INCOME GENERATING OPPORTUNTIES ARISING FROM NATURAL ECOSYSTEMS IN UGANDA

AN OVERVIEW

Alexia Baldascini
Consultant

A Contribution to the Strategic Criteria for Rural Investments in Productivity (SCRIP) Program of the USAID Uganda Mission

The International Food Policy Research Institute
2033 K Street, N.W. Washington, D.C. 20006

The Forest Sector Co-ordination Secretariat
Baumann House, Parliament Avenue, P.O. Box 27314, Kampala

March 2002

Strategic Criteria for Rural Investments in Productivity (SCRIP) is a USAID-funded program in Uganda implemented by the International Food Policy Research Institute (IFPRI) in collaboration with Makerere University Faculty of Agriculture and Institute for Environment and Natural Resources. The key objective is to provide spatially-explicit strategic assessments of sustainable rural livelihood and land use options for Uganda, taking account of geographical and household factors such as asset endowments, human capacity, institutions, infrastructure, technology, markets & trade, and natural resources (ecosystem goods and services). It is the hope that this information will help improve the quality of policies and investment programs for the sustainable development of rural areas in Uganda. SCRIP builds in part on the IFPRI project *Policies for Improved Land Management in Uganda (1999-2002).* SCRIP started in March 2001 and is scheduled to run until 2006.

The origin of SCRIP lies in a challenge that the USAID Uganda Mission set itself in designing a new strategic objective (SO) targeted at increasing rural incomes. The *Expanded Sustainable Economic Opportunities for Rural Sector Growth* strategic objective will be implemented over the period 2002-2007. This new SO is a combination of previously separate strategies and country programs on enhancing agricultural productivity, market and trade development, and improved environmental management.

Contact in Kampala
Simon Bolwig and Ephraim Nkonya
IFPRI, 18 K.A.R. Drive, Lower Kololo
P.O. Box 28565, Kampala
Phone: 041-234-613 or 077-591-508
Email: E.Nkonya@cgiar.org
S.Bolwig@cgiar.org

Contact in Washington, D.C.
Stanley Wood, Project Leader
IFPRI, 2033 K Street, NW,
Washington, D.C. 20006-1002, USA
Phone: 1-202-862-5600
Email: S.Wood@cgiar.org

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Acronyms

CPAC	Community Protected Area Committee
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
FAO	Food and Agriculture Organization of the United Nations
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
MBIFCT	Mgahinga and Bwindi Impenetrable Forest Conservation Trust
MOA	Ministry of Agriculture
MUIENR	Makerere University Institute of Environment and Natural Resources
NAADS	National Agricultural Advisory Services
NEMA	National Environment Management Authority
PMA	Programme for Modernisation of Agriculture
SAFIRE	Southern Alliance for Indigenous Resources
THETA	Traditional and Modern Health Practitioners together Against Aids

1. Introduction

1.1 Background

Uganda has an exceptionally rich and varied natural resource base and a number of important protected areas possessing extremely high levels of biodiversity. In recent decades, lack of political stability, unregulated agricultural expansion (spurred by population growth and low agricultural productivity) and weak institutional capacity have been the major causes of diminishing forests, savannahs and wetlands across the country (IFPRI, 2001).

What can be done to reduce the degradation of these natural ecosystems? It is becoming increasingly recognised that part of the solution to this problem lies in private sector development. Programmes such as SAFIRE and CAMPFIRE operating in Southern Africa have successfully shown that if people make money from their natural resource base, they tend to manage that natural resource base in a sustainable manner. This concept or approach could also work in Uganda, but due to the country's relatively small areas of natural vegetation, implementation would have to focus on small-scale enterprises (rather than large industrial ventures) and include the domestication of selected species from the wild.

The realisation of income opportunities from natural ecosystems for the rural poor is accommodated in principle by the new regulatory framework of the Government of Uganda, which is based on decentralisation of power from central government to Local Councils and on co-management of natural resources between government institutions and local communities. The latter is a key element in, for example, the new Forest Policy and in the mandate of the soon-to-be-created National Forest Authority (NFA). The 1995 Wildlife Statute and the Protected Area System Plan for Uganda (Lamprey et al., 2000) encompass similar approaches. Under the auspices of the Plan for the Modernization of Agriculture (PMA), new modalities for delivery of extension services, including services supporting the sustainable use of natural ecosystems, are being piloted using a new autonomous institution loosely attached to the MOA called the National Agricultural Advisory Services (NAADS). Under NAADS, farmers will be supported in identifying their needs, which will be forwarded to a sub-county level forum where proposals will be made to NAADS. On this basis, tenders will be posted to private and non-governmental service-provision agencies based on recommendations from the resource users themselves.

This regulatory framework and the Institutions involved are being supported by a range of bilateral and multilateral donors, in the hope that the disastrous environmental trends of the last thirty years can be reversed and that natural resources can be managed on a more sustainable basis to the benefit of local people, the nation of Uganda, and the international community.

Within this context, USAID has developed a six-year integrated strategic plan (ISP 2002-2007) for Uganda, which is based on the merging of the economic growth and environment Strategic Objectives (SOs) in a new SO7 "Expanded Sustainable Economic Opportunities for Rural Sector Growth" (USAID, 2001). The SO7 will assist Uganda to reduce rural-based poverty and sustain economic growth by expanding economic opportunities and increasing employment, income and the viability of enterprises while halting environmental degradation and biodiversity loss. To help achieve this aim, USAID/Uganda asked the International Food Policy Research Institute (IFPRI) to develop a strategic planning framework for rural land use development in Uganda (IFPRI, 2001), which subsequently became the Strategic Criteria for Rural Investment in Productivity (SCRIP) policy framework of the SO7. This report on "Income Generating Opportunities Arising from Natural Ecosystems in Uganda"[1] represents one of the studies that are being carried out to develop this framework. An electronic database (described in Section 2.2.1) forms part of the reporting from this study. The study received important logistical and intellectual support from the Forest Sector Co-ordination Secretariat and the International Institute of Tropical Agriculture (IITA) Uganda office.

[1] The prelimnary title of the study was Non-Agricultural Natural Resource-based Livelihood Options in Uganda (see Annex 3).

1.2 Scope of this study

This study aims to:

i. Gather information on existing and potential marketable products and services from plant and animal species occurring in forest, savannah and wetland ecosystems[2] of Uganda;
ii. Select those products with the highest income generating potential and lowest environmental impact, the so-called "win-win" solutions.

There are a vast number of plant and animal products found in nature. While some of them are fairly well known, many of them are not commercially important or are commercialised on a local scale. To provide a comprehensive coverage of all the plants and animals from which marketable products are produced is a very difficult task. This study attempts to provide only a representative selection of income-generating opportunities. The information presented should be considered "tentative" and "preliminary" only reflecting the "tip of the iceberg" of a research that should be carried out in more detail and over a longer period of time.

Given the time constraint, the following decisions had to be made to contain the scope of the study:

i. The study would focus more on economic opportunities from plant species, since opportunities arising from wildlife are currently limited by the shortage of wildlife stock in Uganda.

ii. The study would focus more on non-wood products since more detailed investigation on timber and wood fuel species has already been carried out by the Forest Department (see e.g., Kityo and Plumptre, 1997).

iii. The study would focus more on indigenous species and "collecting from the wild" activities, although some important exotic species with high income generating potential are also mentioned.

2. Research methods

2.1 Collecting information

The study was carried out over the course of five weeks in February and March 2002. The first two weeks were used to collect information from various sources, including the Wood and Non-Wood Products Utilization Branch of FAO, the Forest Sector Co-ordination Secretariat, the Uganda project office of the International Food Policy Research Institute, the Forestry Department, the Botany Department and the Institute of Environment and Natural Resources of Makerere University, the Wetlands Inspection Division, the Natural Chemotherapeutics Research Laboratory, and Uganda Wildlife Authority (UWA). The consultant worked together with a research assistant and a consultant contracted by IITA to collect and analyse information on medicinal products (see Annex 2).

The research involved reviewing relevant literature (obtained from libraries, bookshops and the Internet) and interviewing key informants. A list of contact persons and their relative areas of

[2] A forest is a type of vegetation dominated by trees, many species of which are tall at maturity and have straight trunks. Typically, forests have a fairly complete canopy, reaching heights of 20-30 m at medium altitudes, but lower and with a more open canopy as the altitude increases. Above 1500 m they are referred to as montane forests. Woodlands may have canopies at 5-10 m, covering as little as 20% of the ground, which admits plenty of light; the ground flora is normally dominated by grasses, which are uncommon in forests (Carswell et al, in press). The term savannah is very widely used and accordingly hard to define. It is used to cover the full range of natural and semi-natural habitats whose ground flora is dominated by grasses. Woody vegetation varies from none to rather less than a woodland, and may be of trees, shrubs, bushes or any combination of them (Carswell et al, in press). Wetlands are areas that are permanently or seasonally covered in water and include swamps, smaller rivers and marshes (NEMA, 2000).

expertise is given in Annex 1. The literature collected ranged from publications that addressed broad issues related to the harvesting, processing and marketing of non-wood forest products (NWFP), to publications that contained more detailed information on specific species.

Main sources of information on plant products of Uganda were "Useful Trees and Shrubs for Uganda" and "Wild Food Plants and Mushrooms of Uganda" by A.B. Katende and other authors. Information on economic opportunities of wildlife was more scarce, but was mainly obtained from UWA and the Forestry Department of FAO.

2.2 Organising and recording

2.2.1 Plant products

In order to organise and record the information collected on plant species into a structured format, a framework was designed and developed into a simple Access database. Out of approximately 350 species encountered in the literature, 72 species were selected based on whether they had market value (in addition to domestic use value), and entered into the database with corresponding information on ecological, economic, technological, environmental impact and social/institutional aspects.

The section in the Access database on *ecological aspects* gives the main ecosystem type (forest, savannah or wetland) in which the species occurs, a brief description of its ecological characteristics (i.e. altitudinal range, preferred soil and climatic conditions) and an indication of its geographical distribution in Uganda. It also lists specific environmental uses of the plant species, such as windbreak, mulch, nitrogen fixation, soil conservation and shade.

