life of preserved or freshly harvested WSWFPs reported, varied from 2 days to about 12 months. Most fresh leafy WSWFPs have shelf life of up to 5 days if sparingly watered and kept in a cool place. Wild fruits could be kept up to 10 days under special conditions (e.g. wrappings in fresh banana leaves). Most properly dried plant materials accompanied by proper storage requirements have a long shelf life of 4 to 12 months.

9.2.3 Market potential of traded WSWFPs in the Kingdom (Chapter 6)

Trade in WSWFPs is still largely undeveloped with few traders- mainly women, scattered all over formal markets in trading centres and rural areas; home-based/roadside stalls market, and in mobile business in the form of hawkers moving from place to place (sometimes from one home to another). The selling of WSWFPs was not the primary occupation of most traders. Many traders sold WSWFPs in combination with conventionally farmed products such as tomatoes, okra, oranges, mangoes, lemons, bananas, cabbages, beans and peas.

Out of 62 WSWFPs belonging to 31 botanical families reported in the study, nearly 47% belonging to 12 botanical families were traded within the study area, which is a fairly high number considering that many species are consumed either at the household levels or at their collection sites. Nearly all traders sold WSWFPs in their generic forms without any from processing or value addition. Those who attempted to process or add value, were engaged only in preliminary activities such as washing the plants to remove dirt and soil particles, sorting bad or old ones away from the batches and grading into quality batches.

Market chains for WSWFPs were very short, simple and dominated by traders who doubled as gatherers, and selling directly to customers (mainly elderly persons) at trading centres, village markets, roadside stalls, or homesteads. Traded WSWFPs were primarily delivered to markets on foot and using bicycles. Currently, there are no definite or formal mechanisms of setting prices of traded WSWFPs; most traders relied on the daily market demand, time and risks involved in gathering process, information of the price of substitute food and prices from other areas, knowledge of the past seasons' prices, and on the costs incurred from the suppliers.

Market information system for WSWFPs was largely rudimentary and undeveloped, and traders rely mainly on information from fellow traders as well as their customers to make market decisions. With exception of few species such as *Hibiscus sabdariffa, Solanum nigrum, Amaranthus dubius* and *Amaranthus graecizans*, weekly volumes of WSWFPs traded in the markets were low compared to most conventional food crops. However, prices of most traded WSWFPs were generally similar to those of alternative conventional food plants marketed in area. Some plants like *Hibiscus acetosella, Basella alba* and *Hyptis spicigera* (seeds), had higher selling prices per unit measurement compared to the related conventional food plants.

Average weekly profits yielded from the trade of various WSWFPs were moderate and ranged from UGX 764.5 to 6754.2 (USD 0.38–3.36). Highest return came from few species such *Hyptis spicigera, Hibiscus sabdariffa, Aframomum angustifolium, Borassus aethiopum, Basella alba, Solanum nigrum, Aframomum alboviolaceum* and *Canarium schweinfurthii.*

The main challenges faced in marketing of WSWFPs included high perishability, market dues, inaccurate consumers' perceptions of WSWFPs, seasonal shortfalls and unreliable supply, unorganized markets with products often sold in dirty places and often on the ground, little or no any form of value addition to improve on the demand and market prices, limited market information, few buyers and generally low demands, difficulty in setting the prices, and the inexistence of market promotional activities.

Opportunities to the trade in WSWFPs included the growing market demands for most WSWFPs, increasing focus of most service providers from local governments as well as civil society in creating awareness about WSWFPs, ever-changing public perceptions on nutritional values of WSWFPs, current government emphasis on value addition of traded agricultural products, little or no capital requirement for starting up trade in WSWFPs, and absence of restrictive regulations to sale WSWFPs.

Key strategies for improved marketing WSWFPs included training gatherers and traders on value adding activities prior to sale, deliberate investment in promotional and awareness campaigns to expose the hidden benefits of WSWFPs, scrapping off market dues levied on traders selling WSWFPs, helping gatherers and sellers to organise themselves to form viable supply and market groups, linking gatherers and sellers to good markets, as well as providing them with available market information.

9.2.4 Nutritional values of selected WSWFPs in the Kingdom (Chapter 7)

In light of the objectives of this study and the results described above, the following conclusions can be drawn about the nutritional values of WSWFPs in study area:

Compared to the conventional crop plants (cabbage, mangoes and sesame), most WSWFPs were generally richer sources of macro and micronutrients, including protein, vitamin C, beta-carotene, calories, carbohydrates, dietary fibres, ash, moisture, potassium, phosphorus, magnesium, calcium, sodium to iron, manganese, copper and zinc, and therefore they can help improve household nutrition especially during the months preceding the harvest of cultivated crops and also during periods of social unrests, military conflicts, droughts, famine, and other natural catastrophes. A diet comprising of WSWFPs can definitely assure a relief from some of the major and minor nutrient deficiencies often faced by the poor people in Uganda.

Hyptis spicigera, *Senna obtusifolia*, *Vernonia amygdalina, Acalypha bipartite*, *Asystasia gangetica* and *Physalis peruviana* were the richest sources of calories (50.45–544.31 kcal/100g). Ash content was highest (3.69–6.54 g/100g) in *Vernonia amygdalina*, *Solanum nigrum*, *Senna obtusifolia*, *Hyptis spicigera*, while protein was more abundant (5.20–12.11 g/100g) in *Vernonia amygdalina, Crotalaria ochroleuca, Senna obtusifolia, Acalypha bipartite*, *Corchorus trilocularis* and in *Solanum nigrum.*

Total fat content (40.64 g/100g) was highest in seeds of *Hyptis spicigera* while tender leaves of *Vernonia amygdalina*, *Asystasia gangetica*, *Corchorus trilocularis*, *Senna obtusifolia*, *Asystasia mysorensis*, *Hibiscus acetosella*, also seeds of *Hyptis spicigera*, *Aframomum angustifolium* and *Physalis peruviana* fruits were highest (7.49–38.62g/100g) in carbohydrates contents. Good sources (3.50–7.76 g/100g) of dietary fibres were *Vernonia amygdalina*, *Hyptis spicigera*, *Crotalaria ochroleuca*, *Physalis peruviana*, and *Sonchus oleraceus*.

Vitamin C was highest (98.03–337.05 mg/100g) in *Cleome hirta*, *Vernonia amygdalina*, *Acalypha bipartite*, *Solanum nigrum*, *Crotalaria ochroleuca*, and *Corchorus trilocularis* more than RDA for an adult (65–90 mg). While β-Carotene contents beyond the RDA were found in *Sonchus oleraceus*, *Cleome hirta*, *Solanum nigrum*, *Senna obtusifolia*, *Crotalaria ochroleuca*, *Vernonia amygdalina*, *Asystasia gangetica*, *Vigna unguiculata*, *Asystasia mysorensis*, *Corchorus trilocularis* and *Amaranthus spinosus*.

