

# Utilization and commercialization of dryland indigenous fruit tree species to improve livelihoods in East and Central Africa.

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Compiled By: Parnwell Simitu.



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## Acronyms

AMREF	Africa Medical Research Foundation
ASALS	Arid and Semi Arid Lands
CBO	Community Based Organization
COMESA	Common Market for East and Southern Africa
EAC	East African Cooperation
ECA	East and Central Africa
HCDA	Horticultural Crops Development Authority
ICRAF	International Centre for Research in Agroforestry
IFTS	Indigenous Fruit Tree Species
IGAD	Intergovernmental Authority for Africa Development
IPGRI	International Plant Genetic Resources Institute
JICA	Japan International Corporation Agency
KEFRI	Kenya Forestry Research Institute
LCG	Local Community Groups
NAADS	National Agricultural Advisory Service
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
PEAP	Poverty Eradication Programme
PMA	Plan for Moderation of Agriculture
PRA	Participatory Rural Appraisal
RELMA	Regional Land Management Unit
SOFEM	Social Forestry Extension Model
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa

## Abstract

Drylands have low development indicators against high incidence of poverty, with more than 60% of their population living below the poverty line. The inhabitants are often faced with high incidence of poverty caused by conflicts, harsh climatic conditions such as low and unreliable rainfall, frequent droughts and fragile ecosystem resulting in low and declining land productivity. They live in a tough and inhospitable environment, and face many constraints and uncertainties in meeting their day-to-day livelihood needs. There is need for practical interventions to improve living conditions in these areas and contribute to sustainable land and environmental management.

One of the pragmatic interventions is use of indigenous fruit trees (IFTS), which from time immemorial are known to play an important role in food and nutritional supplement in dryland areas, especially during droughts when there is food shortage. Studies carried out in the region have indeed indicated that IFTS plays a major role in the socio-economy of the inhabitants of the areas where they occur. There are many indigenous fruit trees that could be integrated into dryland farming systems in Sub-Saharan Africa (SSA) to support income and nutrition. Although fruits contain almost all known vitamins and many essential minerals, and while many species are well integrated in the Sahel region, they are generally absent from smallholder farms in East and Central Africa. To date, indigenous fruits in this region are mostly harvested unsustainably from the wild with little domestication, a trend that needs to be reversed, if the increasing demand of these fruits is to be met.

Hundreds of different IFTS grow in drylands of ECA region and have long been valued by local populations for the products they yield. Surveys in the region have shown existing lucrative market of IFTS products in several species, e.g., *Adansonia digitata*, *Tamarindus indica* and *Vitex doniana*. However, unlike the situation in the neighbouring Southern Africa region, where *S. birrea* is utilized extensively in the wine industry, there is little if any use for the tree and other trees in this region, largely because of limited knowledge. For the indigenous fruit trees there is only one choice, use them or lose them. Even though many IFTS products have major commercial possibilities and lucrative markets, these remain largely untapped.

Given these challenges, a regional workshop aimed at widescale training on domestication, utilization and commercialization of the IFTS was conducted. Key elements of the workshop include capacity building on processing, utilization and marketing of IFTS, drawing on case studies from the countries in the region. The goal was to share experiences and learn about the propagation, harvesting, processing and marketing of indigenous fruit products. Several practical demonstrations showed how indigenous fruit tree products could be processed and prepared for wider use and sale, for example jams, juice and wine that are important sources of food and nutrition. The remaining challenge includes markets and capacity in the rural areas to produce quality products acceptable to urban consumers.

## Introduction

Food security and poverty alleviation in rural communities in Africa can strategically be improved by diversifying the existing farming systems. Crop farming alone, without incorporating livestock production, horticulture, tree planting and embracing alternative livelihoods such as bee keeping, irrigated agriculture, indigenous fruits and marketing of non-wood products, would not improve the standards of living for farming communities in Africa. When one of these sources of production fails which can and often does happen, farmers would always have something to fall back on. Their strength and resilience thus lies in the diversity of their farming systems. This is particularly important in the drylands of the eastern and central Africa (ECA) region where frequent famine and droughts are increasing the incidences of hunger and poverty for the over 70 million people who live in these vulnerable lands (Jama *et al*, 2005).

Experiences in many African farming systems have shown that between the cropping seasons, farmers rely on alternative food products that include trees, fruits, animals and sale of non-wood products to earn a living especially during droughts. In the drylands of Africa, incorporating farming with fruit trees such as mangoes for alternative source of food and nutritional security is increasingly becoming popular. Where commercial exploitation of indigenous fruits occur (for example in west and southern Africa regions), indigenous fruits show great potential—as much as exotic fruits—in providing food security, vitamins and income generation. In contrast, indigenous fruits have not been commercially exploited in the ECA region although a diversity of valuable fruit species exists. Research conducted in the region on utilization and commercialization of IFTS provides important information as to why there is less commercial exploitation of these trees. Poor market information and access, lack of processing technology and know-how, weak and exploitive marketing channels and difficulties in entering into trade, all present major hindrances to farmers wishing to develop the commercial potential of IFTS products (Emerton *et al*, 2000).

A priority setting exercise within the ECA region identified utilization and commercialization of dryland indigenous fruit tree species as one of the viable alternative livelihoods in the region. There is a considerable wealth of indigenous knowledge among farmers and rural communities in the region on the value and uses of these fruit tree species. However, there is little domestication of these trees. Most of what is used is collected from the wild, and communities living in drylands often rely on nature to supply indigenous fruit tree products. Unfortunately, each year more and more of these wild trees are being destroyed through processes such as charcoal production (an important economic product for many poor people) and expansion of agriculture into the semi-arid woodlands because they simply do not hold their own in commercial terms - even though this means losing favoured food items and a source of insurance against critical scarcity during drought. National tree seed centers do not stock many indigenous species because, compared to the exotic species, there is little demand for them. In addition, no extension materials have been developed from the few studies on the indigenous fruit species conducted so far (Jama *et al*, 2005). Fortunately, farmers and local communities are familiar with the species, easing their integration into farming systems for conservation so as to tap their potential.

In the case of mangoes, most farmers plant unimproved local varieties that produce little fruits with a lot of fibres, which are not easily marketable. Although there are many improved varieties within specific sites and localities in the region, such materials are beyond the reach and means of most farmers. For the indigenous fruit species such as *Sclerocarya birrea*, *Adansonia digitata*, *Tamarindus indica*, *Vitex doniana*, *Balanites aegyptiaca*, *Parinari curatellifolia* and *Zyziphus mauritiana*, there is need to determine their ecological niches and propagation techniques so that farmers can be guided on how and where to domesticate them. Since ways of supplying these products to wider markets within and outside the region is a key challenge, marketing of the fruits within and outside the local markets needs considerable research and development efforts. In particular, selection for taste, semi-processing, value adding, marketing and storage are areas that require further development. There is, indeed, considerable knowledge on the species, from elsewhere, that can be adapted with modification to hasten research and development efforts in the region.

A logical starting point is the collation and synthesis of existing knowledge within and outside of the region. This was the purpose of the workshop, focusing specifically on the domestication, utilization and commercialization of the species. Based on this synthesis, a framework is proposed that will facilitate use of existing information in the planning, programming, monitoring and evaluation of national and regional strategies for widescale domestication and utilization of indigenous fruits in the drylands of the ECA region. This report thus contains findings and experiences drawn from the region on the domestication, utilization and commercialization of the IFTS presented and shared during the workshop.

The regional workshop was attended by over thirty participants (Appendix 1) drawn from Kenya Tanzania, Uganda, Ethiopia, and Rwanda. Broadly the objective of the workshop was to share knowledge and experiences on the utility, processing and conservation of indigenous fruits, learn methods for processing, developing and marketing commercial products from indigenous fruits and also to form a community of practitioners who share information and network for impact in the region.



## **SESSION 1: WORKSHOP INTRODUCTION AND PRESENTATIONS**

Chair: Dr. Zenroku Oginosako (ICRAF) and James Kimondo (KEFRI)

### **Group introductions**

The Chair welcomed the participants to the workshop and requested them to introduce themselves by mentioning their names, where they come from, and the kind of work they do and why they had come to the workshop. The introductions revealed that the workshop had a diversity of representation. It provided a forum that would enable trainers rich with indigenous knowledge to interact with intellectuals, making it rich of resources persons.

### **Welcoming address: Dr. Zenroku Oginosako. (Dryland team leader of ICRAF-ECA)**

In his address, Dr. Oginosako welcomed and thanked all the participants for attending the workshop, and reminded them that their experiences with IFTS were highly desired. He gave a brief exposition of the importance of the workshop, emphasizing on full participation by all participants. He requested participants to make sure that their expectations are met before the end of the workshop.

### **Opening address: Dr. Bashir Jama, (Regional coordinator, ICRAF-ECA programme)**

In his opening remarks, Dr. Jama welcomed the participants to the workshop and gave a brief introduction of some of ICRAF-ECA activities especially those related to the theme of the workshop. He also gave a presentation that explained in details the purpose of the workshop and why the workshop was important. He said that the focus of the workshop was on concrete, applied learning and information sharing. To achieve the objectives, he pointed out that the workshop program is organized in way that it has lectures and practicals (especially on propagation and product development), hence it will involve a series of field trips to farmer groups on fruit processing, study tours to fruit processing industry for practical demonstration on utilization, production and marketing of IFTS products. This, he said, will be supplemented by extensive sessions for discussions and sharing knowledge among participants.