The section on *economic aspects* includes four main fields:

i. Names of products (e.g. baskets, fruit juice, charcoal and soap) that are or could be made from a given plant species;

ii. The general category of products to which each product belongs (e.g. handicrafts, food and beverages, fuel wood, cosmetics, etc.);

iii. The market demand for each product. This field gives actual and potential market demand and is expressed as local (if the product in question is commercialised in the same area where it is produced), national (if the product in question is commercialised outside the area of production but within Uganda), tourist (if the product in question is bought by tourists) and/or international (if product in question is exported);

iv. The overall-income generating potential of each product. The economic potential of a given product is high if all or some of the following factors are true:

- The product is sold at least at the national level (based on the logical assumption that trade of a product is an indication of its demand and the more it appears in different market places the more it is in demand)
- The product has a high degree of utility (e.g. charcoal is more useful than walking sticks)
- The product cannot easily be substituted (e.g. *Prunus africana* bark used by the pharmaceutical industry cannot be easily substituted with another product)
- The average profit made from the product is relatively higher than the average profit made from other products (e.g. selling timber is more profitable than selling fresh fruit)

The section on *technological aspects* gives a brief description of the harvesting and processing techniques used for each product, as well as ways in which products are currently being stored in rural areas of Uganda.

The section on *environmental impacts of harvesting* is particularly important in the context of Uganda where the size of natural ecosystems and therefore the stock of potential natural products is relatively small. The section identifies the effects that over-harvesting[3] might have on: the population of the species being harvested; other plant and animal species; the soil; and the micro and macroclimate. This information is used to determine the overall environmental impact (high or low) of harvesting a particular product. In general, harvesting that implies cutting the stem or trunk of the plant or stripping it of its bark is deemed to have a higher impact than harvesting of leaves or fruit. The domestication potential (high or low) of each plant is also given as in Uganda commercialisation of products on a larger, national and international scale would normally imply domestication of the species.

The section on *socio-institutional aspects* identifies the prevailing land tenure system (National Parks, Forest Reserves, communal land or private land) in which the species normally occurs and the corresponding institutes and policies that can be referred to for management purposes (e.g., Uganda Wildlife Authority and the Wildlife Statute (1995) for plants occurring in National Parks; the Forestry Department for plants growing in Forest Reserves, and so on). The socio-cultural importance (high or low) of a plant for local communities is also indicated.

The species thus entered into the database were subsequently screened to select products that showed relatively high economic potential and low environmental impact, the so-called “win-win” solutions. This list of plant species makes up part of the “menu of prioritised income generating opportunities” which is summarised in Section 3.1 and discussed in more detail in Section 3.2.

2.2.2 Animal products

Due to the limited amount of information collected on wildlife, no specific database was required to record the information. However, for lists of animal species occurring in the different types of ecosystems the reader should refer to the study on “Ecosystem and Protected Area Characterisation for the Identification of Environmental Threats and Opportunities in Uganda" carried out by the Makerere University Institute of Environment and Natural Resources as part of the IFPRI-SCRIP framework (MUIENR, forthcoming).

3. Analysis and synthesis

3.1 Summary of prioritised income generating opportunities

The following tables contain summary information on income generating products/services related to each type of natural ecosystem. The lists include both plant products and opportunities arising from wildlife.

The lists of plant products presented are the result of a two-step screening process explained in Section 2.1.1. Firstly, 72 plant species of higher economic importance were selected out of the approximately 350 species encountered in the literature and detailed information on each of these species was inserted into the database. Subsequently, an analysis was carried out to identify which of the 72 species had a higher (compared to the others) income generating potential and lower (compared to the others) impact on the environment. The resulting 55 species and their products are included in the tables below.

[3] The impacts of over-harvesting instead of sustainable harvesting were considered, since by definition sustainable harvesting should not impact negatively on the environment.

Table 1. Forest ecosystems

Product/service	Species	Environmental remarks	Southwest Uganda	Prevailing land tenure*	Relevant laws/policies
FOOD & BEVERAGES					
Juice, jam, jellies, pickles	Canarium schweinfurthii	Low impact and high domestication potential	Yes	NP, FR, P, C	The Uganda Wildlife Statute, 1996; The Uganda Wildlife Policy, 1999;The Forest Reserves Order, 1998; The Land Act 1998
Juice, jam, jellies, pickles	Cyphomandra betacea	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
Juice, jam, jellies, pickles	Dovyalis caffra	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
Juice, jam, jellies, pickles	Dovyalis abyssinica	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
Edible leaves/shoots	Catha edulis	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
Vegetable fat	Carapa procera	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
Mushrooms	Armillaria mellea	Low impact. No domestication potential	Yes	NP, FR, P, C	Same as above
Mushrooms	Lentinus prolifer	Low impact. No domestication potential	Yes	NP, FR, P, C	Same as above
BEE KEEPING PRODUCTS					
Honey	Many bee forage species	Low impact	Yes	NP, FR, P, C	Same as above
Wax	Many bee forage species	Low impact	Yes	NP, FR, P, C	Same as above
Propolis	Many bee forage species	Low impact	Yes	NP, FR, P, C	Same as above
HANDICRAFTS					
Basketry	Arundinaria alpina	Destructive harvesting, but high domestication potential	Yes	NP, FR	The Wildlife Statute 1996; The Wildlife Policy, 1999;The Forest Reserves Order 1998
Basketry (stitching fibre)	Raphia farinifera	Low impact and high domestication potential	Yes	NP, FR	Same as above
Drums, fiddles	Polyscias fulva	Low impact because low wood/product ration	Yes	NP, FR, P, C	The Uganda Wildlife Statute, 1996; The Uganda Wildlife Policy, 1999;The Forest Reserves Order, 1998; The Land Act 1998
GUMS, RESINS, LATEXES					
Resin	Canarium schweinfuthii	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
FURNITURE AND BUILDING MATERIAL					
Timber	Eucalyptus spp. (E)	Destructive harvesting, but high domestication potential	Yes	Not relevant	Not relevant

Forest ecosystems (continued)

Product/service	Species	Environmental remarks	South west Uganda	Prevailing land tenure	Relevant laws/policies
Timber	Entandrophragma angolense	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	The Uganda Wildlife Statute, 1996; The Uganda Wildlife Policy, 1999;The Forest Reserves Order, 1998; The Land Act 1998
Timber	Entandrophragma cylindricum	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	Same as above
Timber	Entandrophragma excelsum	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	Same as above
Timber	Maesopsis eminii	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	Same as above
Timber	Pinus carbaea (E)	Destructive harvesting, but high domestication potential	Yes	Not relevant	Not relevant
Timber	Pinus patula (E)	Destructive harvesting, but high domestication potential	Yes	Not relevant	Not relevant
Timber	Podocarpus latifolius	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	The Uganda Wildlife Statute, 1996; The Uganda Wildlife Policy, 1999;The Forest Reserves Order, 1998; The Land Act 1998
Timber	Milicia excelsa	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	Same as above
Timber	Tectona grandis (E)	Destructive harvesting, but high domestication potential	No	Not relevant	Not relevant
Building poles	Arundinaria alpina	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	The Uganda Wildlife Statute, 1996; The Uganda Wildlife Policy, 1999;The Forest Reserves Order, 1998; The Land Act 1998
WOODFUELS					
Firewood, charcoal	Eucalyptus spp. (E)	Destructive harvesting, but high domestication potential	Yes	Not relevant	Not relevant

* NP: National Parks; FR: Forest Reserves; P: Private land; C: Communal land.

Table 2. Savannah ecosystems

Product/service	Species	Environmental remarks	South west Uganda	Prevailing land tenure	Relevant laws/policies
FOOD AND BEVERAGES					
Juice, Jam, jelly, pickles	Tamarindus indica	Low impact and high domestication potential	No	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Juice, Jam, jelly, pickles	Ziziphus mauritiana	Low impact and high domestication potential	No	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Juice, Jam, jelly, pickles	Averrhoa carambola (E)	Low impact and high domestication potential	Yes	Not relevant	Not relevant
Juice, Jam, jelly, pickles	Syzygium cuminnii (E)	Low impact and high domestication potential	Yes	Not relevant	Not relevant
Juice, Jam, jelly, pickles	Annona senegalensis	Low impact and high domestication potential	Yes	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Juice, Jam, jelly, pickles	Annona muricata	Low impact and high domestication potential	Yes	NP, P, C	Same as above
Edible leaves	Ficus dicranostyla	Low impact and high domestication potential	No	NP, P, C	Same as above
Edible leaves	Moringa oleifera (E)	Low impact and high domestication potential	No	Not relevant	Not relevant
Fresh fruit	Moringa oleifera (E)	Low impact and high domestication potential	No	Not relevant	Not relevant
Mushrooms	Termitomyces aurantiacus	Low impact. No domestication potential	Yes	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Mushrooms	Termitomyces eurrhizus	Low impact. No domestication potential	Yes	NP, P, C	Same as above
BEE KEEPING PRODUCTS					
Honey	Many bee forage species	Low impact	Yes	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Wax	Many bee forage species	Low impact	Yes	NP, P, C	Same as above
Propolis	Many bee forage species	Low impact	Yes	NP, P, C	Same as above

* NP: National Parks; FR: Forest Reserves; P: Private land; C: Communal land.

Savannah ecosystems (continued)

Product/service	Species	Environmental remarks	South west Uganda	Prevailing land tenure	Relevant laws/policies
Basketry	Agave sisalana	Low impact and high domestication potential	Yes	NP, P, C	Same as above
GUMS, RESINS, LATEXES					
Gum	Acacia senegal	Low impact (if not over harvested) and high domestication potential	No	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
FLAVOURS, FRAGRANCES					
Spice	Cinnamomum zeylanicum (E)	High impact because branches are usually cut off, but high domestication potential	Yes	Not relevant	Not relevant
Essential oil	Cinnamomum zeylanicum (E)	Low impact and high domestication potential	Yes	Not relevant	Not relevant
COSMETICS					
Shea butter	Butyrospermum paradoxum	Low impact and moderate domestication potential	No	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Cosmetic products (seed oil for soap)	Moringa oleifera (E)	Low impact and high domestication potential	No	Not relevant	Not relevant
Cosmetic products (carbolic soap, toothpaste)	Azadirachta indica (E)	Low impact and high domestication potential	No	Not relevant	Not relevant
BUILDING MATERIAL					
Timber	Borassus aethiopum	Destructive harvesting, but high domestication potential	Yes	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Thatching material	Borassus aethiopum	Low impact and high domestication potential	Yes	NP, P, C	Same as above
WOODFUELS					
Firewood, charcoal	Combretum collinum	Destructive harvesting, but high domestication potential	Yes	NP, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Firewood, charcoal	Acacia senegal	Destructive harvesting, but high domestication potential	No	NP, P, C	Same as above
Firewood, charcoal	Acacia gerradii	Destructive harvesting, but high domestication potential	No	NP, P, C	Same as above
Firewood, charcoal	Acacia seyal	Destructive harvesting, but high domestication potential	No	NP, P, C	Same as above

Savannah ecosystem (continued)