Ca contents were richer (373.50–857.94 mg/100g) in seeds of *Hyptis spicigera* and leaves of *Asystasia mysorensis*, *Asystasia gangetica*, *Acalypha bipartite*, *Amaranthus spinosus*, *Bidens pilosa*, *Senna obtusifolia*, *Solanum nigrum*, and *Cleome hirta*. While K concentrations were highest (365.64–714.14 mg/100g) in *Amaranthus spinosus*, *Sonchus oleraceus*, *Basella alba*, *Asystasia gangetica*, *Asystasia mysorensis*, *Cleome hirta*, *Hyptis spicigera* and fruits of *Aframomum angustifolium*.

Mg content was more abundant (235.90–421.70 mg/100g) in *Asystasia gangetica, Asystasia mysorensis, Hyptis spicigera, Bidens pilosa, Senna obtusifolia,* and *Solanum nigrum.* Na content was highest (234.15–355.75 mg/100g) in *Senna obtusifolia, Bidens pilosa, Vernonia amygdalina,* and *Sonchus oleraceus.* P was more abound (237.78–702.27 mg/100g) in *Hyptis spicigera* seeds, *Asystasia gangetica, Bidens pilosa, Asystasia mysorensis*, and *Senna obtusifolia.*

Fe content was highest (10.77–30.03 mg/100g) in *Acalypha bipartite, Corchorus trilocularis, Asystasia gangetica, Bidens pilosa, Asystasia mysorensis, Senna obtusifolia,* and *Vernonia amygdalina.* Mn was more plentiful (5.74–32.75 mg/100) in *Vernonia amygdalina, Asystasia mysorensis, Asystasia gangetica, Bidens pilosa, Cleome hirta* and *Senna obtusifolia.*

Cu content was more concentrated (2.32–8.81 mg/100g) in *Bidens pilosa, Vernonia amygdalina, Hyptis spicigera, Asystasia mysorensis, Asystasia gangetica,* and *Senna obtusifolia.* Zn was more abundant (6.48–11.43 mg/100g) in *Senna obtusifolia, Bidens pilosa, Vernonia amygdalina, Asystasia gangetica, Hyptis spicigera Amaranthus spinosus* and *Asystasia mysorensis.*

9.2.5 Local management of WSWFPs in the Kingdom (Chapter 8)

In light of the objectives, research questions and the results described above, the following conclusions can be drawn about the management of WSWFPS by local people in Bunyoro-Kitara Kingdom:

A few households were involved in the management of WSWFPs in study area. Common management practices included occasional cultivation and caring, seeds scattering to encourage more availability, and sparing some WSWFPs in the gardens. Women were primarily responsible for the management of WSWFPs. Only 13 of the 62 documented WSWFPs were occasionally cultivated in by some households in the study area. Common ones were *Hibiscus sabdariffa, Amaranthus dubius, Solanum nigrum, Amaranthus hybridus* subsp. *Cruentus* and *Cleome gynandra.*

Selection of the occasional cultivated WSWFPs were based on a number of criteria. Common ones were high market demands, good tastability, fast growth to produce harvestable parts in a short period, cultural and social acceptability, and ease of management. Main challenges to use and promotion of WSWFPs in the Kingdom included their weak market competitiveness compared to conventional crops, their general weedy nature, scarce knowledge on their preparation procedures, negative public perceptions, little promotional support from the government, and the increasing inaccessibility of some of the WSWFPs because of habitat loss.

The main opportunities in promoting WSWFPs in the Kingdom included the increasing awareness of the nutritional values of WSWFPs, growing demand and market value of some of the WSWFPs in face of local and national food problems, existing policies that governs the management of wild genetic resources, and the fact that most WSWFPs are already an integral part of local cultures and present in many traditional food preparation systems.

Key documented strategies for promoting use and management of WSWFPs in the Kingdom were: setting up local community seed centres to maintain and supply planting materials of WSWFPs for interested farmers; scaling-up public awareness campaigns on their nutritional benefits; creating and enforcing supportive legal frameworks on protection, use and management of WSWFPs; promoting their deliberate cultivation and marketing; documenting and disseminating local knowledge on their preparation procedures.

9.4 Recommendations

In light of the findings and conclusions made from the previous Chapters, the following recommendations are made.

9.4.1 Policy recommendations

- There is a need for policy-makers and technocrats both at the local (counties, sub-counties, parishes, villages) and national levels (e.g. Ministry of Agriculture, Animal Industry, and Fisheries) to create policies, by-laws or any other avenues for mainstreaming the management of some of the nutrient-rich WSWFPs into existing the farming systems and any the programs (e.g. Plan for Modernisation of Agriculture) aimed at addressing household poverty and food insecurity.

- Policy intervention on the sustainability of the local knowledge systems on WSWFPs including their harvesting, preparation and preservation practices as well as shelf life is needed. Blanching vegetables for at least 2-3 minutes before sun drying as well as the use of suitable packages (e.g. air tight jars, plastic/glass bottles or plastic bags) for dried products should be promoted.

- There is a need to incorporate WSWFPs as a subject domain in formal and informal education programs. In the former, this should target the science syllabuses at primary and secondary levels of education so that younger people can gain more insights and knowledge about WSWFPs early in life.

- To make preparation and preservation of WSWFPs more diverse and popular, and to provide greater recognition to WSWFPs, a cookbook for WSWFPs should be developed. In the cookbook, some of the preparation processes could be modified to appeal to the town/city dwellers. Food fairs, cooking competitions and cooking demonstrations should also be promoted.

- There is a need for implementation of the feasible marketing strategies that were suggested by traders in this study to improve on the markets of WSWFPs. Such interventions like helping to organise gatherers and sellers to form viable supply and marketing groups, and market promotions support (through local news papers, radios, posters and brochures) could be started with. Other interventions such as trainings on processing and value addition to WSWFPs, prior to sale could then follow later.

- Local people should be encouraged and facilitated to take and display their wild harvests in local agriculture shows and or exhibitions. The exhibitors should be able to prepare WSWFPs to be served at such shows as well as during civic or church events. Such activities can potentially rekindle public interest in WSWFPs thus improving their market demands.

- There is a need for local government (particular county, sub-county, parish and village councils) as well as the extension agencies, private sector, and civil society organisations (NGOs, CBOs, and FBOs) to incorporate some of the strategies (e.g. establishment of seed banks and community demonstration gardens) that were documented in this study into their development plans and judiciously implement them.