Dr. Jama shared with participants his experience on the importance role played by IFTS in food security and alleviating poverty in different parts of the regions. He stressed the need to domesticate IFTS by referring to low-lying Zambezi, an area which relies on wild fruits when villagers ran out of food. In order to still emphasize on the health and nutritional value of the IFTS, he showed a picture that he personally took of a healthy boy called Michael from Uganda, eating mango. The boy had grown healthy because of including fruits in his diet. Just the same way the exotic species are improved by various methods; he also assured participants that the same could also be done to IFTS. He put on view a picture of improved cultivars of Baobab (*Adansonia digitata*) by grafting, which he said can reduce the size and production age from 25 to only 4 to 5 years. To stress on this, he showed a slide containing a new cultivar development

of *Uapaca kirkiana* in Uganda, which has resulted in early fruiting, bigger fruits, heavy fruit loads, smaller trees and uniform quality. He gave another example of improved cultivars of high yielding Indian cultivars (Seb, Umran, Gola) of *Zizyphus* spp and which is now already available for planting. The fruit production age of this species has been reduced from two years to only 6 months, and the fruits are more than 10 times bigger than the local ones. He also underlined the important role of high value fruits such as mango, which he said was now naturalized in the ECA region.

In order to succeed in the utilization and commercialization of IFTS, he advised participants to aim first at local markets or “markets on the move” for the products e.g. selling fruits by the roadside. He emphasized importance of training on processing and enterprise development to achieve a wide scale use and commercialization of IFTS. For this, he said that resource centers would play a great role, and gave an example of Kamarugu centre, a mango processing centre at Mbeere district in Kenya. He advised the trainers to strive to domesticate IFTS and commercialize their products. Dr. Jama took time to give details to participants on the link between domestication, product development, business development and marketing of IFTS.

Dr. Jama informed the participants that he had a lot of confidence in them in achieving the objectives of the workshop. He urged them to make sure that they fulfil all workshop expectations. Some of the expectations he told them to fulfil are; a) to gain skills for product and enterprise development, b) develop plan to train others in their countries and locations, c) developed strategy to network across the region and make recommendations for research and development for advancing the use and marketing of indigenous fruits in the region among others. He indicated that it is important to have a framework that allows the exotic and the indigenous fruit trees work for the improvement of the livelihoods in the drylands of ECA. He regretted that the IFTS have not been optimally exploited commercially in the ECA region; a fact that he attributed to lack of awareness on the value of IFTS coupled with limited knowledge, and encouraged participants to rise above these challenges. He emphasized that it was important to enhance the propagation, use and commercialization of IFTS, which could be done through in-situ conservation, as well as sustainable harvesting of the trees and tree products so as to minimize pressure on the environment. He urged each participant to participate freely in the workshop so that they could learn from each other’s experience and indigenous knowledge for the full achievement of the workshop objectives.

### **Workshop overview and Objectives: Dr. Zenroku Oginosako**

Dr. Oginosako thanked participants for accepting the invitation to attend the workshop. He gave an overview of the workshop and conducted a participatory expectation-setting process for the workshop. He then presented background information on IFTS, in which he underscored the fact that a lot has been done on exotic species and very little on indigenous fruit trees, notwithstanding their important role in food security and nutrition supplement in dryland areas. Quoting from the book titled “Natural Medicine in the Tropics” that “The great danger in tropical countries is losing knowledge of their own culture”, he reminded participants that the workshop was one method of protecting loss of their own indigenous knowledge and a platform for sharing their technology with people from other countries. He touched on the risks involved in relying on introduced species that are not very well adapted to the local environment.

Referring to Dr. Jama's opening address; he went further to present the workshop objectives as follows:

- To share knowledge and experience on the utility, processing and conservation of indigenous fruits.
- To learn methods for processing, developing and marketing commercial products from indigenous fruit trees,
- To learn propagation and management techniques of indigenous fruits
- To form a community of practitioners who share information and network for impact in the region

Workshop participants were then asked to do a participatory setting of expectations by listing their main expectation on cards, resulting in the following list of expectations from the workshop participants:

- To know whether most of the wild fruits provide enough nutrients like vitamin, calcium and iron or there are specific ones in which we should capitalize on.
- To know more about grafting of trees, marketing of mangoes and indigenous fruits
- To learn from participants of other countries on how they utilize indigenous fruits to high value products and marketing them and research issues.
- To learn how to improve indigenous fruit trees for more benefits to farmers
- To acquire knowledge of both planting and preserving fruits throughout the dry seasons.
- To improve skills and knowledge on how to processes and preserve indigenous fruits
- To learn on how to organize local enterprise for marketing purposes
- To add knowledge of planting fruit trees and making juice from these fruits
- To learn on how to market bees wax, *Adansonia digitata* and *Tamarindus indica* fruit products
- To acquire knowledge on value addition of indigenous fruits and establish reliable and sustainable marketing channels of these products.
- To discover how wild fruits, which are in plenty locally are being processed in other countries.
- To know how different communities in Makueni, Mwingi, Kitui and Baringo districts of Kenya are utilizing wild fruits.
- To share knowledge on the priority species of different areas and their use.
- To produce some extension materials such as brochures, manuals and handouts for utilization of indigenous fruit trees.
- To tap knowledge on how to utilize and manage resources in and out of the country
- To gain knowledge on how different high value indigenous fruit species are grown and utilized in other parts of east and central, Africa countries, their agronomic management and how they can be introduced to my country (Rwanda).
- To learn skills and share them with local people on the importance and conservation of the indigenous trees.
- To identify good market for the bee wax and other dryland fruit products.
- To identify strategies for developing and ascertaining products and markets for indigenous fruit trees.

- To be acquainted with skills of making vegetable dishes from *Adansonia digitata* and other trees used as leafy vegetables.
- To learn about fruit processing.
- To gain skills on tree products and enterprise development.
- To learn more on indigenous fruits so as to teach the truth about them.
- To know how to preserve the fruits to stay for long and the materials for preserving.
- To share experience and knowledge on production and processing of indigenous fruits.
- To share processing experiences of IFTS with participants and have products made by group participants.

Dr. Oginosako informed participants to identify key issues from each activity of the workshop. The workshop was structured to include a range of activities to foster a mutually interactive set-up aimed at prompting maximum contribution from all participants. The programme incorporated lectures, practicals, demonstrations (by farmer groups, agricultural officers and business women on fruit processing), study tour to a fruit processing industry, and sessions for discussions and sharing of knowledge among participants.

## Presentations

Chair: Dr. Zenroku Oginosako and James Kimondo

### 1. Indigenous fruit tree species in drylands of Kenya

By: Dr. Benard Muok, Kenya Forestry Research Institute (KEFRI), Kitui Dryland Research Centre.

#### Introduction

Around 30,000 plant species around the world are edible, but out of these, only 7,000 are used as human food (FAO, 1998). Only 20-30 of the edible varieties are staple crops that supply 95% of human nutrition. Three species only supply almost 60% of the calories and proteins that humans derive from plants - maize, rice and wheat (Dulloo, 1999). Indigenous fruit tree species are thus important for domestication as source of human food and nutrition.

Surveys conducted in drylands of Kenya reveal existence of a diversity of valuable indigenous fruit species that can be exploited to improve livelihoods and help alleviate poverty. The following is a description of common indigenous dryland fruit trees in Kenya that are important source of human food and nutrition.

#### *Adansonia digitata*



- Dry pulp is eaten when raw
- Dry pulp dissolved in water, stirred to a milky taste (milk may be added), seeds sieved off and the juice used as a sauce or added to porridge.
- Seeds are roasted like groundnuts.
- Soft tuber like roots are cooked and eaten in times of famine.
- Germinating seed root may be eaten.
- Young leaves are used as vegetable.
- The pulp-coated seed (mabuyu) are coloured and sold as sweets.
- Fibre from the trunk produces a string for weaving baskets and ropes.

#### *Annona senegalensis*



- Ripe fruit edible raw
- It is sweet with acid taste and aroma of pineapple.



- Bark chewed
- Bark source of a brown dye
- Cultivated for their delicious fruit and commonly sold in Kenyan markets.

***Balanites aegyptica***

- Ripe fruits are edible.
- Young leaves and tender shoots are used as vegetable.
- The vegetable is boiled and water may be changed several times then pounded and mixed with fat.
- Seeds (with shell) or cotyledons (shell removed) are boiled for 2 – 3 hours then the bean-like cotyledon is eaten)
- Gum is edible.
- The seeds are a source of fat.
- Bark used as fish poison.
- Animal fodder.
- Elsewhere the fruit is used at some stages to kill bilharzia fluke in water.
- Pulp used as soap.

***Azanza garckeana***



- Ripe fruits are edible and very sweet.
- Valves are chewed, the gelatinous sweet extract is swallowed and the fibrous remains discarded after chewing.



- Can be stored for up to one month without it losing the sweetness.

***Berchamia discolor***



- Ripe (occasionally unripe fruits) are eaten; may be eaten all together with the cover and the seed.
- Gum edible.
- Dried fruit used by Tharaka girls (Kenya) as beads.
- Has a hard yellowish brown durable wood used as poles, in the construction of furniture's and frames for doors and windows.
- Produce excellent charcoal

- Poles used for constructing granaries.

### *Boscia coriacea*

- Boiled cotyledons eaten.
- Preparation.
- Fruits are pounded with a stone to remove the outer green fleshy coat.
- The seeds are briefly boiled to loosen the tough outer skin and then pressed between the stones to release the green cotyledons.
- The skins are floated off in water then the green cotyledons boiled.
- Water is changed 8 – 12 times.
- Boiled seed may be fried.
- Ripe fruit may be sucked for its sweet taste.
- Cooked food sold in Turkana markets.
- Often exchanged with foodstuffs.



### *Carissa edulis*

- Both ripe and unripe fruits are eaten
- The unripe fruits (green to purple) taste tart.
- Ripe fruits delicious, sweet and soft.
- Much liked by children and adults grazing livestock.
- All fruits exude useful milky latex.
- Flowers eaten
- Good goat fodder.
- Good hedge plant.
- Ripe fruit used as a dye for children.
- Silk- moth cocoons occasionally found in the plant.