Product/service	Species	Environmental remarks	South west Uganda	Prevailing land tenure	Relevant laws/policies
Firewood, charcoal	Acacia hocki	Destructive harvesting, but high domestication potential	No	NP, P, C	Same as above
INSECTICIDE					
Insecticide	Azadirachta indica (E)	Low impact and high domestication potential	No	Not relevant	Not relevant
ORNAMENTAL					
Ornamental tree	Spathodea campanulata (E)	Low impact and high domestication potential	Yes	Not relevant	Not relevant
Ornamental tree	Markhamia lutea	Low impact and high domestication potential	Yes	n.a.	n.a.
Ornamental tree	Dordia africana	Low impact and high domestication potential	n.a.	n.a.	n.a.
Ornamental tree	Cupressus lusitanica (E)	Low impact and high domestication potential	Yes	Not relevant	Not relevant
Ornamental tree	Aleurites moluccana (E)	Low impact and high domestication potential	Yes	Not relevant	Not relevant
TOURISM					
Game viewing	See MUIENR (forthcoming)	Low impact	Yes	NP	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999
Bird watching	See MUIENR (forthcoming)	Low impact	Yes	NP, C, P	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998
Trophy hunting	See MUIENR (forthcoming)	Low impact	Yes	NP	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999
Community-based food and accommodation services	Not relevant	Low impact	Yes	NP, C, P	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998

Table 3. Wetland ecosystems

Product/service	Species	Environmental remarks	South west Uganda	Prevailing land tenure	Relevant laws/policies
FOODS AND BEVERAGES					
Cooking oil from fruit and seeds	Elaeis guineensis	If only bunches of fruit are picked, impact is low. Domestication potential high.	Yes	Semliki Park	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999
Cooking oil from fruit and seeds	Fish	Low impact	Yes	NP, FR, P,C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Forest Reserves Order, 1998; International Policy for the Conservation of Wetland Resources, 1995; The Land Act, 1998
HANDICRAFTS					
Basketry	Phoenix reclinata	Low impact and high domestication potential	Yes	NP, FR, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Forest Reserves Order, 1998; International Policy for the Conservation of Wetland Resources, 1995; The Land Act, 1998
Basketry	Cyperus papyrus	Low impact	Yes	NP, FR, C,P	Same as above
Basketry	Alchormia cordifolia	n.a	Yes	NP, FR, C, P	Same as above
Basketry	Thypha spp.	n.a	Yes	NP, FR, C, P	Same as above
Scrubbing brushes	Phoenix reclinata	Low impact and high domestication potential	Yes	NP, FR, P, C	Same as above
Stools, tables, chairs, shelves, lounging chairs, etc	Calamus deederratus	Relatively low impact but low domestication potential	Yes	NP, FR, P	Same as above
Bricks	Clay	High impact if firewood for brick making oven is collected from the wild and not supplied by plantations	Yes	NP, FR, P, C	Same as above

* NP: National Parks; FR: Forest Reserves; P: Private land; C: Communal land.

Wetland ecosystems (continued)

Product/service	Species	Environmental remarks	South west Uganda	Prevailing land tenure	Relevant laws/policies
Pottery	Clay	High impact if firewood for pottery making oven is collected from the wild and not supplied by plantations	Yes	NP, FR, P, C	Same as above
COSMETICS					
Soap	Sesbania sesban	Low impact	n.a	n.a	n.a
WOODFUEL					
Charcoal	Phoenix reclinata	Destructive harvesting, but high domestication potential	Yes	NP, FR, P, C	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Forest Reserves Order, 1998; International Policy for the Conservation of Wetland Resources, 1995; The Land Act, 1998
TOURISM					
Bird watching	See MUIENR (forthcoming)	Low impact	Yes	NP, FR, C, P	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Forest Reserves Order, 1998; International Policy for the Conservation of Wetland Resources, 1995; The Land Act, 1998
Community-based food and accommodation services	Not relevant	Low impact	Yes	NP, C, P	The Uganda Wildlife Statute 1996; The Uganda Wildlife Policy 1999; The Land Act 1998

3.2 Analysis of categories of promising products and services

3.2.1 Food and beverages

Juices, wines and other beverages, pulps, jams and jellies

Distribution in Uganda

Annona muricata, Annona senegalensis, Annona squamosa, and *Zizyphus mauritiana* (Ber) are all found in savannah areas. *Canarium schweinfurthii, Tamarindus indica,* (Tamarind)*, Dovyalis abyssinica* and *Dovyalis cafra* occur in both forest and savannah areas.

Uses
The fruit of these species is used to provide dried pulp, juices, concentrated squashes, some alcoholic beverages, jams and jellies.

Harvesting, Processing and Storage
The fruits of both *Tamarindus indica* and *Zizyphus mauritiana* are harvested by shaking or beating the branches loaded with fruit. The fruit of *Canarium schweinfurthii* is collected after it has fallen to the ground. The fruits of the other species are normally picked from the tree by hand.

Processing for pulp of fruits involves drying the pods or fruit in the sun, removing fibres and seeds, and placing the pulp in containers, such as basket or earthenware pots for storage in dry conditions (Tamarind). Pulp is sold in this form in markets. Tamarind pulp in optimal conditions will last for up to a year. Other fruits are sun-dried for several days and subsequently stored in moisture proof containers under cool conditions (Ber and others).

Juices from all species are normally obtained through pressing or squashing the pulp. In particular, the process for obtaining beverages from Tamarind is as follows. The juice concentrate is prepared by extracting the cleaned pulp with boiling water using the counter current principle, where dilute extracts are used for extracting fresh batches of the pulp. The extract is separated from the pulp by sieving and is concentrated under vacuum in a forced circulation evaporator. When the soluble solids reach 68%, the pulp is placed in cans or bottles. It sets like jam on cooling and the yield of the concentrate is about 75% of the pulp used.

To obtain a squash from *Zizyphus mauritiana*, sugar, citric acid and water are heated together and the result syrup is mixed with the pulp to obtain the beverage. The dried or fresh fruits of *Zizyphus mauritiana* are crushed and fermented for 7 days in earthenware containers using yeast and lactic acid bacteria to produce an alcoholic drink having 2% ethanol. To obtain wine, pulp is treated with pectinase enzyme before fermentation which gives about 9% higher yield with higher alcohol content and better quality (clear, and golden yellow in colour).

Jams and jellies can be obtained from most fruits by boiling the fruit pulp and adding sugar. Ber pulp in particular is submerged in sugar syrup before bottling.

Areas of production and markets
Tamarindus indica is cultivated in 54 countries of the world, 18 in its native range and 36 other countries where it has become naturalised. The major areas of production are in the Asian and American continents. India is the world's largest producer of tamarind products, followed by Thailand and Mexico. Africa, on the whole does not produce tamarind on a large commercial scale, though it is used widely by the local people.

Zizyphus mauritiana is cultivated in India, Pakistan, Bangladesh, Sri Lanka, Central and Southern Africa and in the northern parts of Australia. *Zizyphus* products are almost unknown in the export market and nearly all the produce is sold in local markets.

Other species are harvested and consumed locally.

Development potential
There would appear to be considerable scope for the improvement of Tamarind, particularly the identification of tamarind types with less acidic pulp, commonly referred to as sweet tamarind. Much research is required to ascertain and improve all tamarind products since its ease of cultivation, particularly in areas unsuitable for other crops, could make it a "Tree for the Future".

In Africa, work is being carried out for Ber on the selection of desirable genotypes from the natural variability and evaluation of commercial Ber varieties introduced from India. Vegetative propagation and agronomy are being developed. Some products, made by traditional methods, need to be improved and standardized. Preliminary results obtained from trials conducted in African countries under the Semi Arid Lowlands of West Africa (SALWA) programme of the International Centre for Research on Agroforesty (ICRAF), have provided encouraging results showing compatibility of Ber

with the agroforestry system. *Zizyphus jujuba*, which grows particularly on the Indian subcontinent and parts of Africa, has shown phenomenal increases in production in recent years and this trend is expected to continue. The introduction of this species should be investigated for Uganda, since its nutritious value in minerals and Vitamin C, would go a long way to resolving malnutrition in arid and semi-arid areas.

For other species which produce juices and in some cases jams and jellies, a Food Processing Expert could be requested to study the local fruit producing species and methods of obtaining and preserving these products. A market survey should also be undertaken to ascertain likely outlets.

Edible leaves and shoots

Distribution in Uganda
Arundinaria alpina grows only in protected areas of Uganda. *Ficus dicranostyla* and *Oxytenanthera abyssinica* grow principally in the northern and eastern Uganda. *Catha edulis* grows around Mts. Kadam and Napak and *Maringa oleifera* (an exotic plant) is grown principally in gardens and near Butiaba pier.

Uses
These species provide food from shoots and leaves (both dried and fresh).

Harvesting, processing and storage
The shoots of *Arundinaria alpina* are cut and sold fresh and in some cases smoked e.g. in Mount Elgon area. The fresh leaves of *Ficus dicranostyla* and the fresh and dried leaves of *Oxytenanthera abyssinica, Catha edulis* and *Moringa oleifera* are picked and either used domestically or sold in fresh or dry form in markets.

Areas of production and markets
At present these products are only used for domestic consumption or sold locally.

Development potential
Since several of these species produce not only edible leaves and shoots but also oils, fruits and edible seeds, there could be room for further research by a Food Expert into expanding the markets for these products.

Oils and vegetable fats

Distribution in Uganda
Carapa procera, *Elaeis guineensis* and *Raphia farinifera* are found in the wetter areas of Uganda.

Uses
The first species provides a locally used cooking fat. The other two species produce palm oil.

Harvesting, processing and storage
Elaeis guineensis and *Raphia farinifera* both produce oils. The former is a major producer of palm oil and especially palm kernel oil. Oil can also be obtained from *Raphia farinifera.* Trees of both species are climbed by means of ladders and ropes and bunches of ripe fruits are cut off. A man can usually harvest 100-150 bunches per day. The bunches are then transported to a collection centre and from there are taken to the mill for oil extraction Palm oil is extracted from the fleshy mesocarp of the fruit using pressure and also by solvent from the residues of the pressure extraction. It is used extensively in manufacture of soaps and candles, margarine and cooking fats. Palm kernel oil is extracted by crushing the kernel of the nut of the fruit in two or three different stages at different temperatures. It is used in edible fats, in making ice cream and mayonnaise in confectionery and in the manufacture of soaps and detergents.

Carapa procera fruits are boiled and the fatty substance is removed from the surface after cooling.

Areas of production and markets
The main producers of palm oil are Nigeria, Congo, Sierra Leone, Ghana, Indonesia and Malaysia. The single largest importer is the United Kingdom followed by Japan, and countries of Eastern Europe and the Middle East. Oil from *Raphia farinifera* tends to be marketed locally.