9.4.2 Recommendations for further research

- There is an urgent need for research on the possibility of adapting, growing and intentionally managing some of the commonly consumed WSWFPs (e.g. *Hibiscus acetosella* and *Hyptis spicigera*). A Large proportion of these plants were reportedly gathered from the forests, bush lands (woodlands), grasslands and other out-of-farm niches such as wetlands and along footpaths.

- Investigation of the food-medicinal properties of the documented WSWFPs (e.g. *Capsicum frutescens* and *Vernonia amygdalina*) that had high food-medicinal role indices (FMRI) is needed. In addition, those plants that high taste score appreciation indices (TSAI) and were not analysed in the present study for their nutritive values, should also be investigated for their nutritional attributes.

- Because food preparation and preservation process can either improve or decrease the nutritional value of food, there is need to investigate the effects of different preparation and preservation processes documented in this study on the nutritional quality of WSWFPs. However, there are immense challenges in this direction, since most WSWFPs are often cooked in a mixture of other foods or just added to other cooking foods.

- There is a need for an investigation of anti-nutrient factors or toxic compounds that could be present in some of the documented WSWFPs. Some of these plants may contain lethal levels of toxic principles, and must therefore, be correctly processed before consumption. So far in Uganda, little attempt has been made in this direction. Therefore, attempts to research in this aspect of WSWFPs would be quite rewarding.

- Lastly, attributes and motivations that underlie the market demand and the current appeal of WSWFPs should be explored further. Those attributes and motivations could be useful as selling gimmicks by traders to attract more buyers. At the moment, traders merely employ the art of display (arranging products in an interesting and persuasive manner) and persuasion (calling customers with familiar names, such as mother, father, uncle, sister, brother, and auntie).

9.5 Limitations and lessons learnt

Although the present study is believed to be quite robust, empirical and provides a good image on the use and potential of WSWFPs in alleviating household poverty and food insecurity in Bunyoro-Kitara Kingdom of Uganda, there were nonetheless, a few limitations and lessons learnt which are worth mentioning:

Firstly, there was much limitation in time and financial resources most especially during the field work and data collection. As such it was not possible to undertake a longitudinal survey, which was much desired. Rather cross-sectional survey was undertaken. The danger of cross-sectional survey is that it is often confined to a specific point in time. That is, it provide a 'snapshot' of a sample of a population at a single point in time. Since population characteristics constantly change over time, cross-sectional surveys for such situations may not reflect much the actual situation but a 'snapshot' of the outcome and the characteristics associated with it. On the other hand, a longitudinal survey provides repeated observations over time on a set of variables for the set of persons belonging to the survey. With a longitudinal survey, there is a sufficient duration for in-depth and comprehensive coverage of a wide range of variables, both initial and emergent – individual specific effects and population heterogeneity. Data is also gathered contemporaneously, thereby avoiding the problems of selective or false memory. Better still a longitudinal survey separates real trends from chance occurrence and is able to bring the benefits of extended time frames. Therefore, I would strongly suggest that future research efforts in this direction, should consider using longitudinal surveys.

Secondly, most of the responses during RMS, household surveys, key informants interviews and FGDs relied much on memory recalls. For instance, during the household survey, some respondents could not easily recall names of certain WSWFPs they harvested or consumed in the past twelve months. This problem could also be avoided by use of a longitudinal survey design, where such data on a weekly basis (7 days recall) for an extended period of time. Thirdly, some questionnaire administration sessions took a long time due to much probing for clear responses. This made some respondents become restless, while some could be noticed to have lost interest and concentration in the process. Again this circumstance could be avoided by using a longitudinal survey design where small bits of questionnaire can be administered at a time.

Fourthly, women were found particularly knowledgeable about WSWFPs and household food security issues, and should therefore, be actively encouraged to participate in such studies. Most men were reluctant to share their knowledge on WSWFPs as they believed that women are in better position to talk about WSWFPs because they are the ones who cook. Fifthly, the list of WSWFPs documented in this study is comprehensive but by no means exhaustive. The enumeration process was very much dependant on memory recalls of the interviewees. Many more unreported edible species could be out there. Future attempts in this kind of research should try as much as possible to collect data both in the dry and rainy seasons in order to account for seasonal differences in resource availability, harvesting and patterns of use.

Sixthly, walking around the study area with a key informant was found to be an important part of the interview process, as seeing different plants reminded people of points and food plants they had not mentioned, as well as providing good cross-referencing material. Visiting households during meal preparation time had a similar effect. It provided points of focus, making it easier to clarify questions and giving a more direct contact with the respondent who tended to be more informative with the relaxed approach. Sometimes it was possible to gather interesting information without an interpreter, often by just spending some time with a family and observing their activities. The more the researcher participated in the collection and preparation of the foods, the more enthusiastic the informants became and hence provided greater insight into the subject.

Lastly, a general knowledge of the food economy of the area and being able to demonstrate basic a understanding of the subject helped a great deal during the FGDs process, as this prompted a greater depth discussions. It was also important to be cautious of using leading questions but not dismissing them entirely as they can be used as a tool to provoke more discussions and as a cross-checking device.

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APPENDICES

Appendix I. Questionnaire used in household survey

Questionnaire No.________________ **Locality____**

A) SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

A.1	Sex	Male	Female		
A.2	Age				
A.3	Marital status	Single	Married	Divorced	Widow/widower
A.4	Education level	No formal education	Primary	Secondary	Tertiary
A.5	Major occupation				
A.6	Land ownership	Own land	Does not own land		
A.7	If own land, size of the land own (acres)	<2 acres	2-4 acres	>4 acres	
A.8	Family size (number of people in the household)				
A.9	Food sufficiency in the household	Sufficient	Not sufficient		
A.9	Annual cash income	<200.000	200,000-400,000	>400,000	
A.10	Main sources of cash incomes	On-farm	off-farm		

B) EDIBLE WILD & SEMI-WILD FOOD PLANTS (WSWFPs) CONSUMED BY THE LOCAL PEOPLE

B.1 Have you or your household members ever eaten any WSWFPS? Ye ☐ ☐

B.2 If yes, list the WSWFPs that you or your household members gathers, receives or buys for consumption. If gathered, state where it is gathered from, which parts are consumed and how it's consumed (consumption pattern).