### *Cordia sinensis*

- Ripe fruits eaten raw.
- Large quantities of the fruit are gathered, pounded to a sticky mass, sun dried and stored in a wooden container *eburr* (Turkana).
- Whenever it is needed, water is added to soften it, and then served.
- The fruit pulp is sometimes used for brewing local beer.
- The fresh fruit is squeezed in water to dissolve the pulp. This is mixed with *tamarind* (*Tamarindus indica*) juice then fermented.
- Fresh juice may also be drunk.
- A clear gum produced by the tree is edible.



### *Meyna tetraphylla*

- Fruit edible and sweet. Much liked by pastoralists.
- Root decoction given to pregnant women to ease pain (Pokot)
- Crushed leaves are applied to infected hooves of animals.
- Camel and goat fodder.

### *Pachystigma schumannianum*



- Ripe fruits edible (occasionally eaten unripe). Fruits are sweet.
- Smoking stems inserted into milk to impart good flavor.



### *Sclerocarya birrea*

- Ripe fruit eaten raw cover removed (often after squeezing the fruit several times) and the cream fruit pulp is sucked.
- Pleasantly acid and strongly scented.
- Fruits are high in vitamin C.
- The oil rich seed is edible. The stone is cracked and the contents eaten raw.
- Often sold in the market by the Pokots.
- In southern Africa, the fruit is used in the making of an alcoholic drink, jam and marula jelly.



### *Strychnos spinosa*

- The large ripe yellow fruit is edible and has sweet-acid taste.
- Juice can be extracted from ripe fruits.



### *Tamarindus indica*

- The fruit pulp is eaten raw and has a strong acid taste.
- The pulp is dissolved in water and the resulting solution used in flavouring porridge.
- The solution may also be added into stews as a flavoring for various foodstuffs such as tea and rice or with dried termites.
- Young leaves are chewed like *Catha edulis* (*khat*, *miraa*)
- Young leaves are also cooked as vegetable.
- Seeds are fried and eaten.
- The fruit pulp is used in the preparation of beer.
- Fruits, after the coats are removed, are tied into bundles and stored in a sack up to two years.
- The pulp can also be used to prepare jams, juice and sweets.
- Tamarind pulp is sold in large quantities in the largest shops in Coastal towns.



### *Vangueria infausta ssp. rotundata*

- The ripe fruits are much relished.
- This pulp is sucked and the skin and the seed discarded.
- The pulp is added to milk or water to make a kind of porridge.
- Mature unripe fruits are kept to ripen.
- Dry fruits may be stored for a year without much loss of the sweet acid taste.
- Soaking fruits soften them further.



### *Vitex payos*



- The ripe fruit has a black pulp, which is sweet and edible.
- Covering green mature fruits in ash accelerates ripening.
- Dry stems very hard. Straight trunks used as poles.



### *Ximenia americana*

- The juicy fruit pulp is eaten raw. The thin outer skin is removed and the fruit is sucked until the seeds are clean.
- Dried root bark is used in flavouring tea.
- The seeds contain upto 60% oil that is extracted and used for healing cracking feet (Pokot, Turkana).
- Seed oil is obtained by roasting the seed in a pan and used for skin and tanning leather skirts and blankets (Pokot, Turkana).
- The oil rich seed were once piled on sticks of *Acalypha racemosa* (*mukulw'a*) and burned as candles.

### *Zizyphus mauritana*

- The fruit is a very important food in arid zones.
- In most cases only the pulp is eaten, but among the Turkana and the Pokot a large amount of the may be gathered and dried, pounded in a mortar (*kono*, Pokot) and winnowed to remove particles of crushed seeds.
- The fine flour may be mixed with figs in honey and stored in large containers (*Kosim*) to be used in times of food scarcity (Pokot).



## **2. Socio-economic survey of *Adansonia digitata* and *Tamarindus indica* in Kitui.**

By: Parnwell Simitu and Zenroku Oginosako, ICRAF-ECA programme

### **Introduction**

Indigenous fruit trees have since time immemorial been used as an alternative source of food and nutrition for many people especially in the drylands. Due to the important role that these indigenous species play, ICRAF-ECA regional programme plans to develop a program that promotes utilization and commercialization of these fruit trees for improved livelihoods in the region. This is particularly important in the drylands of ECA, which occupy between 30 and 80% of the countries' total land masses and where these species are found in significant numbers, with limited commercialized knowledge being the major constraint to their use. Information on production, use and marketing of these vital but under-utilized fruit species would significantly increase their utilization hence improved livelihoods. Through its dryland programme, ICRAF-ECA is committed to the commercial utilization of these species in the drylands and link the products to market to ensure long-term economic viability of the program. It is keen to borrow a leaf from its' West and Southern Africa Regions' counterparts where these species are used commercially.

A rational starting point to the success of this programme is the collection and synthesis of existing information on domestication, utilization and commercialization of these species within and outside of the region. This information would then used in planning, programming, monitoring and evaluation of national and regional strategies for widescale planting and utilization of these species in the drylands of the ECA region. *Adansonia digitata* and *Tamarindus indica* are among the top five most promising species after a priority setting exercise within the ECA region, which identified a number of indigenous fruit species useful in the drylands of the region (Jama *et al.* 2005). Consequently, a survey to gather information on the current level of production, use and commercialization of these two important fruit species common in the drylands of Kitui district of Kenya was conducted.

### **Purpose of survey**

The overall purpose of the survey was to identify the current situation on the utilization and commercialization of *Adansonia digitata* (baobab) and *Tamarindus indica* (Tamarind).

Specifically, the objectives were:-

- To identify the method of establishment of these species
- To identify local uses of these two species
- To discover any processing or post- harvesting method applied to these species
- To document the existing economic value of these species.
- To document any indigenous knowledge on these species
- To document any other relevant information useful for this activity

## Methodology

The survey was done from February 14<sup>th</sup> to 17<sup>th</sup> 2005, in Kitui district, Kenya. Questionnaire was used to document fundamental information concerning these two species from individual farmers visited. Household heads were valuable in giving information to the survey team on these species on their farms. Farmer's personal knowledge and experience with these species was recorded to capture indigenous knowledge on the species. Any other relevant information such as general tree farming characteristics, existence of local community groups and issues on training willingness for increased utilization of these species among others was also collected. The interviews were carried out at randomly selected households that had at least one of these species on their farm. An open-ended questionnaire was used to allow respondents to give spontaneous replies to unstructured questions. Excel and SPSS (Statistical Package for Social Sciences) packages were used for analysis of the data.

## Results and Discussions: Findings of the survey.

### Tree farming characteristics of the survey area.

#### Household data

Average family size = 8 persons

Average farm size = 7.9 acres (91% used for food crops)

Average No. of cows/farm = 2

Average No. of goats/farm = 4

#### Main trees in the farm

Species	Average No./farm
<i>Commiphora spp.</i>	65
<i>Acacia tortilis</i>	39
<i>Terminalia brownii</i>	28
<i>Senna siamea</i>	11

#### Tree species farmers plan to plant for various purposes:-

Species for timber

Species	Percentage of responses
<i>Melia volkensii</i>	42
<i>Commiphora baluensis</i>	23
<i>Eucalyptus saligna</i>	11

## Species for food or fruit

Species	Percentage of responses
<i>Mangifera indica</i>	28
<i>Citrus sinensis</i>	19
<i>Carica papaya</i>	19
<i>Citrus limon</i>	14

## Species for medicine

Species	Percentage of responses
<i>Azadirachta indica</i>	52
<i>Acacia mellifera</i>	14
<i>Commiphora baluensis</i>	10
<i>Terminalia brownii</i>	10

## Constraints of tree production

Constraint	Percentage of responses
Termite infestation	30
Drought	27
Livestock effect	18
Water shortage	12

### a) *Adansonia digitata* (Baobab)

#### Methods of establishment

The trees exist both on the farm and Wild. Trees on farm existed prior to land ownership. Some trees date back to more than 100 years. Other small trees are growing on some farms. Establishment is thus by natural regeneration and nobody ever planted a baobab tree. They, however, take care of the trees by clearing bush around the tree and protecting the small tree from destruction by domestic or wild animals. The spatial management practice of the trees is by scattering all over the farm without any specific niche. Averagely, each farm has 7 trees, but most of the trees are found in the wild (uncleared bush).



*A. digitata* standing on cropland

## Uses

The major utility of the tree is domestic. Although the tree is sometimes sold to get income, this use is not common due to the low income fetched from this business. The main uses of this tree are:-

**Food:** An edible white, powdery pulp found in the fruit makes a refreshing drink. Ripe fruits are collected and cracked to remove 'flour', which is mixed with milk to prepare a flavored fermented porridge. Having high water content, the wood is chewed by humans and animals in case of extreme water scarcity. The seeds are refreshing to suck, and when soaked in water make a palatable drink. Baobab seeds act as an important supplementary food during critical famine times.



Baobab fruits are rich in vitamin C and B2.

**Fodder:** Young leaves, fruits, pods and seeds provide fodder for domestic animals. During drought, donkeys and game animals chew both the bark and fibrous wood for sap. Livestock and game often destroy young trees.

**Apiculture:** The tree is a source of fine quality honey. Wild bees manage to perforate the soft wood and lodge their honey in the holes. In many parts of the survey area, the hollow trunks and other parts of the tree were used for beekeeping.

**Fuel:** The long-fibred wood is suitable for firewood. Shells and seeds are also used for fuel, which potters use to smoothen earthenware and necklaces before firing.