Development potential
Since both *Elaeis guineensis* and *Raphia farinifera* are multi-purpose trees producing several others products besides oil (*Elaeis guineensis* produces animal feed, palm wine, and is used in thatching and to make baskets and mats while the leaves of *Raphia farinifera* are used in construction activities) their cultivation needs to be expanded. There would appear to be considerable domestic market potential for these trees. Further information is required on *Carapa procera.*

Edible Mushrooms

Distribution in Uganda
Armillaria mellea, Lentinus prolifer, Termitomyces aurantiacus, Termitomyces eurrhizus and Termitomyces microcarpus all grow in most parts of Uganda.

Pleurotus ostreatus, commonly known as oyster mushroom, is not indigenous and grows worldwide.

Uses
Armillaria mellae, Lentinus prolifer and *Termitomyces aurantiacus* are used as a relish or sauce. *Termitomyces currhizus* and *Termitomyces microcarpus* are used as a staple.

Pleurotus ostreatus is a commonly used and appreciated food, used in many regions of the world.

Harvesting, processing and storage
Armillaria mellea is a parasite growing on forest trees. It is collected during the rainy season and, after drying, can be stored for over a year in banana fibres or polyethylene bags. *Lentinus prolifer* is collected throughout the year and can be dried and stored. *Termitomyces aurantiacus* is dried in the sun and stored in jars or wrapped for future use. *Termitomyces eurrhizus* must be dug up with care, as the most edible part is underground. *Termitomyces eurrhizus* and *Termitomyces microcarpus* are cleaned and boiled before eating.

Areas of production and marketing
Information on marketing was not available, but it is believed that all indigenous mushrooms are used locally.

Development Potential
Armillaria mellea is unlikely to have any future development as a crop since it is considered a parasite that can destroy trees. The domestication of the other mushrooms living in symbiosis with other organisms (termites) needs further study both of the possibility of growing together with other crops and to discover if there are greater market outlets.

Pleurotus ostreatus is extremely easy to grow. It can be cultivated on pieces of bark, or straw. It requires a somewhat constant temperature and humidity. It has great market potential and is grown and consumed in many parts of the world. The Enterprise Development Project of MBIFCT has commissioned the Mycolex Institution in Kampala to carry out a detailed market survey for this type of mushroom. The report should be available by April 2002.

Honey

The Enterprise Development Project of MBIFCT has commissioned the Uganda Honey Beekeepers Association to carry out a detailed market survey on honey and its by-products (wax, vinegar, propolis). The survey will be made available in April 2002, but certain general remarks on the production, processing and marketing of honey can already be made.

Natural resources

Uganda has an abundance of bee forage species. A few names include *Acacia spp., Albizia spp., Azadirachta indica, Caesalpinia decapetala, Cajanus cajan, Calliandra calothyrsus, Calodendrum capense, Combretum spp., Cordia spp., Doyalis spp., Eucalyptus spp., Garcinia buchananii, Leucaena leucocephala, Mangifera indica, Markhamia lutea, Moringa oleifera.*

Human resources: beekeeping skills, training and extension skills

Traditional beekeeping and honey hunting skills are widely known and practised in Uganda. With appropriate training, local communities could harvest honey products of higher quality and value. Where training has taken place, too much emphasis is placed on encouraging farmers to change technology, without the skills and resources to support the change e.g. Some farmers possess Top Bar Hives that are empty of bees because they lack the required training.

Physical resources

Beekeeping equipment, containers and packaging are all difficult for rural communities to obtain. The answer is not to freely distribute these items, but rather to give the right training so people can make their own equipment.

Social resources: Sector support

Uganda Honey Beekeepers Association (UHA) is a national beekeeping NGO representing the interest of beekeepers. The goal of UHA is to upgrade the production capacity of honey and beeswax. The objectives of the UHA include:

- Training of the Honeybee keepers;
- Manufacture of beekeeping Equipment;
- Marketing/market
- Action research.

Areas of production and markets

National, annual honey production is somewhere upwards from 3000 tonnes, worth 4,800 million UShs. There is negligible formal export of honey, although honey is flowing in informal markets between Uganda and her neighbours.

Constraints for farmers

- Lack of appropriate training and technical advice;
- Lack of training material;
- No access to suitable containers for honey
- No access to protective clothing and smoker and other beekeeping equipment
- Poor market access
- High product prices

Constraints for traders

- Lack of access to products of sufficient quality and quantity
- Poor diversity of retail packaging materials
- Non availability of credit

Constraints for the industry as a whole

- No beekeeping policy for protection of the industry
- No coordination between apiculture and other sectors: horticulture, forestry, health, environment sectors
- No linkages between producers and buyers
- Little extension material
- No product promotion

3.2.2 Handicrafts

Uses

The main types of handicrafts produced in Uganda are basketry products, rattan furniture, woodcarvings and pottery. A relatively new venture has also been the production of handmade paper from natural fibres, promoted by a private enterprise "Naturaleaf" and Uganda Community Tourism Association (UCOTA).

Basketry products made from *Phoenix reclinata*, *Raphia farinifera*, *Agave siselana*, *Cyperus papyrus*, *Alchormia cordifolia* and *Thypha spp*. include baskets (2,500-6,000 UShs), mats (10,000-20,000 UShs), table mat sets (4,000-20,000 UShs), hats (4,000-7,000 UShs), chairs (35,000 UShs), tables (40,000 UShs) and lampshades (5,000-10,000 UShs). Bamboo (*Arundinaria alpina*) is generally used to make bigger baskets. These products are sold to locals, tourists (at a tourist destination site) and in many selling points in Kampala (e.g. UCOTA shop, Banana Boat shop, Mango Shade shop, National Theatre).

Rattan (*Calamus deederratus*) is used to make furniture such as stools, chairs, tables and shelves and prices can be obtained from the many vendors who sell their ware alongside the road from Kampala to Masaka.

Woodcarvings from *Diospyrus mespiliformis*, *Syzygium guineense*, *Erythrina abyssinica*, *Polyscias fulva* include a range of products (sculptures, bowls, candlesticks, carved boxes, drums, fiddles, etc.). These products are also sold to locals, tourists (at a tourist destination site) and in many selling points in Kampala (e.g. UCOTA shop, Banana Boat shop, Mango Shade shop, National Theatre).

Pottery items, such as bowls, mugs, vases, jewellery and candleholders can also be found in the above selling points in Kampala, as well as in wetland areas where the raw material, clay, is available.

Development potential

In general, skills to produce the above handicrafts tend to be rather basic and training should be carried out to improve on design, range and quality of products. An assessment of potential export markets and their requirements will be carried out in March 2002 by the Enterprise Development Project of MBIFCT. However, the general trend can be summarised in the following points:

- Buyers indicate that their demand is being constrained at the outset by the difficulty in identifying organised associations of suppliers.

- The life cycle per product has been strongly reduced and is now very short. For most crafts it is 2 years. This puts an enormous pressure on the producers to come up with new ideas and products all the time in order to sustain their market share.

- Design of the product rather than the type of material used is the key to success. This implies that the look/design together with the usefulness has become a decisive factor. The producers have to combine their skills in standard materials with other materials to create new products (e.g. clay pots with woven material tops).

- Customers, especially in the higher price segments of the market, expect to have detailed information about their purchases (with regard to materials, methods of production and the people who produced the products). Thus a culture like that of the Batwa ethnic group could be used as a marketing strategy for products from their area.

- Marketing strategy should also be based on promotion of natural and environmentally friendly products.

- Customers are no-longer impulse buyers - they only buy products they really need (as opposed to tourist markets)

3.2.3 Gums, resins and latexes

Gum arabic

Distribution in Uganda
The principal source of gum arabic (exudate gum) is *Acacia senegal*. This is widely distributed in several regions of Uganda. *Acacia seyal* is also widely found in the country. Gum arabic can be found in *Albizia lebbeck, which grows around the salt lakes in the Kasese District of Uganda,* and Albizia *saman*, which grows in many parts of Uganda.

Uses
The principal use of gum arabic (principally from *Acacia senegal*) is in confectionery to prevent crystallization of sugar or to act as an emulsifier. In candy and bakery products it is used as a glaze and as a means of encapsulating flavours (for example, spray-dried flavours and citrus oils). It is also used in soft and alcoholic drinks either as a vehicle for flavouring or as a stabilizer or clouding agent. In the pharmaceutical industry it functions as a binding agent or as a coating prior to sugar coating, and as a suspending and emulsifying agent. In the printing industry it is used to treat offset lithographic plates; as a protective coating to prevent oxidation; as a component of solutions to increase hydrophilicity and impart ink repellence and as a base for photosensitive chemicals. It is also used to strengthen clay in ceramics and, to a lesser extent, in textiles, paints and adhesives.

Acacia seyal is more friable and therefore less marketable than *A. senegal* and is principally used locally as an adhesive or ingredient of traditional medicines. The use of gum talha from *A. seyal* is also permitted in small quantities in some pharmaceutical products both in the U.K. and the United States. *A. sieberana* grows in some parts of Uganda and is an occasional source of gum. *Albizia lebbeck* and Albizia *saman,* due to their lower quality, also have a far lower demand.

Harvesting, processing and storage
In some countries gum from *Acacia senegal* is obtained by tapping the trees while in others, natural exudation occurs. *A. seyal* gum comes entirely from natural exudation but in small tears or driblets, making their collection time consuming. Tapping begins when the trees begin to shed their leaves. A specially designed tool with a pointed metal head is pushed tangentially into the stem or branch so as to penetrate just below the bark, and then pulled up so as to strip a small length of bark longitudinally from the wood. Damage to the wood should be minimal. Several branches are treated in a similar manner at one taping. The tears of gum which form should be picked by hand when they have dried and hardened. Importance is laid on maintaining the harvested gum clean and dry. Mixtures of various *Acacia* species should be avoided to prevent lowering the quality of the gum. Traders undertake the process of cleaning and grading the gum. Kibbling or powdering the gum for easier use is normally undertaken in the consumer countries.

Areas of production and markets
Sudan is the world's biggest producer of gum arabic, and since very little is consumed domestically, it is also the main source of gum in international trade. The overall annual average of exports from Sudan in the period 1988-94, was 25 000 tonnes, with variations from 14 000 to 27 000 p.a., due to drought and other factors. Gum arabic is produced in a broad band across Sub-Saharan Africa from Mauritania, Senegal and Mali in the west, through Burkina Faso, Niger, northern parts of Nigeria and Chad to Sudan, Eritrea, Ethiopia and Somalia in the east and northern parts of Uganda and Kenya. Sudan's exports account for up to 85%, followed by Nigeria and Chad in far smaller quantities. (Coppen, 1995). Prices of gum arabic in 1995 were US$5 000 per tonne, while prices for other types of gum from other *Acacia* species were only US$1 000 per tonne (Coppen, 1995a).