Wild & semi-wild food plant (WSWFPs).	Where it is gathered from (niche)	Which parts are consumed*	How it's consumed*	Any positive comments on the species

* *Parts are consumed (Bark; roots or rootstocks; Roots of only young plant parts; bulbs; stems; leaves; leaves stalks; young whorls of leaves; leaves with a few stems; shoots; shoots of only young parts; buds; flowers; receptacles; fruits; seeds; whole aerial parts, etc).*
* *Usage- how it's consumed (Raw as snack; raw in salads; fried; boiled; boiled- then stewed, fried or pasted with groundnut/simsim; soups; stewed; roasted; condiments/spices; jams/jellies; syrups, etc).*

B.3 Who main gatherers (collectors), and the consumers of WSWFPs?

Main gatherers: ____

Main Consumers: ____

B.4 If harvests WSWFPs, how much did you harvest (estimate) in the previous 12-month period. State whether or not WSWFPs was "used", "given away" or "received" by members of your household during the previous 12-month period.

Wild & semi-wild food plants (WSWFPs)	Amount harvested in the previous 12-month period	"Used" during the previous 12-month period		"Given away" during the previous 12-month period		"Received" during the previous 12-month period	
		Yes	No	Yes	No	Yes	No

B.5 State your perceived availability, utilization frequency, taste score appreciation, and food-medicinal role of the WSWFPs

Wild & semi-wild food plant (WSWFP)	Perceived availability*	Utilization frequency*	Use localization of the WSWFP	Taste score appreciation*	Food-medicinal role*

** Perceived availability (Very common, common, and rare).*
** Use localization of the WSWFPs (Ubiquitary, localised, very localised)*
** Utilization/consumption frequency (more than once/week, once/week, once/month, more than once/year but less than twelve's times, once/year)*
** Taste score appreciation (Best/excellent, very good, good, fair, poor, and terrible/bad).*
** Food-medicinal role (That WSWFPs is a medicine; that WSWFPs is quite a medicine- with clear specification of the treated affection; that WSWFPs is very healthy; that WSWFPs is healthy- no specification of a particular therapeutic action; that WSWFP food-medicinal role is not recognised)*

B.5 In terms of months, how long in a year does you or your household members depend on WSWFPs?

1-3 months ☐ 4-6 months ☐ 7-9 months ☐ 10-12 months ☐

B.6 Does WSWFPs' consumption carries any social implications? Yes ☐ No ☐

B.7 If yes, what are these social implications?

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B.8 What are your general perceptions about WSWFPs?

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NOTE: ***Focus group discussion will be held to:*** *– (i) Construct seasonal calendar of the availability of different WSWFPs consumed in the region (ii) Characterise the commonly consumed WSWFPs in terms of growth form (tree, shrub, herb, climber, graminoid) and life cycle.*

C) MARKETING OF THE WILD AND SEMI-WILD FOOD PLANTS (WSWFPs)

C.1 Have you ever sold any WSWFPS in the last 12-month period? Yes [ ] No [ ]

C.2 If no, do intend to sell any in future? Yes [ ] No [ ]

C.3 If yes in C.1, what quantity did you sell in the last 12-month period? How much did you sell per unit? Where did you sell it? Whom did you sell to? How did you get information on where to sell? How did you determine price to sell the WSWFPS?

Wild & semi-wild food plant (WSWFPS) sold	Estimated quantity sold (units)	Price/per unit	Place/ outlet where sold*	Customer WSWFP sold to*	Source of market information	Price setting/ determination*

* *Place/ outlet where sold- At home, village market, roadside, trading centre, etc*
* *Customers- Neighbours, women, men, pregnant women, elderly people, from town people and other places ... ...*
* *Price may set based on: the cost of gathering the WSWFPs, demand, previous (past) season prices, information on the prices from other areas, daily market price, price of alternative foods sold in the market.*

C.3 Do you carryout any form of processing on WSWFPs before selling? Yes ☐ No ☐

C.4 If yes, what form of processing (value addition) do you carry out on WSWFPs before selling? Are there established groups for marketing (joint marketing) of the WSWFPs in your locality? If yes, are you a member to any of these groups? What benefits do get from these groups?

Wild & semi-wild food plant (WSWFPs)	Processing done	Existence of group (Yes/No)	Member to the groups (Yes/No)	Benefits from joint marketing groups

C.5 What do you think are the market-related opportunities to trade in WSWFPs in this locality?

C.6 What problems do you experience while marketing the WSWFPs?

C.7 In your opinion, what do you think can be done to improve the marketing of the WSWFPs in this locality?

D) MANAGEMENT PRACTICES, OCCASIONALLY CULTIVATED AND SELECTION CRITERIA FOR WSWFPs

D.1 Do you or your household manage the gathered WSWFPs? Yes ☐ No ☐

D.2 If yes, how do you or other people generally manage them?

D.3 Do you cultivate/grow any of the WSWFPs gathered? Yes ☐ No ☐

D.4 If yes, which WSWFPs do you grow?

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D.5 What criteria do you use for selecting which WSWFPs to grow on-farm?

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E) CONSTRAINTS, OPPORTUNITIES & STRATEGIES TO USE AND MANAGEMENT OF WSWFPs

E.1 In you opinion, what do you think are major challenges/factors limiting the use and management of the WSWFPs in this locality?

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E.2 What opportunities do you see or foresee, could enhance the use and management of WSWFPs in this area?

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E.3 What strategies/plan do you think could be put in place to promote sustainable use and management of WSWFPs in this place?

E.4 Do you have any additional information about use and management of WSWFPs in this area?

Appendix II. Questionnaire used in Rapid Market Survey (Traders)

Questionnaire No.________________   Market location ____

A) SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

A.1	Sex	Male	Female		
A.2	Age				
A.3	Marital status	Single	Married	Divorced	Widow/widower
A.4	Education level	No formal education	Primary	Secondary	Tertiary
A.5	Major occupation				
A.6	Family size (number of people in the household)	<3people	3-6 People	>6people	
A.7	Annual cash income	<200.000	200,000-400,000	>400,000	
A.8	Main sources of cash incomes	On-farm	off-farm		

B) WSWFPs SOLD, SOURCES, BUYING PRICES, QUANTITY SOLD AND SELLING PRICES

B.1 Please state the WSWFPs that you trade in, specifying the sources, buying prices/unit, quantity sold /week/ and selling price/unit.

WSWFPs sold	Source of supply of WSWFPs	Buying price /per unit	Quantity sold / week (units)	Selling price/per unit	Main customers (buyers)

** Sources of the WSWFPs traded in: (Gather by self from, supplied by the gatherers, buy from other traders etc)*

B.2 How do you obtain the WSWFPs from the source(s)? Is there any type of ties between you & the people that supply with the WSWFPs that you sell? If yes, which ties? When collecting WSWFPs by yourself from source, how much do you incur in transporting and other market expenses?