**Fibre:** The bark from the lower part of the stem of younger trees and of the roots is removed to produce valuable fibre. If managed properly, the trees are not seriously damaged, and even after repeated use, the bark regenerates and can be stripped again some years later. It is used to make excellent ropes, harness straps, mats, snares and fishing lines, fibre cloth, musical instrument strings tethers, bed-springs and bow strings.

## Processing/post harvest

The users harvest fruits, break them and use the seeds for making porridge or store them in sacks ready for sale. Ripe fruits are collected and cracked to remove the 'flour', which is mixed with milk to prepare a flavoured fermented porridge. There is no drying done since they harvest the fruit when it is ripe i.e. when it is dry. Even the seeds sold are not dried but put in the sack directly for sale from the tree.

## Economic value of the products

Most of the fruits are used within households and very few are sold. For the ones sold the price of one kilogramme of Baobab seeds costs 7 US dollar cents. There is no processing done before selling the fruit. Ripe fruits are collected and cracked to remove the seed, which is put in the sack

and sold directly to the buyers. Most buyers come from Mombasa and the farmers are not aware of what happens after the buyers buy seeds from them and transport the seeds with lorries. In each harvesting season the farmers can sell an average of 250 kilogram's of baobab seeds.

### **Indigenous Knowledge**

The local people are able to differentiate between the sweetest fruits and less sweet ones just by looking at the shape of the fruits. The long shaped fruits are sweeter than the short shaped fruits. Trees that are liked by the monkeys are the ones that normally produce sweet fruits. Such trees are normally very big and old. The tree flowering period begins on October and the fruit dries by April. The tree is very sensitive to fire and often dried up when exposed to fire or stem is burned. Superstitiously, the community have a believe that one cannot cut three mature baobab trees consecutively, and if so he does, he was bound to die!. This notion is used to make sure that the trees are conserved for use especially during critical famine times as food supplement.

### **b) *Tamarindus indica* (Tamarind)**

#### **Establishment methods**



*T.indica* standing on a compound

The species exists both on farms and in the wild. Trees on farms existed prior to land ownership. The trees on farm initially existed as wild but after clearing the land for farming, they were retained on boundaries, contours or scattered on the cropland. Some trees date back to more than 100 years, hence it's difficult for the farmers to estimate with precision their ages. Other small trees are growing on some farms and in the wild.

Farmers said they preferred not to cut the trees due to their important future use. They said they would even protect the trees from animals. Establishment is by natural regeneration and nobody ever planted a tamarind tree. However, farmers mentioned that of late, this species is being raised in tree nurseries and in the near future, they will start establishing it by planting because of its increasing popularity. Although the spatial pattern of the trees is scattering all over the farm without any specific niche, most trees are on the riverine or places where there is a high water table. Averagely each farm has 6 trees, but most of the trees are found in the wild (uncleared bush) neighbouring the farms.

#### **Uses of Tamarind**

The main uses of this tree are:-





**Food:** The ripe fruit of the sweet type is usually eaten fresh, whereas the fruits of sour types are made into juice or syrup by soaking the fruit in water. Ripe fruits are collected and soaked in water to produce a juice, which is mixed with milk to prepare a flavoured fermented porridge. The leaves are also soaked in water and boiled to produce liquid used in making flavoured porridge.

*T.indica* fruits. They are marketed worldwide in sauces, syrups and processed foods.

**Fodder:** Livestock consume the foliage as fodder especially in dry seasons when the tree is still green.

**Apiculture:** Flowers were reported to be a good source for nectar, making it ideal for honey production.

**Fuel:** Provides good firewood and it also produces an excellent charcoal. Due to the availability of many other species that can be used for charcoal burning, this tree is not commonly used for charcoal burning in this area.

**Timber:** Sapwood and heartwood are very hard, durable and strong and responds well to a fine polish. It is thus used locally for general carpentry, wheels, wooden utensils, agricultural tools, mortars, toys and furniture.

**Medicine:** Young leaves are applied to sores and wounds, or administered as a poultice for inflammation of joints to reduce swelling and relieve pain. Decoction of the leaves is used against throat infection, cough and fever. The pulp is used to treat scurvy, while powdered seeds are given to cure dysentery and diarrhea.

**Shade or shelter:** The extended crown of the tamarind offers shade giving it a popular reference as a 'rest and consultation tree' in villages. Because of its resistance to storms, it lends its use as a reliable windbreak. Since the tree is not very compatible with other plants because of its dense shade, broad spreading crown and allelopathic effects, it's also commonly used for firebreaks, as no grass will grow under the trees.

**Boundary/barrier/support:** Trees growing on the riverine or the boulder are used as living fence or boundary markers.

**Ornamental:** Due to its evergreen habit and the beautiful flowers, it's normally preserved for ornamental purposes.

## **Processing/post harvest**

The users harvest fruits, break the outer cover and soak the uncovered fruit in water ready for making porridge. There is no drying done since they harvest the fruit when it is ripe i.e. when it is dry. Even the fruits for sell are not dried but put in sacks ready for sale from the tree. It is in very rare cases, and on special request by the buyer, when fruit drying is done before packing in sacks for selling.

## **Economic value of the products.**

Most of the fruits are consumed by households and very few are sold. For the ones sold, the price of one kilogramme of tamarind fruit costs 4 US dollar cents. There is no processing done before selling the fruit. One farmer when interviewed mentioned that most of the farmers are reluctant to sell the tamarind fruits because of poor prices, citing a case where one buyer asked to harvest a whole tamarind tree for just 67 US dollar cents!. Most buyers come from Mombasa and the farmers are not aware of what happens after the buyers buy fruits from them and transport the fruits with lorries. However, some said the fruits are exported to Arab countries, where they are sold expensively after they are processed to produce different products. In each harvesting season, the farmers said they sell an average of 400 kilogram's of tamarind fruits, though this depends on how many trees the farmer owns among other factors.

## **Indigenous Knowledge**

The local people said that trees that grow along big rivers fruit through out the year, while the others in small rivers fruit periodically such as twice a year. Others said that when there is much rain, the tree has more fruits compared to when the rain is less. Superstitionally, the community believes that if one dies when harvesting honey from a particular Tamarind tree, the tree together with the beehive belong to the family of the deceased.

## **Other information collected**

### **Local community groups (LCGs)**

The survey revealed that there are various Local community groups with various activities in this survey area. The LCGs have active collective activities in place and are well established. They are thus easy to mobilize for successful implementation of the programme. The various activities that the groups are engaged in include:-

- i.) Well digging in riverbeds
- ii.) Project management such as a water piping project by AMREF
- iii.) Merry go rounds
- iv.) Carrying out HIV/AIDS sensitization campaigns
- v.) Adult Education Programmes
- vi.) Soil and water conservation issues
- vii.) Poultry keeping as a business
- viii.) Goat Keeping for business purposes and

## ix.) Beekeeping

Such groups meet on specific days of the week to work collectively as agreed and also make some decision on the meetings affecting their activities. Such groups are thus very united and active and can thus be effectively used in technology transfer.

### **Proposed program**

We sought to know farmers' opinion on the program aimed at promoting the utilization and commercialization of indigenous fruit trees, and the following were their responses; all the farmers interviewed said that they have never had any program on either of these two tree species. They said they have never known the commercial use of the species and that's why they do not use it commercially. Additionally, they did not know the direct ready market for the products of these species and this is why they did not take the commercial use of them seriously. Furthermore, middlemen who came to buy the fruits from them offered them very poor prices and later sold the same product at very high profits to other buyers.

Farmers commented that they would really appreciate the initiation of any program geared towards the commercial use of these two wild species because the trees are readily available in the area and in significant numbers. One farmer mentioned that he has a store in town full of baobab fruits and is looking for a reasonable buyer to sell the fruits. He said he sells the fruits to the buyers at a throw-away price, and any training on the processing for increased value and direct sale is highly welcome.

### **Conclusion**

There is continuing traditional importance of the two species throughout the survey area because of nutritional value and contribution to the health status of rural communities. Although there is limited trade of the tree products at present, there is extensive potential scope for commercial initiatives given the positive response from the farmers concerning willingness for training on processing these fruits.

Farmers appreciate the multiple uses of IFTS in the whole survey area. Although precise published literature on IFTS is limited, there is a wealth of indigenous knowledge on their use and management. Farmers know the positive and negative effects of IFTS. The negative effects are related to the disappearance of IFTS through other uses such as medicine, firewood, poles and charcoal. The positive effects include multiple uses and food supplements during the dry season. There is need to explore farmers' knowledge on the use of IFTS and incorporating the knowledge in research efforts to improve their availability.

IFTS have the potential to contribute to improved livelihoods in the drylands. From this survey, it is clear that there is a lot of indigenous knowledge from the farmers on identification, management practices and utilization of IFTS. However, scientific knowledge is required to compliment that of farmers especially in the areas of management, utilization, propagation and conservation so as to increase productivity and open up more avenues for income generation.

## **Recommendations**

- Farmers are willing to domesticate IFTS. There is need to enhance research efforts geared towards increased access to improved germplasm and development of appropriate management and production systems.
- Households lack skills of processing and enterprise development which has hampered development of marketable products from indigenous species. They should be encouraged and facilitated to establish indigenous fruit processing enterprises.
- Poor and undeveloped markets are a major problem facing the sustainable utilization of these species. Access to market information and development of market strategies needs to be addressed.
- There is generally limited expertise in the ecology, management, use, processing and marketing of these species. Integration of indigenous knowledge available on the species with scientific knowledge is fundamental to overcoming these constraints.

### 3. Socio-economic survey of *Tamarindus indica* in drylands of Kenya

By: Dr. Benard Muok, KEFRI regional Research Centre, Kitui.