The European Community is the biggest regional market for gum arabic. Annual imports in the years 1988-93 averaged almost 28 000 tonnes. The United States is the second largest import market with

an average rate of 7 500 tonnes in the period 1991-94. Japanese imports averaged 1 900 tonnes/year during 1988-94 (Coppen, 1995a).

Following the drought of 1973-74, and consequent world shortage of gum arabic, major users sought alternative modified cellulose and fermentation products such as xanthin and gellan. Furthermore, gum importers and users consider that the almost monopolistic control of the market by Sudan is bad for trade confidence. Research into higher-yielding gum trees has not, as yet, brought about significant results.

Development potential

After supply constraints and the switch of end-users to alternatives, the demand for gum arabic in general is unlikely to reach previous heights. However the superior quality of gum arabic from *Acacia senegal* will ensure that it retains substantial markets if availability is assured and prices are favourable. Production of high quality gum arabic not only can meet domestic needs but should also be capable of entering the export market. Great importance must be attached to the production of high quality gum, which meets standards in the importing countries. Users also feel that there is a need to spread the sources of supply to ensure supply in cases of major crop failure, particularly in the Sudan.

In semi-arid areas where *A. senegal* is found, the local people are often pastoralists and where climatic and ecological conditions are not favourable to agriculture, there are few opportunities for growing cash crops. In these circumstances production of gum arabic - either from an existing, wild resource of a suitable *Acacia* species or from *A. senegal,* planted as part of an agroforestry system - can generate much-needed cash.

Since *Acacia* is an excellent plant for afforestation of arid tracts and soil reclamation, the promotion of planting gum arabic trees can help to show local people the advantages of preserving trees, which produce marketable products as opposed to their destruction for firewood.

Resins

Natural resin is a solid or semi-solid material, usually a complex mixture of organic compounds called terpenes, which is insoluble in water but soluble in certain organic solvents. Oleoresin has a higher content of volatile oil than natural resin, which makes it softer than natural resin.

i. Pine resins (Naval stores)

Distribution in Uganda

The only species producing pine resin in Uganda is *Pinus caribaea, which* is widely cultivated in moist lowlands.

Uses

The products obtained from crude resin are Rosin and Turpentine. Rosin is the major product obtained from pine resin. It remains behind as the involatile residue after distillation of the turpentine and is a brittle, transparent, glassy solid. Most rosin is used in a chemically modified form. Amongst its derivatives are salts, esters and maleic anhydride adducts, and hydrogenated, disproportionated and polymerized rosins. These are used in the manufacture of adhesives, paper sizing agents, printing inks, solders and fluxes, various surface coatings, insulating materials for the electronics industry, synthetic rubber, chewing gums and soaps and detergents.

Turpentine is a clear, flammable liquid. It is used in whole form usually as a solvent for paints and varnishes or as a cleaning agent. It can be further distilled to isolate desirable chemicals that are then transformed into value-added derivatives (but this is economic only if carried out on a large scale). The biggest single turpentine derivative, synthetic pine oil is used in disinfectants, cleaning agents and other products with a 'pine' odour. Many derivatives, including isbornyl acetate, camphor, linalool, citral, cintronellol, citronellal and menthol are used either on their own or in the elaboration of other fragrance and flavour compounds.

Harvesting, processing and storage
Resin is obtained from pine trees by tapping using methods similar to those for gum arabic, given above. In some cases, small holes are made in the trunk, whereas in others, strips of bark are taken off, to allow the resin to exude. These wounds vary in size according to the method of that country. Chemicals (sulphuric acid) are sometimes added to stimulate and maintain the resin flow. The resin flows from a gutter into a cup, which is collected at regular intervals in drums and transported to a central storage depot. Some of the resin forms a hard residue that is collected and processed separately from the rest of the resin, and it will yield a slightly lower grade of rosin.

Areas of production and markets
The focus of production for world gum naval stores is Southeast Asia, especially the People's Republic of China. Since the 1980s, Indonesia has become the second biggest producer of gum rosin and turpentine. Portugal and, to a lesser extent, Brazil, also export these products. In China estimated production of crude resin in 1993 was 570 00 tonnes, for rosin 430 000 tonnes, and for turpentine 50 000 tonnes. For Indonesia, these figures were 100 000, 69 000 and 12 000 respectively. In Uganda, commercial tapping of *P. caribaea* began on a small scale in 1994 (Coppen and Hone, 1995).

Almost all non-producing countries import rosin and turpentine or their derivatives or synthetic competitors. The biggest markets for gum rosin are Japan, Western European countries, particularly Germany, the Netherlands and France, as well as the Republic of Korea, the United States and India. France, Spain, Japan and India are amongst the largest importers of gum turpentine

Trade in crude resin developed in the 1990s. This is due to the need of some countries to earn extra revenue without investing in additional capacity for processing.

Development potential
The many *Pinus* species are found almost all over the world. They occur in the People's Republic of China, Indonesia and other countries of southeast Asia, Portugal and other Mediterranean countries, Russia, North America, Central and South America and the Caribbean and Africa. It has been estimated that producers of rosin in developing countries would incur smaller costs than producers in, for example, the United States. Since sale of crude resin may entail low prices and buyers' minimum volume requirements, it is recommended that processing capacity for rosin and turpentine should be expanded in line with domestic or regional demand, and that exports to more distant markets should be approached when processing plants can produce sufficient quantities to make transport costs bearable.

ii. Non-pine resins

Distribution in Uganda
The only non-pine species producing resin in Uganda is *Canarium schweinfurthii.* This is common in Kalinzu Forest Reserve and in the forests around Lake Victoria and Kampala city.

Uses
Oil is extracted from the resin, which is used for fragrance and medicinal purposes.

Harvesting, processing and storage
The resin used to obtain the oil is harvested by removing narrow strips of bark from the tree. The resin, which exudes, solidifies and darkens on drying and is then removed from the tree. Tapping is repeated several times a year.

Areas of production and markets
Hard resins are divided into various groups, e.g. copal, damar, and mastic and dragons blood. The resin damar, comes from several species (*Shorea, Hopea, Vatica, Vateria, Balanocarpus,* and *Canarium*) is produced mainly in Indonesia, but also in Viet Nam, Laos and Cambodia. The oil used for fragrance is produced principally in India.

This resin is used in Uganda for incense on a national level. No figures are available for production and markets.

Development potential
Although the market appears limited, further research is required to ascertain if new markets could be found.

3.2.4 Tannins and dyes

Distribution in Uganda
Acacia nilotica is found in savannah areas and *Albizia lebbek* is found around salt lakes in Kasese District.

Uses
Up to the latter part of the nineteenth century, colouring materials for dyeing textiles, cosmetics and foodstuffs, originally came from vegetable or animal sources. These have gradually been replaced with synthetic dyes, which are comparatively cheaper, have a greater reliability of supply and consistency of quality. However, *Acacia nilotica* and *Albizia lebbeck* are still used locally used as tannins.

Development potential
The potential for expanding the market for the local species is small, although within the country they are still widely used. Further research is needed to investigate the possibility of increased use of local plants for tanning, although the probability that this could become an important source of income seems unlikely.

3.2.5 Flavours and fragrances

Eucalyptus

Distribution in Uganda
Eucalyptus citriorodora grows well in a wide range of climates, in particular in Central and Western Regions of the country.

Uses
Eucalyptus citriorodora produces perfumed oils and is widely used in medicines.

Harvesting, processing and storage
Eucalyptus leaf for oil production is obtained by one of three methods:

- Recovery of 'waste' leaf from felled trees which have been grown primarily for their wood;
- Short-rotation harvesting of plantations established specifically for oil production. Under such a system of coppicing, plants are allowed to grow for no more than about 20 months before cutting; branches are cut from the trees and leaves removed;
- Regular harvesting of wild stands either by felling of trees or cutting of branches.

The foliage must not be left on the ground for too long before transportation to the distillery or there is a risk of losing volatile oil. The distillery is normally within reasonable distance of where the eucalypts are growing and foliage is distilled either the same day or the following day. The enhancement of cineole content of the crude oil by a process of rectification entails carrying out a fractional distillation under reduced pressure.

Areas of production and markets
The principal producer and exporter of cineole-type eucalyptus oil in 1991 was the People's Republic of China (2 480-3130 and 1870-2070 tonnes respectively). Portugal, India, South Africa, Australia, Swaziland, Chile and Spain produced approximately 220-50 tonnes and exported from 150 to 50 tonnes in the same period.

Globally the European Community is the largest importer of eucalyptus oils while the United States is the largest single country market. (Coppen, 1995b).

Development potential

The advantage of Eucalyptus over most other essential oil-bearing tree crops is that it offers the possibility of genuine multipurpose utilization. Moreover, the trees can be grown on a large, plantation scale or on an individual or communal woodland system. The rapid growth of the trees means that income can be derived from sales of the stems for poles, fuel wood or other purposes within a fairly short time (7-10 years) during which period leaf can also be harvested for oil production. However, although increasing, the world market for eucalyptus oil is not growing rapidly and with no major new uses for it which could absorb large volumes, opportunities for new producers are likely to rest mainly with meeting local or regional needs rather than trying to compete in the wider international market. Further research is also needed to maximize the returns on eucalypts planted (solely or partly) for the production of oil.

Cinnamon

Distribution in Uganda

Cinnamon or *Cinnamomum zeylanicum* grows well in the Central Region of the country. It is not, however, an indigenous tree but originates from tropical Asia.

Uses

Cinnamon bark oil is used mainly in the flavouring industry where it is used in meat and fast food seasonings, sauces and pickles, baked goods, confectionery, cola-type drinks, tobacco flavours and in dental and pharmaceutical preparations. It has a limited use in some perfumes.

Cinnamon leaf oil is used as a flavouring agent for seasonings and savoury snacks. As a cheap fragrance it is added to soaps and insecticides. The oil's high eugenol content also makes it valuable as a source of this chemical for subsequent conversion into iso-eugenol, another flavouring agent.

Cassia oil is used mainly for flavouring cola-type drinks, with smaller amounts used in bakery products, sauces, confectionery and liqueurs. Like cinnamon bark oil, its use as a fragrance is limited by its skin sensitising properties.