WSWFPs sold	*How the WFP is obtained from the source	Any ties btn you & suppliers (Yes/No)	If yes, which ties	Transport cost	Other costs

** How the WSWFP is obtained from the source (collect byself, delivered by gatherers to the business place, delivered by middlemen, etc)*

C) PRE-SALE PROCESSING/VALUE ADDITION ACTIVITIES

C.1 Do you carry any form of pre-sale processing/value addition on the traded WSWFPs? Yes ☐ No ☐

C.2 If yes, what form of pre-sale processing/value addition do you carry out?

D) PRICE SETTING, GROUP MARKETING & PROMOTIONAL CAMPAIGNS

D.1 How do you determine price to sell your products? Are there any established (organised) groups marketing WSWFPs in your locality? If yes, are you a member to any of these groups? What benefits do get as a trader from these groups?

Price setting/ determination*	Existence of groups (Yes/No)	Member to the groups (Yes/No)	Benefits from the groups

* *Price may set based on: the cost of gathering the WSWFPs, demand, previous (past) season prices, information on the prices from other areas, daily market price, price of alternative foods sold in the market*

D.2 Are there any cartel/organisation-controlling marketing of the WSWFPs in this locality? Yes ☐ No ☐

D.3 If yes, are you a member to any of these cartels/organisations? Yes ☐ No ☐

D.4 Do you undertake any form of campaigns to promote WSWFPs you are selling to your prospective customers? Yes ☐ No ☐

D.5 If yes, what promotions do you undertake?

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D.6 Are there many buyers and sellers of WSWFPs in this locality? Yes ☐ No ☐

D.7 Do you have the freedom to sell WSWFPs with anybody restricting you? Yes ☐ No ☐

D.8 Do the traders (sellers) here deal in the same type (homogenous products) of WSWFPs? Yes ☐ No ☐

E) CONSTRAINTS AND STRATEGIES TO IMPROVE MARKETING OF WSWFPS

E.1 What problems do you experience while marketing WSWFPs?

E.2 With these marketing problems in the background, do you think it is worth trading in the WSWFPs? Yes ☐ No ☐

C.8 If yes, why

C.9 In your opinion, what do you think can be done to improve the marketing of the WSWFPs in this locality?

Appendix III. Checklist used in focus group discussions (FGDs)

F.1 Group ranking of WSWFPs consumed in the locality

F.2 Generation of seasonal calendar of the availability of different Wswfps consumed in the region

WSWFPs	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec

Note: A single check/tick will be placed in the month box when the food is available, and two check/ticks will be placed in the month box for the peak season.

F.3 Characterisation of the commonly consumed WSWFPs in terms of growth form (tree, shrub, herb, grass) and life cycle*

WSWFPs	Growth form (tree, shrub, herb, climber, graminoid)	Life cycle (annual, biennial, perennial)

* To be verified and validated from the literature

F) **The selection of the preferred species for nutrient content analysis** (SWOT analysis guided by: preferences, occurrence in natural habitats (availability), market value and information available on nutrient contents)

G) **Harvest, preparation and preserving the commonly consumed WSWFPS**

G.1 Local methods of harvesting popular WSWFPs

G.2 Description of how local people prepare the commonly consumed WSWFPs in the region

Preparation procedures

Time required for preparation / cooking

G.3 Description of the local preservation techniques of the popularly consumed WSWFPs in the region.

G.4 Documentation of shelf-life of the gathered or preserved WSWFPs- how long they are kept before it start to get spoiled/bad.

G.5 Relative importance of the local methods of harvesting WSWFPs (scoring).

G.6 Relative importance of the local preservation methods (scoring).

G.7 Who in the household is mainly involved in the management of WSWFPs (scoring).

H) **Management of WSWFPs**

H.1 Caring practices for occasionally cultivated WSWFPs (scoring).

H.2 Human activities responsible for the loss of habitat of WSWFPs in the study locality (scoring).

H.3 Strategies to promote use of WSWFPs (scoring).

Appendix IV. Some phrases rehearsed for focus group discussions

(adapted from Grueger, 1994 *In* Henn *et al.*, 2006)

Keeping to the point:

'That's an interesting point – we will perhaps talk about that later'

Dominant talkers:

'Thank you X. Are there others who wish to comment on the question/the issue?'

'Does anyone feel differently?'

'That is one point of view. Does anyone have another point of view?'

Rambling respondents:

Discontinue eye contact after 15-20 seconds (the assistant moderator should do likewise).

Views: Intensity and Dis/agreement:

'That is a very clear view, now does anyone else agree with that? Why? How strongly do you feel about this?'

'And does anyone disagree with that view? Why? How strongly do you about this? or

'Does anyone see it differently? Or, are there any other points of view?'

Sometimes ask the question in turn to participants.

Ending questions:

'All things considered. Suppose you had one minute to say what you considered to be the most important issue in these discussions of ours, what would you say? And why?'

Give summaries (to include all views- including the minority ones)

Silence:

Often the best question is no question! Simply waiting for a response allows those who need more time to formulate an answer, or those who are uncertain, to do so.

Probing and prompting:

Try 5-second pauses (coupled with eye contact) after questions – gives respondent the opportunity to elaborate/additional point points of view.

'Would you explain further?/Would you give me an example of what you mean?/would you say more?/Is there anything else?/Please describe what you mean?/I don't understand.'

Appendix V. SWOT (strengths, weaknesses, opportunities and threats) analysis of selected WSWFPs for nutritional study