#### Introduction

International Plant Genetic Resources Institute (IPGRI) together with Kenya Forestry Research Institute (KEFRI) organised a survey in order to establish the socio-economic status of *Tamarindus indica* in drylands of Kenya. The survey objectives were:-

- To determine the value of the products of *T. indica* to the average household
- To determine how farmers manage the species, the problems they encounter, and the species growth characteristics.
- To assess opportunities for, and farmers' interest in improving the species.
- To assess the trends in production and potential demand for the increased production of the products and
- To identify conservation threats and status

#### Methodology

A random sampling technique was used to select farmers to be interviewed in the chosen study sites, using a pre-tested semi-structured questionnaire. On each site, at least five farmers were randomly selected for the interview. Questions were asked on propagation, establishment, management, diseases, processing, marketing, uses and conservation threats. The interviews were conducted from October to December 2000.

#### Results

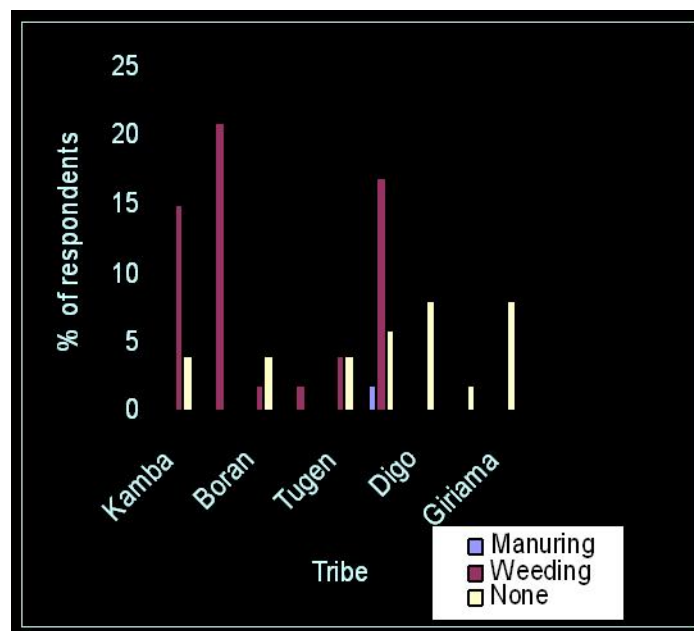
- A total of sixty farmers were interviewed from nine ethnic groups

##### Regeneration method

- Natural regeneration 63%
- Seedlings 23%, Both 2%

##### Tending and management

- Weeding 62%
- Manure application 2%
- None 36%
- Only 38% of the respondents carried out some form of management practices
- Pruning 30%, and Coppicing 8%



Graph showing tending practices for *T. indica* by various tribes of Kenya

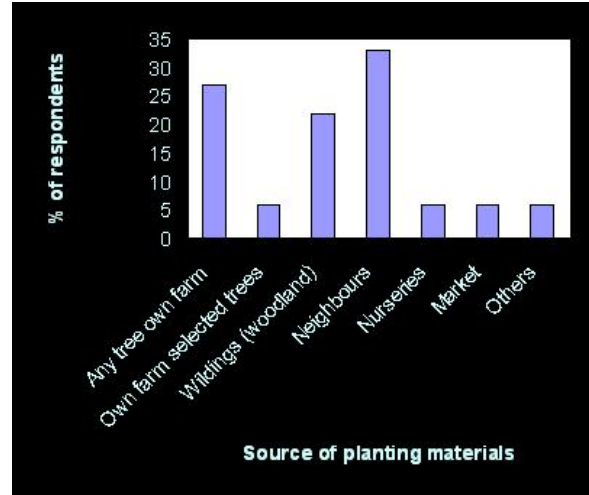
## Source and criteria for selecting of planting materials

Most of the respondents (62%) indicated that they planted trees from any material that was available.

- Farmers are aware of variation in fruit taste and trees considered superior were more protected

### Effect on companion crops

- Negative 47%, no effect 38% and positive effect 4%
- Many farmers were still retaining trees on their crops despite the negative effect on the crops. Many of the negative attributes emanated from poor management e.g. lack of pruning.



Graph showing source of planting materials

## Uses as recorded in the survey

### Food

- Crude extract of the fruit is used as a flavour in porridge.
- The fruit extract is also used for food seasoning.
- Ice, drink and juice are prepared from the fruit extract.
- Young leaves are chewed as a stimulant



T. indica standing on cropland

### Medicinal

- About 55% of all the respondents indicated that they use the species for medicine for a variety of ailments such as de-worming, stomachache, measles, inducing diarrhea, elephantiasis of the scrotum, cough and a variety of venereal diseases (gonorrhea and syphilis).

### Timber

### Woodfuel

- About 94% of the respondents reported that they use the species for woodfuel.
- The Tugen indicated that it is a taboo to use *T. indica* for woodfuel.

### Fodder

- About 66% use the species for dry season fodder.

### Socio-economic issues



Tamarind fruits at market

#### Processing and marketing

Three uses of crude fruit extracts were recorded:

- Flavouring porridge (98%)
- Making drink (26%)
- Seasoning food such as stew, tea and rice (19%)



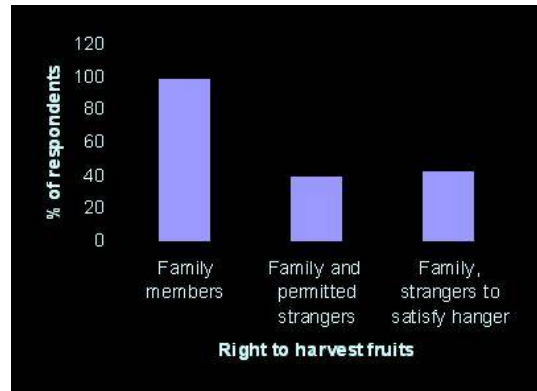
Farmers make a drink using tamarind fruits

### Gender roles

- Mainly women and children agenda

### Tree tenure

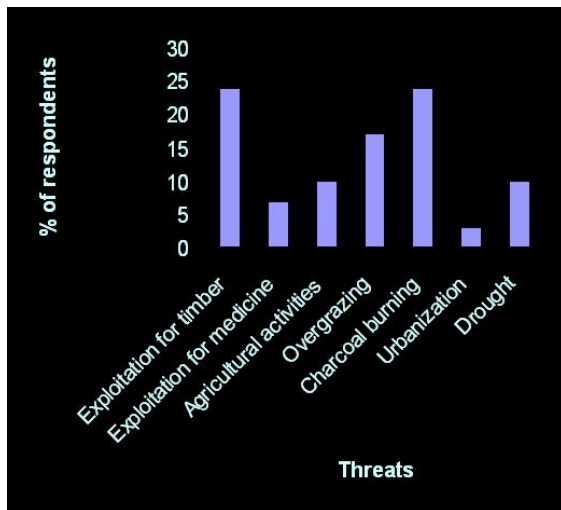
- Family right and special cases community right



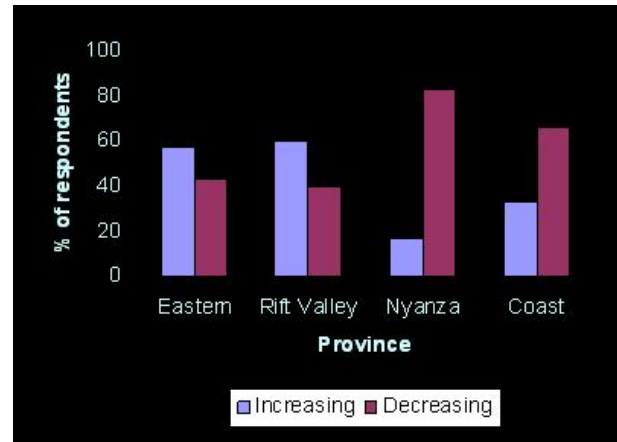
Graph showing the role of tree tenure in use of tamarind tree

## Conservation

### Conservation threats



Graph showing conservation threats of tamarind

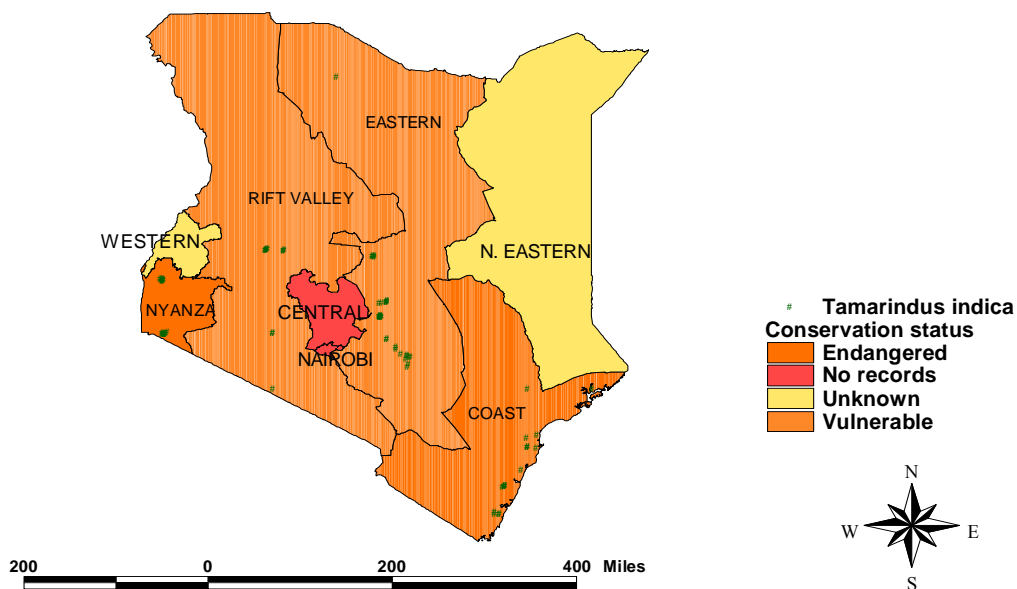


Graph showing population trends by province

Most of the tamarind trees are exploited for timber, charcoal burning and overgrazing. There is need to change this trend so that the tree is fully utilized sustainably.