Harvesting, processing and storage

Different parts of the cinnamon tree are used to produce various products. Cinnamon bark, which produces the more expensive oil, is collected, after an initial establishment period, by cutting the stems low down and harvesting the bushy re-growth stems at regular intervals thereafter. The stems are cut during the rainy season to facilitate peeling of the bark. Strips of bark are then formed into familiar compound quills (cinnamon) or hollow quills (cassia) of the spices. The oil from cinnamon leaves is obtained by collecting the leaves after the tree has been pruned. The leaves are usually allowed to dry for a few days before distillation, either by steam, water-steam or hydro-distillation. Cinnamon oils are normally rectified within the importing country before sale to end-users to give a cleaner product or to provide an oil with more uniform composition. Cassia oil is produced by distilling a mixture of leaves, twigs and fragments of bark.

Areas of production and markets

Sri Lanka is the only regular supplier of cinnamon bark oil (averaging approximately 2.6 tonnes per year in the period 1987-92) and leaf oils (averaging approximately 116 tonnes in the same period) (Coppen, 1995), whereas Madagascar and the Seychelles have been intermittent suppliers of leaf oil on a minor scale. India produces very small amounts of leaf oil for domestic use. Most cassia oil in international trade is of Chinese origin (approximately 210 tonnes per year, 1987-1990) (Coppen 1995b). Small quantities of cassia oil are produced in Indonesia, Viet Nam, India and Nepal.

The European Community is the largest importer of cinnamon bark oil, and France the biggest single importing country. In recent years the United States has emerged as the second largest importing country. Similarly the United States and Western Europe are the biggest importers of cinnamon leaf oil. Hong Kong is also a significant importer although most of the oil is re-exported. Figures for exports of cassia oil particularly from the People's Republic of China are not available. Imports into

the United States have risen in recent years (from 221 tonnes in 1987 to 445 tonnes in 1993) and also into Japan. (Coppen, 1995b).

Development potential
For cinnamon and cassia oils of international commerce, production of oil is secondary to the production of the spice. The establishment of new areas of these cinnamon species will depend upon demand for this spice and remunerative returns to the farmer. Research should however be undertaken to see if cinnamon could be produced at a sufficiently economic price for regional consumption.

Other trees

The only other species under this heading is *Canarium schweinfurthii*, which grows particularly in the forests around Lake Victoria and Kampala city. The resin from it is used to produce an incense used locally.

3.2.6 Furniture and building material

Due to lack of time, less attention was paid to this field as other detailed studies on production, processing and marketing of timber have already been carried out by the Forestry Department (e.g. Kityo and Plumptre, 1997). However, during the literature review the following important timber species were mentioned: *Vernonia amygdalina*, *Tectona grandis*, *Podocarpus latifolius, Pinus patula*, *Pinus caribaea*, *Maesopsis eminii* and *Eucalyptus spp*.

3.2.7 Woodfuels

Distribution in Uganda
Important wood fuel indigenous species are *Acacia gerrardii*, *Acacia hockii*, *Acacia Seyal*, *Combretum collinum*, and *Maesopsis eminii* principally found in savannah areas. Preferred exotic species include *Eucalyptus grandis*, *Eucalyptus camaldulensis*, *Eucalyptus citriodora*, *Senna spectabilis* and *Senna Siamea*.

Uses
Firewood and charcoal are used for cooking in rural and urban areas, as well as in the bakery, brewing, brick making, pottery and blacksmiths industries. The desirable characteristics of wood for firewood and charcoal are:

- Rapid growth, high volume production, ability to coppice or sprout readily when cut and requiring minimum management.
- Dense wood with a low moisture content, relatively easy to cut, easy to handle, with few or no thorns, splitting easily and readily transportable.
- Slow burning with high calorific value, producing very little smoke without neither objectionable nor toxic fumes, nor spits and sparks.

Development potential
It is generally accepted that the current use of trees for fuel nationally is exceeding incremental growth. In order to reduce some of the pressure on the existing fuel resources investigation should focus on increasing plantations of wood fuel species and promoting more efficient stoves (e.g. peko pe commonly used in northern Uganda).

3.2.8 Ornamental plants

Although often overlooked in considerations of the development potential of wild plants, species that are used as ornamentals have a considerable role in world trade and have great potential for development in farming systems in many parts of the world. Ornamental plants are important in most cultures and societies. In addition, the international ornamental plant trade has been conservatively estimated at US$1 000 million annually (FAO, 1999), not to mention the very substantial illegal trade.

The horticultural and flower trade is expanding rapidly around the world and new cut flower and pot plant introductions are in constant demand. In South Africa, indigenous ornamental flower species represent an untapped resource of inestimable proportions. Many species are commercially harvested from the wild and also cultivated. Cut flowers both cultivated (in the region and worldwide) and harvested from the wild include species of *Leucadendron*, *Leucospermum* and *Protea (Proteaceae)* and *Brunia (Bruniaceae).* Everlasting species of *Helichrysum (Asteraceae)*, Aloe and Erica and thatching species of *Chondropetalum* and *Thamnochortus (Restionaceae)* are commercially harvested from the wild but rarely cultivated.

In Australia, many species of value as ornamentals or cut flowers have been identified and are being promoted by the nursery industry. These include many rare and threatened species, whose conservation through cultivation is being encouraged. The challenge for farm households is to seek ways of cooperating with the nursery trade and becoming involved in the cultivation of such species.

In Uganda, ornamentals from both indigenous and exotic plant species are produced on a commercial basis by privately owned nurseries. The ornamental plants are sold along roadsides in urban areas and are purchased by tourists and visitors from other countries and to a greater extent by local people for landscaping and gardens as well as indoor decorations. A few important indigenous ornamental plants include *Spathodea campanulata*, *Markhamia lutea*, *Dordia africana*, *Dracaena fragans*, *Dovyalis caffra* and Dovyalis *macrocalyx*.

3.2.9 Cosmetics

Shea butter

Distribution in Uganda
Butyrospermum paradoxum is a tree, which produces shea nuts and grows in savannah land, particularly in the northern and eastern part of the country.

Uses
Shea butter is used as a basis for soaps, creams, moisturizers, hair conditioners and shampoos, and as an ingredient in chocolate products, often substituting cocoa.

Harvesting, processing and storage
The nuts, which are embedded in a soft fruit, fall to the ground during the harvesting period (normally June through August). They are then buried in pits causing the pulp to ferment and disintegrate. This process also prevents germination. The nuts are dried for a few days and later shelled and winnowed, usually by hand. The kernels are then dried further to reduce moisture. Fractionation separates the oil (olein) and butter (stearin). The liquid oil is extracted by heating and kneading the crushed kernels and straining the resultant oil mass. Shea butter is produced on a commercial scale in Europe using hydraulic presses on the nuts and then placing them in hot ovens. The butter must then be stored and transported in cool conditions and in airtight containers to avoid becoming rancid.

Areas of production and markets
Shea nuts are primarily grown in West and Central Africa in the semi-arid Sahel. The important nilotic variety is produced primarily in northern and eastern Uganda and southern Sudan. The major producer of shea nuts is Nigeria with an average of over 350 000 metric tons per year over the period 1994-98 (Raise Organization - www.raise.org/natural/pubs/shea/stm). Export statistics are only primary estimates, showing Ghana as the major exporter of shea nuts in 1997 (19,654 MT). (Raise Organization). Exports as a whole, during the last two years of available statistics, are approximately 50 000 MT with an export value of around US$10 million. Major importers are the European Community, Japan and Russia. Much of these imports are however used as food products (cocoa butter equivalents) not permitted in the United States and some of the EC countries. Demand is however increasing for shea butter as an ingredient in cosmetics and soaps, especially in France and the United States. The retail price for the refined butter is US$6 per ounce in the US. Unrefined nilotica shea butter produced in Uganda is priced at US$60/kg while unrefined shea butter from West

Africa is priced at US$200/mt (c.i.f. Europe). The refined butter particularly of the nilotic variety is a valuable addition to moisturizers, creams, shampoos, hair conditioners and soaps.

Potential development

Nilotic shea butter is presently the object of study under the Shea Project of the Cooperative Office for Voluntary Organizations (COVOL) Uganda. This project is an integrated conservation and development project which now covers an area of over 10 000 square miles across northern Uganda, involving over 400 community-based groups. The particular qualities of the nilotic shea butter and its consequent high value give Ugandan farmers (principally women) over five times the amount received by their West African counterparts. The development potential, both nationally and internationally, for this product appears to be considerable.

3.2.10 Medicinal products

Uses

In Uganda, over 80% of the rural population depends on traditional medicine for their primary health care needs, either serially or concurrently with modern medicine. Certain indigenous species such as *Prunus africana, Warbugia ugandensis, Mucuna* and *Rauvolfia* are already being used in modern medicine and elements of the plants have been isolated and are used in pharmaceuticals.

Harvesting, processing and storage

Many traditional remedies can involve total destruction of a natural resource. Processing often requires the total excavation of the plant roots, or degradation of the species through stripping the bark, twigs and leaves.

Areas of production and markets

Uganda Revenue Authority provides a very limited amount of information on quantities and export markets for medicinal products. Traditional healers have revealed that many medicinal plants are illegally exported from Uganda to Europe, mainly via the Democratic Republic of Congo.

Development potential

A great deal of research is required to ascertain the quantities of medicinal plants available; if and how they can be harvested more sustainably; and which markets could be found for these products.
A two-phased project entitled Medicinal Plants and Biodiversity has been launched by the Ministry of Health, with funding from the Canadian International Development Research Council (IDRC), to identify availability of medicinal plants and methods for their preservation, together with the development of cooperation and research among traditional healers, ethno-medicine researchers and health workers.

Table 4. Short-list of medicinal plants and their uses in Uganda

Name	Species type	Key Purpose/uses
Rauvolfia vomitoria and oxyphylla	Indigenous Tree	Drug Ravolfine isolated. Used for high blood pressure and early epilepsy.
Warburgia Ugandensis	Indigenous Tree	Cough expectorant, malaria, anthelmintic, skin infections, epilepsy
Spathodea campanulata	East, Central and West African Tree	otitis medea, headache, jaundice, diarrhoea
Prunus Africana	Indigenous Tree	Anthelmintic, Prostrate Cancer
Fagara (Zanthoxylum chalybeum)	Indigenous Tree	Fevers sickle cell anaemia, malaria, pain.
Steganotaenia araliacea	Indigenous Tree	Diarrhoea (esp in AIDS), sickle cell
Erythrina abyssinica	Indigenous Tree	Dysentrry, ulcers, colic, vomiting, roots for epilepsy
Dioscora	Herb	Tubers contain a sapogenin used in birth control pills
Seciridaca longepedunculata	Indigenous Tree	Astringent, pain, malaria
Maytenus senegalensis	Indigenous Shrub	backache, jaundice, infertility.
Rhus vulgaris	Shrub	Snake bite, cough and diarrhoea
Carissa edulis	Indigenous Shrub	Threatened abortion, backache, infertility
Dracaena Steudneri	Agave Shrub	Whooping Cough, backache, infertility stomacheache,
Capparis erythrocarpus	Shrub	Menstrual pain, infertility, anaemia
Lonchocarpus laxiflorus	?	Abdominal pain, backache, malaria, pain, meningitis.