	Strength	Weakness	Opportunities	Threats
Acalypha bipartite Müll. Arg.	- Beside food, stems and leaves extract used for the treatment of diarrhoea.	- No clear information is traced on the nutritional composition of this plant. - No statistical information on market values are traced	- Could be alternative cheap source of food-medicine	- A weedy plant - Good fodder crop
Amaranthus spinosus L.	- Viewed as food-medicine (e.g. roots and leaves decoctions are drunk for the treatment of internal bleeding, severe menstruation)	- Only collected from the wild, mainly in the early rainy season, and not cultivated - No clear information traced on its nutritive composition	- Could be alternative cheap source of food-medicine - Could be cultivated for leafy vegetables	- Often growing as a weed on disturbed sandy soil - Uncertainties in exploiting opportunities offered by the species.
Asystasia gangetica (L.) T.Anders.	- Food-medicinal. Concoction from the plant is used to treatment many ailments (e.g. to ease pain during childbirth, as an enema in the later months of pregnancy).	- No clear information is traced on the nutritional composition of this plant. - No information on market values are traced	- Could be alternative cheap source of food-medicine	- A weedy plant - Good fodder crop
Asystasia mysorensis (Roth) T.Anders.	- Food-medicinal. Infusion from the aerial part is used as relieve for constipation and malaria.	- No clear information is traced on the nutritional composition of this plant. - No statistical information on marketing/economic values are traced	- Could be alternative cheap source of food-medicine	- A weedy plant - Good fodder crop
Basella alba L.	- Food-medicinal. Eaten as a remedy for constipation, measles and a relief from pain to pregnant women.	- Scarce information its nutritional composition of this plant.	- Good market potential as the leaves are traded in some local markets.	- Uncertainties in exploiting opportunities offered by the species
Bidens pilosa L.	- Food-medicinal. Fresh leave or half-cook leaves are also chewed as a medicine for increasing blood level in people with leukemia.	- Little information on its nutritional compositions.	- Prolific in growth	- Weeds on farms.
Cleome hirta (Klotzsch) Oliv.	- Many local communities where it occurs use it as food-medicine reduce hypertension and to cure measles - Can be eaten mixed with other leafy	- Only collected from the wild, mainly in the early rainy season, and not cultivated - No clear information traced on the nutritive composition of *Cleome hirta*, but it is probably comparable to the better	- Could be alternative cheap source of food-medicine - Could be cultivated for leafy vegetables	- Often growing as a weed on disturbed sandy soil - Uncertainties in exploiting opportunities offered by the species

	vegetables (e.g. peas or amaranth) or used alone when more preferred vegetables are not available, and eaten with a staple food.	known and more widely used *Cleome gynandra* L. - No statistical information on marketing/economic values are traced		
Corchorus olitorius L.	- The leafy vegetable is reported to have a high market value and consumers' preference. - Some information on the composition of *Corchorus olitorius* leaves been reported (Leung *et al.*, 1968).	- As ingredient of slimy sauces, it can be replaced by other *Corchorus* species e.g. the wild and cultivated *Corchorus tridens* L. and the wild species *Corchorus asplenifolius* Burch.	- Growth of *Corchorus olitorius* seedlings is fast. - In some places, it is semi-cultivated - Could be alternative cheap source of food-medicine	- The seeds are poisonous to mammals and insects..
Crotalaria ochroleuca G.Don	- Could be alternative cheap source of food-medicine. Leaves are used to cure stomach-ache, swellings and malaria. Roots are used to treat sore throat and mouth thrush. - Occasional cultivated.	- The leaves are very bitter. - Scarce information on its nutritional composition.	- It has been included in the traditional African vegetables mandate list for conservation in the SADC region. - Reported to be having a good market value.	- Still neglected by some people.
Hibiscus acetosella Welw. *ex* Hiern	- Food-medicinal. Fresh cooked leaves are said to induce more milk in lactating and breast-feeding mothers	- Leaves in dishes can be replaced by roselle (*Hibiscus sabdariffa* L.) or other leafy vegetables. - No available information on its markets.	- Could be alternative cheap source of food-medicine.	- Seeds are reported to be to toxic - Uncertainties in exploiting opportunities offered by plant
Senna obtusifolia (L.) Irwin & Barneby	- Food-medicinal. Its leaves, seeds, and root are chewed to relieve cough and chest pains.	- No clear information traced on the its nutritive composition	- Protected near homesteads to repel snakes.	- Plant is an aggressive weeds and a good coloniser of farmlands.
Solanum nigrum L.	- Little information available on its nutritional composition (Leung *et al.*, 1968). - Bitter taste of the cooked leaves and fresh shoots is liked by many people	- Cooked leaves and fresh shoots can be very bitter in taste. - In dishes, leaves can be replaced by those of other solanum species - Statistical figures on the market values are not readily available.	- Alternative source for salt in dishes - Good market potential - Semi-cultivated (semi-wild)	- Neglected by some people because of it bitterness.
Sonchus oleraceus L.	- Good famine food.	- No clear information is traceable on its nutritional composition and market value	- Emergency food.	- A weedy plant - Lack clear management strategies
Vernonia amygdalina Del.	- Food-medicinal. Leaves and roots extract is used for treatment of	- No clear information is traceable on its nutritional composition.	- Could be alternative cheap source of food-medicine	- Liked only mainly by older people.

	malaria/fever, stomach ache and intestinal worms.	- No available information on its market.		- Unmanaged and cleared down by most people.
Vigna unguiculata (L.) Walp.	- Good famine food.	No clear information nutritional composition is traceable on this wild food plant.	- Also good fodder for animals (goats and pigs).	- Disappearing from the wild.
Hyptis spicigera Lam.	- Delicious both as seeds and leaves - Food additives (flavouring), the seeds can be used to extract oil	- No available information is traced on the nutritional composition of composition of *Hyptis spicigera.*	- Potential oil crop alternative - Could be alternative cheap source of food-medicine. - Insect repellents (e.g. mosquitoes).	- Largely growing wild - Uncertainties in exploiting opportunities offered by the species

Appendix VI. Plant sample collection data sheet for laboratory analysis

Sample No. __________

Locality: __________

Date: __________

Local Name: __________

Part of the plant collected: __________

Notes (e.g. on the colour of leaves, fruits etc.): __________

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Collector: __________

Appendix VII. Positive attribute reported about the WSWFPs documented

WSWFPs	Local name	Positive attribute reported about the plant
Abrus precatorius L.	Akarunga	Seeds often carried by people in their pockets, necks or waists as: - lucky charms, - spiritually defending pendants. Used for making love beads, which are worn in the waists. - Leaf infusion extract is drunk like tea as a therapy for malaria/fevers
Acalypha bipartita Müll. Arg.	Egoza, Ayuu	- Leaves and leaves extract used for the treatment of diarrhoea - Good fodder - Stems use for making winnowing trays
Aframomum (Ridley) K.Schum *alboviolaceum*	Amasaasi, Ocao	- Fruit pulp eaten as a remedy for malaria/fever, - leave infusions is used as remedy for measles.
Aframomum angustifolium (Sonnerat) K.Schum.	Amatehe, Kongo amor	- Fruit pulp eaten as a remedy for malaria/fever
Amaranthus dubius Mart. *ex* Thell.	Doodo	Colour dyes are made from the plant leaves Decoctions from the leaves and roots are use as: - remedy for tapeworm, - relief of respiratory disease
Amaranthus graecizans L.	Nyabutongo, Ocoboro	- Regularly consumption helps prevent stomachaches. - Colour dyes made from the plant leaves - Used as potash salt - Helps in easy to constipation - Available year round.
Amaranthus hybridus subsp. *Cruentus* (L.) Thell.	Omujuiga	Also favoured as fodder by: - goats, - sheep & - pigs Colour dyes are made from the plant leaves
Amaranthus lividus L.	Bwora, Mboog'ennene	Leaves are eaten to remove poison from the body. Roots infusion is used externally to relieve headaches Decoction from the plant is also used as remedy for : - tumours and warts - ulcerated mouths and throats, - skin ulcers and sores