### Conservation status

#### Conservation status of *Tamarindus indica*



Map showing conservation status of *Tamarindus indica* in Kenya.



Tamarind in most parts of the Kenya is endangered. Urgent measures need to be taken to conserve this valuable tree.

### **Constraints**

- Lack of awareness by farmers on the need to plant and manage indigenous fruit trees;
- Seedlings of indigenous fruit trees are often not available in local tree nurseries;
- Lack of knowledge on propagation
- Slow growth rate and low quality of indigenous fruit species compared to exotic fruits;
- Poor marketing outlets and low pricing of products; and
- Negative attitude towards the use of wild fruits, especially among the adult male population who consider wild fruits as suitable for only children and women.

### **Recommendations**

- **M**en should be involved in processing and trade *T. indica* to enhance conservation
- Conservation strategies should be developed to address the declining natural population.
- There is need to liaise with the industrial sector to develop appropriate processing techniques and market infrastructure.
- Future country- wide studies to quantify the resource base need to be undertaken.

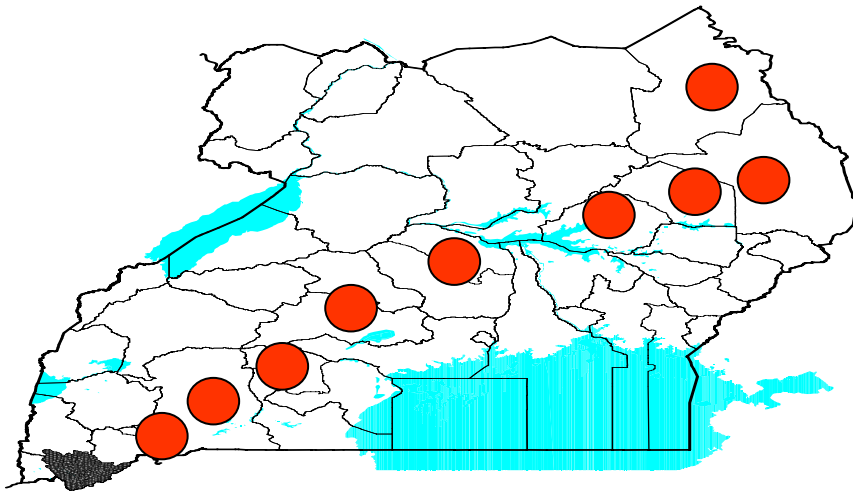
## **4. Utilization and domestication potential of IFTS in the drylands of Uganda. A case study of Lira district, Northern Uganda**

By: Dr. John Bosco Lamoris Okullo, Faculty of Forestry and Nature Conservation, Makerere University, Uganda.

### **Background**

- Indigenous fruit trees have for a long time been crucial in the diet of the local communities in Lango region.
- Few decades ago, changes in the eating habits of the local people resulted in shift from eating fruits.
- Today, however, they are widely being eaten as famine foods especially when crops are not ready for harvesting.
- In this study, it was strongly felt that indigenous fruit trees should be domesticated and farmers encouraged domesticating them.

### **Drylands of Uganda (cattle corridor)**



### **Problem Statement**

- Little research has been undertaken on indigenous fruit trees in Uganda
- There is lack of information on indigenous fruit trees for on-farm cultivation
- Challenge to the countries' programs e.g. PEAP (Poverty eradication programme), PMA (Plan for modernation of agriculture) and NAADS (National agricultural advisory services) in trying to help rural farmers to improve their incomes and eradicate poverty.

## Objectives

The broad objective was to assess the utilization and potential of domesticating indigenous fruit trees in the drylands of Northern Uganda.

Specific objectives were to:

- Determine fruit tree species diversity in the farming systems.
- Generate a species priority list, characterize and document values of indigenous fruit trees as perceived by farmers.
- Develop a criteria for selecting indigenous fruit trees for on-farm cultivation.
- Assess the opportunities and constraints to promotion of indigenous fruit tree cultivation
- Assess farmer's attitudes towards indigenous fruit tree cultivation.

## Research questions

- Which indigenous fruit trees are valued by farmers and why?
- Which indigenous fruits are sold in the local market?
- What are the features of fruit trees that can aid their selection for on-farm cultivation?
- What are the attitudes of farmers towards cultivation of indigenous fruit trees?
- Which are the sources of planting materials and mode of regeneration of indigenous fruit trees?
- What are the local methods of propagating or managing indigenous fruit trees?
- What other tree species are grown together with fruit trees?
- Which agricultural crops would grow alongside fruit trees?
- What opportunities and constraints exist for promoting on-farm cultivation of indigenous fruits trees under PEAP (PMA, NAADS) and NFP?

## Methods

- Reconnaissance survey- Purpose was to develop a fieldwork procedure and to test the validity and reliability of data collection instruments.
- Literature review and synthesis
- Semi-structured questionnaire and interviews using participatory Rural Appraisal (PRA) method (Jackson and Ingles, 1998) were used.
  - opportunities and constraints
  - farmers' attitudes towards indigenous fruit tree
  - socio-economic variables
  - 120 households were interviewed

- On-farm walks- In Omito Parish., 30 farms were randomly sampled and surveyed.
- Preference matrix ranking- was used to generate a species priority list of indigenous fruit trees preferred by the local people.
  - Each respondent was asked to indicate 15 species in order of preference.
  - highest priority species was assigned 15 points
  - the lowest ranked species assigned 1 point
  - The points for each species were summed across all respondents

### Data analysis

- SPSS and MINITAB statistical package- were used to analyze the questionnaire responses.
- Logistic regression analysis was used to show the influence of socio-economic characteristics on local people's willingness to plant indigenous fruit trees.
- Shannon-Wiener's diversity index (H')- was used to analyze on-farm diversity of indigenous fruit tree species.
- The values of the index usually lie between 1.5 and 3.5

### Results

#### Indigenous fruit trees grown/retained on farms land

Fruit	% response
<i>Vitellaria paradoxa</i> (Yao)	92
<i>Tamarindus indica</i> (Chwao)	62
<i>Bridelia scleroneura</i> (Orweco)	55
<i>Anona senegalensis</i> (Obwolo)	51
<i>Vitex doniana</i> (Owelo)	51
<i>Ximenia americana</i> (Olimu)	51
<i>Carisa edulis</i> (Achuga)	42
<i>Vanueria apiculata</i> (Amalera)	34
<i>Diospyros mespiliformis</i> (Chumu)	32
<i>Strychnos spinosa</i> (Akwalakwala)	32
<i>Ficus sur</i> (Ebuu/Oduru)	26
<i>Ficus sycomorus</i> (Olam)	25
<i>Lantana camara</i> (Cholawinyo)	23
<i>Borassus aethiopicum</i> (Tugu)	18
<i>Phoenix reclinata</i> (Otit)	04



*Vitellaria paradoxa*

## Diversity of indigenous fruit trees on farms

Species	No. spp	Pi	ln Pi	Pi lnPi
<i>Shea butter</i>	176	0.305	-1.187	0.362
<i>Anona senega</i>	101	0.175	-1.743	-0.305
<i>Vitex doniana</i>	82	0.142	-1.951	-0.277
<i>Grewia mollis</i>	40	0.069	-2.669	-0.185
<i>Tamarindus indica</i>	35	0.061	-2.802	-0.170
<i>Carisa edulis</i>	33	0.057	-2.861	-0.164
<i>Borassus aethiopium</i>	27	0.040	-3.062	-0.143
<i>Bridelia scler</i>	22	0.038	-3.267	-0.125
<i>Ximenia americana</i>	17	0.029	-3.525	-0.104
<i>Vanueria apiculata</i>	11	0.019	-3.960	-0.075
<i>Ficus sycomorus</i>	9	0.016	-4.161	-0.065
<i>Strychnos spinosa</i>	6	0.010	-4.566	-0.047
<i>Diospyros mesp</i>	11	0.019	-3.960	-0.075
<i>Ficus natalensis</i>	3	0.005	-5.259	-0.027
<i>Ficus sur (Ebuu)</i>	3	0.005	-5.259	-0.027
<i>Lantana camara</i>	1	0.002	-6.358	-0.011

**Total**                    **577**        **H' = - Σ Pi ln Pi = 2.164**



*Borass aethiopium*; Fruits are used in production of cooking oil.

## Proportion of farmland under indigenous fruit tree cover

- Average proportion of farmland under fruit tree cover was low (23.3% ± 5).
- Only six farms had fruit tree cover >or = 40% of the total farmland area.
- A lot has, therefore, to be done if farmers are to meaningfully integrate indigenous fruit trees in their farming systems.



*Annona senegalensis*

**Regeneration of indigenous fruit trees and people’s perception on their cultivation**

Indigenous fruit trees in cropland were either planted or preserved when new plots were being cleared. Some regenerated naturally from wildlings or coppicing like *Vanueria apiculata*.

Variable	%
<b>Regeneration of fruit trees</b>	
Planted	15
Growing naturally	85
<b>Should wild fruits be cultivated?</b>	
Yes	89
No	11



*Vitex doniana*

**Criteria for identifying suitable wild fruit trees for on-farm cultivation**

Farmers who either retained or planted indigenous fruit trees in their land different criteria to choose or retain indigenous fruit trees

Criteria	%
Food value(domestic consumption)	66
Cash value	58
Medicinal value	28
Growth habit (not shading crops)	27
Ease of management	6
Drought resistance	4
Early fruiting	2



Tamarind fruits. They are marketed worldwide in sauces, syrups, processed foods and are rich in vitamin B.