For further information under this heading, see Annex 2 (Medicinal Plants in Uganda - An Overview by Pamela Kertland Wright).

3.2.11 Wildlife

In Uganda, over the last 30 years, wildlife in general has been severely reduced by poaching and habitat alteration (Arinaitwe et al., 2000; Lamprey et al., 2000). Several species have become extinct and many are in a precarious state. In many protected areas, wildlife populations have been reduced to less than 10 percent of their levels in the 1960s. Due to this decline, severe laws have been introduced into the country, which make game hunting, for the vast majority of species, illegal. In the short to medium term, any exploitation of wildlife in Uganda will necessarily rely on conservation of the species rather than hunting for wildlife products.

Ranching and farming of wildlife species provide two forms of income generation that conserve wildlife. Mammals are most commonly used in wildlife ranching. Ranching of birds and reptiles involves the collection of breeding stock from the wild, either in the form of eggs or hatchlings and breeding them under controlled conditions. In Uganda this is feasible for guinea fowl and for some types of francolins, for reptiles such as python, monitor lizard, and crocodiles. Snakes such as cobras, vipers and mambas could be used for venom extraction and snake parks. Butterfly ranching is also possible. Wildlife farming means the management of remnant or introduced wildlife in a

natural ecosystem. Regulations for this form of farming include removing only mature wildlife and observing closed seasons and controlling marketing to minimize illegal taking and marketing.

One of the most promising potential sources of income from wildlife lies in the development of ecotourism. Uganda has one of the largest number of different bird species (over 1 000) in the world and bird-watching tours could be an important sector of the tourism industry. Although some animals are rare, there are many species that could draw game viewing visitors (elephants, hippopotamus, giraffes, chimpanzees, antelopes, etc.). In particular, gorillas are a source of attraction to tourists who pay high fees to undertake a trek to view these animals in the Bwindi Impenetrable Forest and Mgahinga National Parks. Examples of tourism projects with significant local benefits include the gorilla "base" at Buhoma, and the forest/chimpanzee site at Kanyancu in Kibale National Park.

In this field, example should be taken from ventures such as that in Zimbabwe under CAMPFIRE programme and that under TAWICO in Tanzania (although it should also be borne in mind that the relatively small size of Protected Areas in Uganda do not allow for wildlife-based tourism on the same scale as in those countries.) These community-based wildlife management programmes provide profits at three levels: to the villagers, who receive cash and/or employment; to the community, which receives revenues and development; and to the nation, which benefits from increased tourism revenues and the effects of increased rural productivity. Restocking of parks with wildlife can be a first step in improving animal numbers in Uganda. (For example, in the Phinda Reserve in South Africa, elephants were imported from Zimbabwe to replenish low stocks.) Subsequently when wildlife numbers reach a defined level, strictly controlled trophy hunting safaris could be re-introduced, charging participants high fees for each animal culled.

The opportunities for ecotourism in Uganda, through the conservation and increase of wildlife, are considerable and far greater importance should be given to this fast-developing field. Ecotourism might also be promoted in Uganda's unique montane ecosystems, such as Mount Elgon and the Rwenzori mountains, which contain the 3rd and 4th highest peaks in Africa.

4. Conclusions and recommendations

The study has revealed that there are indeed income-generating opportunities arising from natural ecosystems in Uganda. Tourism, food products, handicrafts, medicinal plants, cosmetic products and ornamental plants emerge as the categories with more potential for making money at low cost to the environment. Some of the opportunities within these categories are discussed in Section 3.2 and the potential for their development is described under the last heading of each specific product.

This study, however, is by no means comprehensive and it is recommended that the following actions be taken in this order to build on this initial research:

i. Carry out more detailed investigations of the harvesting, processing and commercialisation aspects of species and products identified by this study as the most promising in terms of generating local incomes without destroying the environment.

ii. Carry out in-depth market research to identify products that have high demand in national, regional and/or international markets. Although it is important to be aware of existing products in Uganda, investments should not be overly focussed on the supply side: just because a community has a product, it doesn't mean the market wants it. Research should therefore start from the market and work backwards.

iii. Select a small number of products with market potential, develop them to market readiness, and then commercialise their production. The idea is to be practical, by pinpointing a small number of "promising" products and setting up small enterprises to see if they work, rather than using resources on researching a large number of less-promising products.

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ANNEX 1

Persons contacted	Institution	Area of expertise
Anthony Katende	Botany Department, Makerere University	All Ugandan plant products
Mike Harrison	Forest Sector Coordination Secretariat	Forest products
Damian Akankwasa	Forest Sector Coordination Secretariat	Neem (Azirachta indica)
Judith Voermans	UCOTA	Tourism and handicrafts
Richard Lamprey	UWA	Wildlife
Annie Pageau	Naturaleaf	Hand made paper products
C.A. Amai N.K. Mubiru (Director)	Natural Chemotherapeutics Research Laboratory	Medicinal plants
Dr. Kabatesi Nina Rwomushana	Traditional and Modern Health Practitioners together Against Aids (THETA)	Medicinal plants
Dr. Odyek Dr. Jasper Ogwal-Okeng	Department of Pharmacology and Therapeutics, Makerere	Medicinal plants
Dr. Banana	Forestry Department, Makerere University	Non-wood forest products
Lawrence Bbaale (Vice-Chairman)	Kyojja Wetland Management Association	Wetland products
Christopher Mujuni	Enterprise Development Officer, MBIFCT	Handicraft and honey market surveys to be carried

ANNEX 2

International Institute of Tropical Agriculture
Foodnet
Bandali Rise
Bugolobi, Kampala
Uganda

Medicinal Plants in Uganda

An Overview

Prepared by Pamela Kertland Wright
February 2002

Background

A four country exercise is underway to gather information on the status of niche market herbs, spices and medicinal plants in Uganda, Rwanda, Ethiopia and Madagascar. The first phase is a scoping exercise to develop information on the areas of production, processing and community linkage.

This report is a part of that exercise, with a focus on medicinal plants, done in conjunction with the IFPRI Study on Non-Agricultural Natural Resource- based livelihood options in Uganda. It became rapidly apparent that an accurate overview of the medicinal plant market in Uganda would take years to accomplish – the number of districts, tribes and traditional practises makes for a very lengthy database. A brief overview has been prepared, based on literature review and key-informant interviews.

Findings

In Uganda, over 80% of the rural population depends on traditional medicine for their primary health care needs, either serially or concurrently with modern medicine (Uganda Journal, Issue 42). The Health Review Commission recommended in 1987 that:

> "The Ministry of Health should work closely with traditional healers in order to achieve the objective of 'health for all' by the year 2000. Traditional healers should be members of the health team at the local community level and should be welcome to participate in primary health care. "

In response to this recommendation, the Government of Uganda, through the Ministry of Health appointed a traditional healer to the board of the National Drug Authority, the regulatory body for drugs and herbal medicines. Government is also encouraging collaboration between traditional and modern medicine in HIV/AIDS control and treatment.

The Natural Chemotherapeutics Research Laboratory (NCRL) was established by the Ministry of Health to address the development of Uganda's natural products with therapeutic potential. A two-phased project titled Medicinal Plants and Biodiversity has been launched, with funding from the Canadian International Development Research Council (IDRC) to identify ways and means to improve availability of plants (Phase 1). This included a study in 1993 called Ethnobotanical and Traditional Healers Survey of Uganda's Districts. Twenty-four districts were studied and a separate volume has been produced for each of these districts. *It has been made very clear by all informants used in this report that traditional medicine varies significantly from district to district.*

Phase 2 of the project is underway and is much more comprehensive. Objectives include: to identify ways and means to enable a larger community within Uganda and beyond to be aware of both the medical and economic advantages of preserving the biodiversity of medicinal plants, while supporting the development of experience and expertise among traditional healers, ethno-medicine researchers and health workers.

The role of traditional medicine

The top ten causes of mortality and morbidity in Uganda have been cited by the NCRL as:

- Malaria
- Respiratory tract infection
- Diarrhoea
- Measles
- Malnutrition
- Worm infestation
- Skin infections
- Meningitis
- Tuberculosis
- Tetanus

The annual cost to government hospitals and health care units for treating these problems is over US$5,000,000. It is widely believed that traditional medicine practitioners could help alleviate this burden.

Four case reports have been done on herbal treatment of Malaria (Bitwawha, Tumwsigye and Kabariire, 'Tropical Doctor'). With regards to treating HIV/AIDS symptoms and complications, collaborative clinical trials have already been initiated comparing herbal therapies with modern pharmaceutical treatment for the following:

- Weight loss
- Chronic diarrhoea
- Herpes

Results of the trials indicate equal benefits. (Dr. Kabatesi and Dr. Rwomushana). Further collaborative clinical trials or studies will be done to include evaluations of the effects on skin conditions and oral fungal conditions. The Joint Clinical Research Centre has produced a study on the effectiveness of WWL in the treatment of HIV patients. WWL or Wampi Wazayirwa is a liquid preparation of 9 different medicinal plants, eight of which are processed from bark, and one from the leaf. The plants identities have not been revealed. (There is a lot of mystery and secrecy surrounding the study of medicinal plants).

All of this indicates a real opportunity to further investigate the potential of Medicinal Plants in Uganda. Further, traditional remedies are less costly than imported pharmaceuticals, and healers are widely supported within Ugandan cultures.

On the flip side, many traditional remedies can involve total destruction of a natural resource. Processing often requires the total excavation of the plant roots, or degradation of the species through stripping the bark, twigs and leaves. Some plants face extinction. It is clear that a better understanding of the value of a natural resource can foster broader support for conservation and sustainable use.

Important Medicinal Plants

The Natural Chemotherapeutics Research Laboratory have, as part of the Medicinal Plants and Biodiversity Project, shortlisted 15 important medicinal plants for further research. All are considered very useful for the domestic market, with international market potential, and all are vulnerable to overharvesting.