Amaranthus spinosus L.	Doodo y'amahwa	Roots and leaves decoctions are drunk for the treatment of: - internal bleeding, - diarrhoea and dysentery - severe menstruation and - snake bites - vomiting Externally, it is used as therapy for: - ulcerated mouths, - vaginal discharges, - gonorrhoea - nosebleeds and - wounds
Ampelocissus Africana (Lour.) Merr.	Anunu, Olok	- Infusion from the roots is used to relieve snake-bites - Aerial parts of the part are used as a remedy for lice infestation in poultry (chicken, ducks and turkeys).
Annona senegalensis Pers.	Mubengeya, Obwolo	The roots and the barks boiled and drank as a remedy for: - malaria, - stomachache, - vomiting & - diarrhoea.
Asystasia gangetica (L.) T.Anders.	Temba, Odipa ikong	Concoction from the plant is used: - to ease pain during childbirth, - as an enema in the later months of pregnancy, - to treat stomachache, - as remedy for asthma and - to treat snakebites Sap is used as a remedy for: - swellings, - back pains, - neck pains and - intestinal worms Good fodder
Asystasia mysorensis (Roth) T.Anders.	Nyante, Acwewanggweno	Infusion from the aerial part is used as relieve for: - constipation and - malaria Good fodder

Basella alba L.	Enderema	Eaten as: - a remedy for constipation, - measles and - a relief from pain to pregnant women. Leaves and root extracts used as treatment for snakebite
Bidens pilosa L.	Obukurra	Fresh leaves and roots are chewed/decocted as a remedy for - malaria - dysentery and - kidney problems. Fresh leave or half-cook leaves are also chewed as a medicine for increasing blood level in people with leukemia. Fresh leaves are also squeezed and the liquid extract used to treat: - cuts, - wounds, - eyes problems & - ear problems. The oiled ash of the seeds, mixed with other medicinal plants, is applied to hemorrhoids (swelling and inflammation of veins in the rectum and anus) Leaf boiled and taken as tea
Borassus aethiopum Mart.	Ekituugu, Tugo	- Juice from fruit pulp is used to make local wine - Fruits are eaten to treat: stomachache, skin, and respiratory problems. - Leaves are used to make mats and baskets.
Canarium schweinfurthii Engl.	Empafu	- Resin from the tree is mixed with water for the treatment of a disease called *mwanamimba* (Swahili), a female disease. - A decoction of the resin with other plant leaves is used as a bathe for children affected by measles.
Capsicum frutescens L.	Kamulari, Alyera	- A weak infusion of the fruits is used as a gargle to treat minor mouth and throat infections Daily consumption of the fruits is a: - remedy for stomachaches, - food digestive stimulant. Rubbing pepper onto sore muscles and joints helps relieve pain. Rubbing red pepper onto forehead also helps to reduce headache. - Dried fruits are used as food preservatives - Plant and the fruit is insect repellents

Carissa edulis (Forssk.) Vahl	Omuyonza, Acuga	Decoction from the boiled roots and leaves is used to treat: - malarial fever, - diarrhoea, - gonorrhoea, - chest pain, - abdominal pains, - headache, - breast cancer.
Cleome gynandra L.	Eyobyo	Decoction from the root and leaves is used to treat: - malaria/fevers, - chest pains & - diarrhoea.
Cleome hirta (Klotzsch) Oliv.	Akayobyo akasajja	Decoction from the roots and leaves is used as a medicine for: - painful menstruation, - chest pains & - diarrhoea.
Corchorus tridens L.	Eteke	Leaves are chewed and squeezed on the following to heal them: - fresh cuts, - wounds & - burns. Pounded dry leaves and stems are used to treat syphilis wounds Infusions from the leaves is drunk as a blood purifier
Corchorus trilocularis L.	Otigo lum	- Decoction of roots and seeds is used as treatment for syphilis. - Cooked leaves used as demulcent against sore throats and intestinal ulcers - Infusions from the leaves is drunk as a blood purifier - Pounded seeds is used externally as a remedy for edema (abnormal accumulation of fluid beneath the skin)
Crassocephalum crepidioides (Benth.) S.Moore	Ekinami	Leaves extract used to treat: - Wounds, - Kidney problems, - Eye problems (pink eye) - The plant is put into a pot of local for beer to prevent it from going bad. - A leaf-decoction is taken for abdominal pains

Crotalaria ochroleuca G.Don	Kumuro, Alaju	- Leaves are eaten as remedy against malaria, seeds repels storage insect pests, improves soil fertility
Cymbopogon citratus (DC.) Stapf	Lemon grass	- Leaves infusion as used to treat: malaria, high blood pressure, gastrointestinal problems and as an anti-inflammatory. - Plant is protected near houses to repel mosquitoes and other insects.
Dioscorea minutiflora Engl.	Kaama/Ekihama	Root decoction is used as a remedy for: - abdominal pain and, - boils/swelling
Erucastrum arabicum Fisch. & C.A.Mey.	Oburobwenaku	- Leaves are rubbed on the skin to reduce skin rashes.
Ficus sur Forssk.	Kabalira, Oduru	- Sap from the tree is used as a remedy toothache.
Garcinia buchananii Bak.	Museka	- Infusion from the bark of the tree is taken as an aphrodisiac and tonic. - The infusion is also used to treat ulcers.
Hibiscus acetosella Welw. *ex* Hiern	Makawang kulo, Gwanya	- Fresh cooked leaves induce more milk in lactating and breast-feeding mothers. A leaf-decoction is taken: - as a remedy for coughs, and - for 'increasing blood' in anaemic people Increases ones' appetite for eating
Hibiscus sabdariffa L.	Bamya, Ekikenke	- Fresh cooked leaves induce more milk in lactating and breast-feeding mothers. - Increases ones' appetite for eating
Hyptis spicigera Lam.	Amola, Lamola	- Whole plant, or the leaves, is infused and drunk hot to treat fevers. - A leaf-mash in hot water is rubbed on the body to reduce the temperature from the fever attack. - Plant is also burned in homes to get rid of mosquitoes and other insects like cockroaches.
Imperata cylindrical (L.) Raeuschel	Rusojo	- Its young inflorescence and shoots are cooked and eaten - Its ash is used as a salt substitute Decoctions from flowers, and rhizomes are used for treatment of: - diarrhoea, - dysentery, - stomach troubles, - Wounds, - kidneys - haemorrhages, - fevers, - urinary tract infections