**Demographic and socio-economic variables that influences farmers’ willingness to plant indigenous fruit trees**

The logistic regression analysis: gender, education, farm size & occupation/income influences positively farmers’ willingness to plant indigenous fruit trees

Variable	Coefficient	S.E ±	P-value (5%)	R	Odd ratio
Education	1.21	0.37	0.03	0.11	0.14
Farm size	1.17	0.44	0.04	0.16	0.19
Occupation	1.11	0.39	0.01	0.13	0.17
Gender (sex)	0.83	0.25	0.01	0.18	0.16
Income	0.54	0.18	0.09	0.07	0.09
Land ownership	-0.88	0.40	0.82	-0.02	0.01
Marital status	-0.67	0.15	0.55	-0.04	-0.11
Age	-0.73	0.19	0.64	-0.05	-0.13
Family size	-0.97	0.16	0.40	-0.08	-0.01

### Indigenous fruit trees preferred by the local people

A range of trees were identified as sources of edible fruits. Highest ranked species was Shear butter trees followed by *Vitex doniana* and *Anona senegalensis*

Fruit	Weight	Rank
<i>Vitellaria paradoxa</i> (Yao)	754	1
<i>Vitex doniana</i> (Owelo)	517	2
<i>Anona senegalensis</i> (Obwolo)	463	3
<i>Tamarindus indica</i> (Chwao)	418	4
<i>Bridelia scleroneura</i> (Orweco)	361	5
<i>Vanqueria apiculata</i> (Amalera)	288	6
<i>Ximenia americana</i> (Olimu)	275	7
<i>Carisa edulis</i> (Achuga)	239	8
<i>Diospyros mespiliformis</i> (Chumu)	214	9
<i>Borassus aethiopum</i> (Tugu)	201	10
<i>Ficus sur</i> (Ebuu/Oduru)	178	11
<i>Strychnos spinosa</i> (Akwalakwala)	155	12
<i>Ficus sycomorus</i> (Olam)	113	13
<i>Lantana camara</i> (Cholawinyo)	86	14
<i>Phoenix reclinata</i> (Otit)	52	15



*vitellaria paradoxa*; ranked highest

### Tree species grown together with indigenous fruit trees

Many tree species including exotic fruit trees were grown or retained together with indigenous fruit trees on farm by local people

Species	% response
<i>Mangifera indica</i> (Aeme)	80
<i>Carica papaya</i> (Apapalo)	68
Combretum spp.(Odugu)	66
<i>Citrus sinensis</i> (Acungwa)	66

<i>Eucalyptus</i> spp.	61
<i>Acacia</i> spp. (Okutu)	59
<i>Albizia coriaria</i> (Itek)	43
<i>Citrus limon</i> (Alemon awach)	41
<i>Citrus reticulata</i> (Magada)	46
<i>Grewia mollis</i> (Opobu)	40
<i>Markhamia lutea</i> (Nsambya)	56
<i>Moringa oleifera</i>	27
<i>Piliostigma thonningii</i> (Ogali)	40
<i>Psidium guajava</i> (Amapera)	45



*Psidium guajava*

### **Propagation and management of indigenous fruit trees**

Local people practice very little or no management and propagation of indigenous fruit trees.

21% carried some form of management.

- Pruning, Weeding
- Fire control, Termite control
- Pollarding
- protection of young fruit trees

25% practiced some form of propagation

- Transplanting
- Direct seeding/sowing on the farm
- Sowing on the nursery, Cuttings



Fencing protects young fruit trees

Majority of farmers still regard indigenous fruit trees as wild and planted by God



## Market potential of indigenous (wild) fruits

Prices of these fruits are lower than that of other fruits in local markets.

Many people have free access to wild fruits and do not perceived them as having a market value

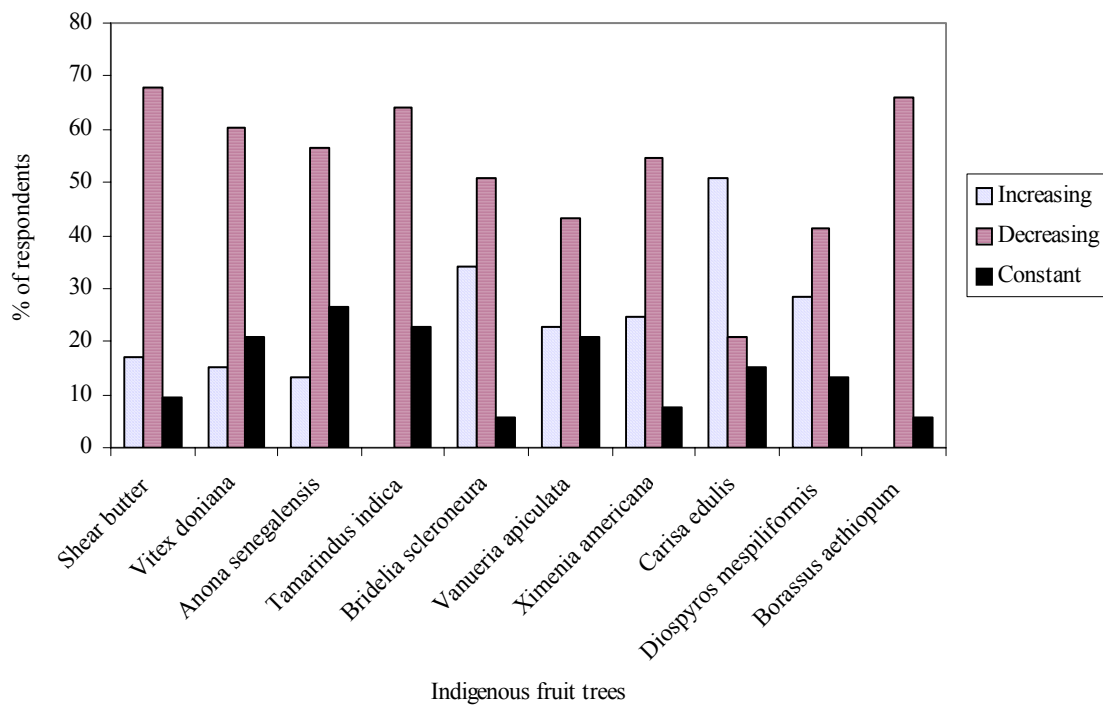
Products	Quantity	Price (Shs)
Shea butter	1basin	4000-8000
<i>Tamarindus indica</i>	1heap	200 - 400
<i>Mangifera indica</i>	1dish	500-1000
<i>Psidium guajava</i>	1dish	800-1500
<i>Carica papaya</i>	1fruit	200 - 500
<i>Citrus limon</i>	1dish	300 - 500
<i>Citrus reticulata</i>	1dish	1000-1500
<i>Citrus sinensis</i>	1dish	500-1000
Sweet banana	1bunch	300 - 500
<i>Persea americana</i>	1fruit	100 - 300
Apple	1fruit	500 - 600



Farmers sell shea butter fruits

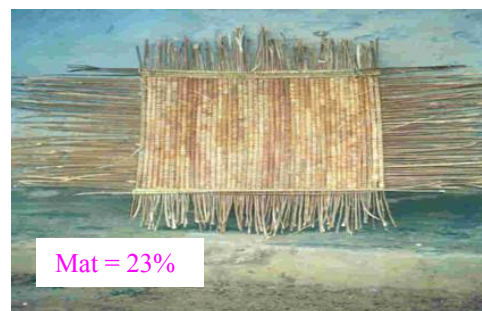
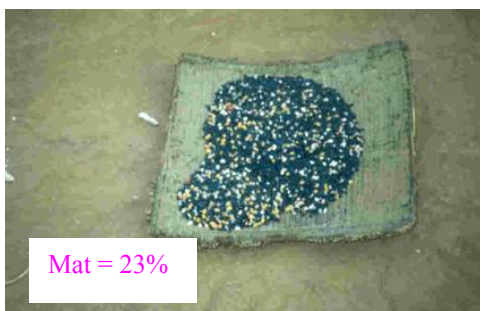
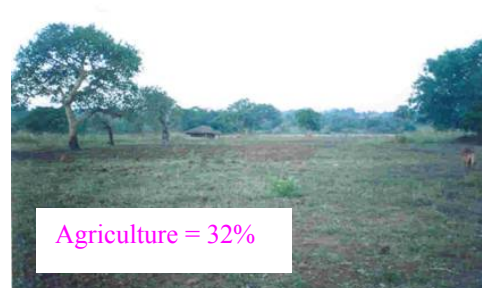
## Conservation status of indigenous fruit trees

Population of the 10 most preferred fruit trees is declining



Graph showing population trends of the ten most preferred fruit trees

## Conservation threats to indigenous (wild) fruit trees



## Constraints to planting/managing wild fruit trees on farmland

- Lack of awareness by farmers on the need to plant and manage indigenous fruit tree species (68%).
- Unclear information about food values of the wild fruits (63%).
- Lack of seedlings of indigenous fruit tree species in local nurseries (62%).
- Lack of clear markets for indigenous fruits (60%).
- Slow growth and low prices of indigenous fruits (50%).
- Fruit trees attracting birds which destroy crops (50%).

## Others

- Poor propagation knowledge.
- Competition for light, water and nutrients of trees with crops.
- Lack of awareness of planting seasons.
- Lack of money to buy improved planting materials.

## Mitigation measures to the problems as suggested by farmers

- Farmers suggested provision of better planting materials.
- Sourcing information on planting seasons.
- Information on the food values of wild fruits.
- Improving security for both people and seedlings.
- Developing markets of indigenous fruits and
- Establishing demonstration tree nurseries

## Opportunities for domesticating/ planting indigenous fruit trees

- Land availability (70%).
- Interest in and willingness to plant indigenous fruit trees (58%).
- Time availability (49%).
- Increasing support by the NAADS/Extension agents under Plan for Modernization of Agriculture- PMA (38%).
- Willingness of the local people to be trained on indigenous fruit tree propagation techniques for improved fruit yield (17%).