Name	**Species type**	**Key Purpose**
Rauvolfia vomitoria and oxyphylla	Indigenous Tree	Drug Ravolfine isolated. Used for high blood pressure and early epilepsy.
Warbugia Ugandensis	Indigenous Tree	Cough expectorant, malaria, anthelmintic, skin infections, epilepsy
Spathodea campanulata	East, Central and West African Tree	otitis medea, headache, jaundice, diarrhoea
Prunus Africana	Indigenous Tree	Anthelmintic, Prostrate Cancer
Fagara (Zanthoxylum chalybeum)	Indigenous Tree	Fevers sickle cell anaemia, malaria, pain.
Steganotaenia araliacea	Indigenous Tree	Diarrhoea (esp in AIDS), sickle cell
		Dysentrry, ulcers, colic,

Erythrina abyssinica	Indigenous Tree	vomiting, roots for epilepsy
Dioscora	Herb	Tubers contain a sapogenin used in birth control pills
Seciridaca longepedunculata	Indigenous Tree	Astringent, pain, malaria
Maytenus senegalensis	Indigenous Shrub	backache, jaundice, infertility.
Rhus vulgaris	Shrub	Snake bite, cough and diarrhoea
Carissa edulis	Indigenous Shrub	Threatened abortion, backache, infertility
Dracaena Steudneri	Agave Shrub	Whooping Cough, backache, infertility stomacheache,
Capparis erythrocarpus	Shrub	Menstrual pain, infertility, anaemia
Lonchocarpus laxiflorus	?	Abdominal pain, backache, malaria, pain, meningitis.

Please Note: A more extensive list of plants is provided in the database as an addendum to this report. This database includes information on ecosystem, geographical location of the plant, harvesting, processing methods, storage requirements, regeneration period of the plant and references.

Medicinal Gardens

Four separate medicinal gardens have been planted in four different districts in Uganda and the above trees, shrubs and herbs have been incorporated. Of them all, Fagara has been the most difficult to propogate:

South: Kabale, representing the highlands. There are 576 registered traditional healers in the district. Medicinal garden is located in Maziba sub-county in Ndorwa county.

East: Iganga. This district is well known for its traditional medicine and healing beliefs and culture. Medicinal garden is located in Busiki county, Magada sub-county

North: Lira. Representing lowland monomodal rainfall. There are 519 registered traditional healers in the district. Medicinal garden is located in Dokolo subcountry, Dokolo county

Central: Luwero, representing both savanna and low and bimodal rainfall areas. Medicinal garden is located in Katikamu county, katikamu sub-county.

Institutions involved with medicinal plants

Traditional medicine is practices all over Uganda. The illnesses treated can vary from sub-county to sub-county, district to district. The same is said of the treatment used. There are a number of institutions and associations set up in the area of medicinal plants and traditional medicine.

Institution	Contact	Location
Natural Chemotherapeutics Research Laboratory	C.A. Amai N.K. Mubiru (Director)	Next to Ministry of Health, Wandegeya
Traditional and Modern Health Practitioners together Against Aids (THETA)	Dr. Kabatesi Nina Rwomushana	Kamwokya
Department of Pharmacology and Therapeutics, Makerere	Dr. Odyek Dr. Jasper Ogwal-Okeng	Mulago
Pharmacy Department, Makerere Medical School	Adrian Kakooko	Makerere
Entebbe Botanical Garden	N/a	Entebbe
Bull's General Agencies Ltd (Salonpass)	N/a	William Street
Department of Botany, Makerere	N/a	Makerere University
Uganda ne ddaggala Men and Womens Association	N/a	N/a
Yen te Uwaro Association	N/a	N/a
Uganda Herbalist and Cultural Association	Hajji Haruna Lutakome	Busabala, Entebbe Road

Trade in Medicinal Plants

The International Union for the Conservation of Nature (IUCN) have been monitoring trade in natural resources through several organisations. This includes Medicinal Plants, but this source has not been explored in depth for this project. Potential sources of information through the IUCN are:

1. TRAFFIC
2. "Plants Under Threat" CAMP (Conservation Assessment Management Plan)
3. Guidelines on the Conservation of Medicinal Plants
4. Biodiversity Support Program (a consortium of the WWF, the Nature Conservancy and the IUCN)

Further, a report was produced by Dr. Ogwal-Okeng through the Department of Botany (with funding from the World Bank) on the economic value of Uganda's Medicinal Plants. While Dr. Ogwal-Okeng was out of the country at the time of this contract, it was suggested by other sources that this report would be of some value to further understand the potential of this Market.

Exportation of Medicinal Plants

The Plant Quarantine at Kawanda Agricultural Research Institute, in place to ensure plant material is clear of fungal infection, has data that can be helpful in determining export levels of medicinal plants. It has been noted that small volumes of medicinal herbs and plants are exported 'for research purposes only', and then larger volumes of the same herb are later exported. This data needs to be further examined.

Some companies involved in medicinal plant export include:

- RECO Industries Chinchona Peel or Quinine, ginseng root, liquorice root
- Ets Robert Mayskens Chinchona
- Butambala Enterprises Licorice Root
- MAGRIC Chinchona

The URA is a potential source of more information regarding the legal exportation of medicinal plants, and the Export Promotion Board could be another source.

This does not take into account the illegal trade between Uganda and Kenya, Tanzania, Rwanda, and DRC. Sources (traditional healers) have revealed that the DRC is a well-known conduit for illegal export of many medicinal plants from Uganda to Europe.

Where to go from here?

This brief report only scratches the surface of the Medicinal Plant market in Uganda. During the process of literature review and informant interviews it became increasingly evident that more research is needed to clearly understand the current situation. Volumes of literature have been produced by various bodies and organisations, and there are a number of informed sources who could assist in the process of research.

What is lacking is a comprehensive report that ties the botanical side with the medical side (or it could be that it was produced but has not yet been uncovered). And the economic potential of Medicinal Plants still remains intangible. With the added complication of the lack of intellectual property protection and the resulting secrecy practised by people in the industry, the next stage will be more like detective work than research. The primary sources of information should be:

- IUCN
- URA and EPB
- THETA
- NCRL
- Makere Dept of Botany
- World Bank and EU (who funded several studies)
- And a deeper study of what the international medical industry needs

Certain indigenous species like Prunus Africana, Warbugia Ugandensis, Mucuna and Rauvolfia are already being used in modern medicine. Elements of the plants have been isolated and are used in pharmaceuticals. What is not yet clear is whether Uganda is currently supplying these plants.

Further, interviews with the semi-formal sector like Salonpass or Bull Industries will clarify the supply chain.

A second phase of the research is recommended to examine the above, and to examine the area of herbs and spices and aromatics which, given the time constraints, was not possible in this study.

Annex 3

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE (IFPRI)
Strategic Criteria for Rural Investment in Productivity (SCRIP)
– a research project funded by USAID-Uganda

STUDY ON NON-AGRICULTURAL NATURAL RESOURCE-BASED LIVELIHOOD OPTIONS IN UGANDA

TERMS OF REFERENCE

Introduction

The Plan for the Modernisation of Agriculture (PMA) is the Government of Uganda's strategic framework for eradicating rural poverty through agricultural transformation. The PMA seeks to place the poor at the centre of the poverty eradication process, and to empower the poor to take advantage of a wide range of livelihood opportunities.

Within this context and in order to assist the USAID Mission in Uganda to design programmes under the SO7 "expanded sustainable economic opportunities for rural sector growth", IFPRI has commissioned a study to generate information on environmental goods/services and livelihood options provided by different non-agricultural ecosystems in Uganda.[4] The study will provide a prioritised 'menu of livelihood options' for further assessment, but will focus on market-oriented micro-enterprises, which promise high incomes for local communities (e.g., adding value to non-timber forest products through processing or providing services that link up with the tourist industry) and at the same time have low/positive environmental impact – the socalled 'win-win' solutions.

Each livelihood option will be linked to a spatial data base, based on the National Biomass Study (1996) land cover classes (and possibly Langdale-Brown (1964) for south western Uganda), by identifying the ecosystem attributes (e.g., availability of certain plant and animal species, water, etc.) required for its realisation.[5] While thus being organised by ecosystem types irrespective of geographic location, the study will pay more attention to the types of ecosystems (and associated goods/services) prevailing in south western Uganda (i.e., Kisoro, Kabale, Rukungiri, Ntungamo, Bushenyi and Kasese districts) and within this region in particular the ecosystems and goods/services of protected areas. For south western Uganda the ecosystems attributes will also be linked to the Langdale-Brown (1964) ecosystem classification.

The study will be based on a literature review and key-informant interviews and will be supervised by a Steering Committee composed of a representative from IFPRI, the USAID Uganda Mission, the Forest Secretariat, and MUIENR.

Objectives/Activities

The specific objectives/activities of this consultancy are:

1. For each type of ecosystem (NBS land cover class;), identify existing and potential non-agricultural natural resource-based livelihood options for rural communities and the ecosystem attributes required for their realisation. Such livelihood options would include the harvesting, processing and marketing of products/goods generated by natural ecosystems (e.g. nectar →

[4] Agriculture refers here to crop cultivation, livestock production and fisheries.
[5] This will enable IFPRI to link the livelihood options with information on selected ecosystem goods/services (biodiversity, water regulation, etc) associated with the NBS land cover classes, to be generated by another study.

honey in jars), as well as the provision of services based on natural ecosystem services (e.g. wildlife & scenery → food and lodging for tourists).

2. Make a preliminary assessment of the local demand and wider market potential for the products/services.
3. Identify spatially dependent key preconditions for the viability of the livelihood options and micro-enterprises. By this is meant factors that vary over space and that would help to determine the best location for a particular option, or in other words, constraints that cannot be overcome through programme investments. For example constraints related to climate, road and transport infrastructure, and access to land and other natural resources.
4. Describe how each option would be a 'win-win' solution, i.e. in what ways does it reconcile ecosystem conservation/restoration with local livelihood objectives.
5. Select those options with the (estimated) highest, sustainable income-generating potential and which therefore merit further attention by USAID and its partners. The selection should be based on economic, environmental, social (equity), and technological criteria, of which the first two are given more weight, and the methodology used should be documented.

Output

A report describing a set of existing and potential, non-agricultural natural resource-based livelihood strategies. The tabulated information in the report should be structured in such a way that it can be readily entered into a GIS database based on the NBS land cover classes (e.g. by using MS Access tables) to be used for programme design purposes. How exactly to structure and aggregate the information will be determined together with the Steering Committee in the first phase of the consultancy. Such aggregation should not exclude the presentation of detailed information in other parts of the report, however. List and hard/soft copies of reviewed literature and databases; documentation of other information sources (e.g., names and contacts of key informants and institutions).

Work Plan

21/1 – 27/1	FAO, Rome
28/1 – 17/2	Kampala
15/2	Presentation of preliminary results at the USAID Mission
18/2 – 24/2	FAO, Rome

The final report should be submitted to IFPRI no later than 25th February.

Terms and Conditions

The consultant will be paid a technical fee of USD XX per day for 35 days plus a daily allowance of USD XX for 21 days. A Research Assistant recruited and paid for by IFPRI will assist the consultant.