		Decoctions from flowers and rhizomes are drunk to lactation stimulant. The plant is used in thatching huts
Ipomoea eriocarpa R.Br.	Acatolao, Podowia kuri	- Liquid extract from the leaves are used as enema/ inserted into the bowels via the rectum as a treatment for constipation. - Decoction from the leaves also used as a remedy for: back, neck, shoulder and knee pains.
Lantana camara L.	Jerenga, Abelwinyo	Decoctions from the roots is used as remedy for: - Influenza, - cough, - Painful swelling of the salivary glands, - persistent high fever, - malaria, Decoction from the bark, leaves and flowers is boiled and taken as remedy for: - high fever, - lung tuberculosis, - skin rashes (eczema) - Sprains and - wounds
Mondia whitei (Hook.f.) Skeels	Omurondwa	Fruit pulp is used as first aid for the treatment of: - burns and - scalds - back pain, - neck pain, - shoulder pain and - knee pains Decoction of the root is used as remedy for painful toothache. - Daily consumption of the fruits helps prevent heart problems Concoctions from the plant is used as insect repellents (insecticides) -
Ocimum gratissimum L.	Mujaja	Roots chewed: - as sexual stimulant - for clearing alcoholic hangovers - as an appetiser. - as a medicine for de-worming stomach - as a stimulate for milk production in lactating mothers

Oxalis corniculata L.	Kanyunywa mbuzi	- Leaves are boiled in water & taken as refreshing tea to relieve fatigue. Liquid extract from leaves is drunk to remedy of: - diarrhoea, - cough, - cold, - malaria, - yellow fever and - abdominal pain. The plant is protected around houses as a mosquito repellent.
Oxalis latifolia Kunth	Kanyeebwa	Infusion from leaves are used for treating: - wounds and - toothache Ash of the plant is mixed with powdered dung of cattle for treatment of teeth cavities.
Oxygonum sinuatum Hochst. & Steud. *ex* Meisn.) Dammer	Kacumita bagenge, Cuguru	Infusion from leaves are used for treating: - wounds and - toothache Ash of the plant is mixed with powdered dung of cattle for treatment of teeth cavities.
Phaseolus lunatus L.	Amaijalero, Okuku	Infusion from the boiled leaves and stems used for treating: - snakebites, - stomach aches and - boils. Juice squeezed from fresh leaves are used in eye treatment
Phoenix reclinata Jacq.	Omukindo	- Seeds are used as remedy for fevers. - Roots are used as narcotic/sedative.
Physalis peruviana L.	Ntuutu	Leaves are used to make: - baskets, - hats and - mats.
Rhus pyroides var. pyroides Burch.	Obukanjakanja, Awaca	Eaten as remedy for: - asthma, - cancer/leukemia, - hepatitis/liver problems and - malaria. Leaves extracts used for treatment of Rash & ringworm
Rubus pinnatus Willd.	Amakerre	Stems are popularly used as toothbrushes. Stems are boiled and liquid extract is used to treat:

		- cuts, - wounds, - burns, - fever and - stomachache.
Senna obtusifolia (L.) Irwin & Barneby	Oyado, Luge	- A leaf-infusion is given to children for as a de-wormer for intestinal worms
Sesamum calycinum Welw.	Amacande ga kanyamunya	Its leaves, seeds, and root are chewed to relieve: - cough and - chest pains. Decoction from leaves, seeds, or root is also used to treat: - Fevers, - wounds, - snake bites - stomachache Protected near homesteads to repel snakes.
Sida alba L.	Orucuhya	Oil extract from the seeds is used as remedy for ringworms. Mucilage extract from the leaves is used to treat: - eye problems, - burns and - wounds.
Solanum anguivi Lam.	Obuhuruhuru, Katukuma	Leaf-infusion is taken as remedy for: - stomach disorders - kidney troubles.
Solanum lycopersicum L.	Bunyanya bunyoro	- Roots and leaves decoction is drunk as a remedy for typhoid fever.
Solanum macrocarpon L.	Bugorra	Decoction from the roots is used as a remedy for: - skin itch, - general body aches, - asthma, - wounds Powder from the seeds are used to treat toothache.
Solanum nigrum L.	Enswiga	Whole plant is chopped and boiled and the liquid extract is taken orally as abortifacient and foetus is discharged in short time. Fruits are eaten as remedy for diarrhoea Juice squeezed from fresh leaves is used externally to ease pain from: - boils and

		- burns. The juice is also used as a remedy for: - ringworms and - earache
Sonchus oleraceus L.	Kizimyamucho, Apuruku	- Infusions from the leaves clears high heat and toxins from the body leaf sap is used as a remedy for: - ear problems - eye problems
Tamarindus indica L.	Mukoge	- Roots and leaves decoction is drunk as a remedy for fevers (esp. yellow fever). - Fruit pulp is also used to make a refreshing drink to reduce fever. - Fruit juice drunk as a remedy for constipation.
Tristemma mauritianum J.F.Gmel.	Oburo bw'enkombe	- Leaves are chewed to relieve sore throat - Decoctions from the leaves are used to ease delivery by expecting women
Urtica massaica Mildbr.	Orugenyi, Ekicuraganyi	Leaves infusion use for treatment of: - Boils, - skin sores, - skin itch The plant easily sprouts when cut/harvested.
Vangueria apiculata K.Schum.	Matungunda	Decoction from the leaves and roots are used: - as a remedy for constipation, - to aid delivery in expectant women - good luck charm - roundworms
Vernonia amygdalina Del.	Kibirizi	Leaves and or roots are boiled and the liquid extract is used for treatment of: - malaria/fever, - stomach ache, - intestinal worms, - hypertension - diarrhoea The crush leaves are applied to skin eruptions. Small amount of powdered leaves is mixed with local beer to make it strong.
Vigna unguiculata (L.) Walp.	Mugobiswa	Good animal fodder esp. for: - goats and - pigs
Vitex doniana Sweet.	Muhomozi, Owelo	Leaves, bark & leaves are used as medicine for: - eye treatments, - headache,

		- anemia, - genital stimulation, - paralysis, - epilepsy, - chickenpox - convulsions, - gonorrhoea - leprosy, - diarrhoea, - dysentery, - stomach deworming - lactation stimulation Fruits eaten as a treatment for constipation
Ximenia americana L.	Enseka, Olimo	Decoction of the roots and leaves are used as a remedy for: - fever and - headaches

Then God said, "I give you every seed-bearing plant on the face of the whole earth and every tree that has fruit with seed in it. They will be yours for food.
-Genesis 1:29-