## Conclusion

Species diversity of indigenous fruit trees on-farm was relatively high with *Vitellaria paradoxa* (Shea butter) being the most abundant. However, the average proportion of farmland under indigenous fruit trees was low. Shea butter trees (*Vitellaria paradoxa*), *Vitex doniana*, *Anona senegalensis* and *Tamarindus indica* were the most preferred indigenous fruits by the local people. Domestication and commercialization of these species can easily be enhanced. All the same, the population of preferred indigenous fruit trees is generally declining and there is need for their *in-situ* and *ex-situ* conservation.

The preferred uses of indigenous fruits are food, medicinal and cash values respectively. The market prices of these species are however low as compared to exotic fruits. Many farmers have positive attitudes towards on-farm cultivation of indigenous fruit trees. Even so, gender, education level, farm size and occupation/income status influence their willingness to plant fruit trees. The major hindrances to cultivation of indigenous fruit trees are lack of awareness on the need to plant and manage indigenous fruit trees, unclear information about food values of the wild fruits and lack of clear markets.

## **5. Utilization and commercialization of indigenous fruit trees in Tanzania**

By: Mr. Remen Swai (ICRAF Tanzania) and Mrs Bernadeta P. Kimata, ( Tumbi Agricultural Research Institute, Tanzania).

### **Introduction**

Tanzania covers an area of 942,784 km<sup>2</sup> , with dry landmass comprising 881,289 km<sup>2</sup>. Forests and woodlands cover 45% of this area. The total population is 34 million people. The major problems facing the people of Tanzania are, food shortage, widespread poverty, HIV and AIDS, malnutrition and degradation of renewable resources.

Miombo woodlands is one of the important resource in the western and southern parts of Tanzania mainly because of its rich biodiversity resources, safe nets and a source of daily food and income. It contains more than 83 IFT species and provide food (fruits and nuts), medicine, timber, fodder and food security to many people of Tanzania. IFTS are an important source of food and nutrition in Tanzania, probably more than in any other country of eastern and central Africa.

### **Utilization of IFTS by communities**

The communities recognize and consume IFTS just like any other fruits. IFTS are gathered from the wild and eaten directly or sold to earn income. Children and women are major users of these fruits, which are available mostly in the dry seasons. The fruits are occasionally processed in the following:-

- Dried and pounded to flour,
- Fermented to beer and wine,
- Extraction of oil from seeds and nuts,
- Seeds and nuts roasted and used as dessert,
- Pulp prepared into juice.

There are however some limitations on the wide use of IFTS.

### **Limitations to wide use of IFTS**

The following are the limitations to the wide use of IFTS in Tanzania

- Low awareness of value of IFTS
- Poor processing technologies
- Poor processing and storage facilities
- Lack of markets for IFTS products
- Lack of capital
- Cultural beliefs

Some research and development work has been done to promote the wide use of these species.

## **IFTS research and development**

Some species have been successfully domesticated. IFTS priority setting has already been done also with the following species as the priority species;- *Parinari curatellifolia*, *Vitex mombassae*, *Strychnos cocculoides*, *Vitex doniana*, *Uapaca kirkiana*, *Flacourtia indica*, *Barchemia discolor*, *Adansonia digitata*, *Tamarindus indica* and *Sclerocarya birrea*. Germplasm collection and evaluation yielded the following provinces;- *U.kirkiana* (5 provenances), *S.cocculoides* (6 provenances), *S.birrea* (10 provenances), *P.curatellifolia* (3 provenances) and *V.mombassae* (1 provenance). Propagation of the species is also done on the following;-

- Seed germination: seed pre-treatment
- Vegetative propagation: cuttings, grafting, air layering, and top working
- Substrates: potting mixtures

This achievement is a necessary, but not sufficient condition towards successful utilization and commercialization of IFTS in this country.

## **Processing and commercialization**

The following has been achieved as far as processing and commercialization of IFTS in Tanzania is concerned.

- Recipes have been developed and tested for juices, jams, wines, pickles chutney and beer
- Product/species priority setting has been established
- Nutritive contents of IFTS have been established
- Training has been carried on processing, marketing and small scale enterprises established
- Women groups and associations have been formed and facilitated with credits, training and facilities to establish processing and selling centers. Market outlets have also been linked with medium and large processors.

Following this achievement, a number of challenges arose for which technical solutions have also been largely developed.

## **Challenges**

The following are the challenges encountered on the process of utilizing and commercializing these species:-

- Low product quality
- Poor product presentation, packaging and labelling
- Production volume is small
- Stiff competition with exotic fruit products
- Limited supply of raw materials
- Limited market

## **Way forward**

The following are the recommended ways to counteract these challenges:-

- Promotion of on-farm production of IFTS
- Capacity building at all levels on; processing, marketing, and entrepreneurship skills
- Standardization of product quality
- Product promotion
- Market studies
- Promotion of cottage industries

## 6. Processing and value adding of IFTS products of drylands of ECA.

By: Mr. Remen Swai (ICRAF Tanzania) and Mrs Bernadeta P. Kimata, (Tumbi Agricultural Research Institute, Tanzania)

### Contributions of IFTS to rural livelihood

IFTS contribute a lot to improvement of rural livelihoods in the following ways;

#### A) Food security

- The fruits are available in dry seasons, drought and famine periods when they are highly needed because of food scarcity
- They have good storability and they can live longer before expiring
- They also provide fodder for livestock which in turn produce milk and meat, to supplement the fruits.



Photos: Left, a woman selling fruits and right, buyers of the fruits. IFTS is a source of food and income to rural people.



#### B) Nutritional security

- They have high contents of minerals, vitamins, protein and carbohydrates

#### C) Health security

- Besides food, they are also sources of medicine

#### D) Income security

- They are sources of income to the majority rural dwellers
- They also produce employment opportunities to rural communities e.g. in the processing enterprises.

#### E) Service

- They do also provide other services to the community such as shelter, windbreak, ornamental, boundary or support

## Limitation of utilization of IFTS

- Lack of awareness of value of IFTS knowledge
- Lack of technology for processing and handling
- Cultural barriers
- Lack of market outlets
- Lack of processing and storage facilities
- Inadequate supply from the wild



Collected fruits. Inadequate supply from the wild is a limitation to their wide scale use.

## Opportunities

- Willingness of small scale IFTS processors
- Consumers attach greater utility value to IFTS
- Willingness of farmers to grow IFTS



Small scale processors: Their willingness to adopt new processing technologies is an opportunity.

## Challenges

- Adequate and sustainable supply of fruits
- Availability of improved germplasm
- Management of IFTS on farms
- High quality and competitive products
- Capacity building (training)



Photos: ICRAF Director General (left) and ICRAF-ECA coordinator (right) admire IFTS products of women group in Tanzania. Production of high quality and competitive products is a challenge.





## Processing IFTS to high value products

### Juice making

#### Procedure

- Sorting
- ▼
- Wash or shell
- ▼
- Pulp extraction
- ▼
- Extract lemon juice and rind
- ▼
- Prepare sugar solution
- ▼
- Mix
- Heat
- ▼
- Fill
- ▼
- Seal
- ▼
- Heat
- ▼
- Cool

#### Particulars

- Remove dirt and plant debris
- Fruits washed in clean water cut. Cut and remove hard skin
- Soak in hot water and sieve
- Cut in half and pressed & gratify skin
- Dissolve sugar in warm water, add rind and strain.
- Mix juice with sugar syrup and lemon juice.
- Pasteurize below boiling point for 5 -10 min.
- Fill the juice in sterilized bottles
- Seal bottles
- Pasteurize in boiling water for 5 min.
- To room temperature

## Jam making

### Procedure

- Sorting
- ▼
- Wash or shell
- ▼
- Pulp extraction
- ▼
- Extract lemon juice and rind
- ▼
- Prepare sugar solution
- ▼
- Mix
- 
- Heat
- ▼
- Set
- ▼
- Fill
- ▼
- Cool
- ▼
- Label

### Particulars

- Remove dirt and infected fruits
  
- Fruits washed in clean water
  
- Cut and remove hard skin
  
- Soak in hot water and sieve
- Cut in half and squeeze
  
- Dissolve sugar in hot water and strain.
  
- Mix all ingredients
  
- Boil the mixture, stir until thick
  
- Drop jam on a plate with cold water or use refractometer (69%) brix
  
- Fill the jam in sterilized bottles and seal
  
- To room temperature

## Wine making

### Procedure

- Sorting
- ▼
- Wash or shell
- ▼
- Pulp extraction
- ▼
- Extract orange/lemon juice
- ▼
- Prepare yeast
- ▼
- Melt sugar or make tea
- ▼
- Ferment
- ▼
- Stir
- ▼
- Filter
- ▼
- Ferment
- ▼

### Store

- ▼
- Bottle and label

### Particulars

- Remove dirt and infected fruits
- ▼
- Fruits washed in clean water
- ▼
- Cut and remove hard skin
- Soak in hot water and sieve
- ▼
- Cut in half and squeeze
- ▼
- Mix yeast, sugar, lemon juice & water
- ▼
- Heat sugar until it changes to brown and mix with juice or add tea.
- ▼
- Transfer the mixture to fermentation vessel and store
- ▼
- Stir once everyday for 8 days
- ▼
- Filter the mixture
- ▼
- Transfer to ferment. vessel which allows CO<sub>2</sub> escape while prev. O<sub>2</sub> from entering the vessel.
- ▼
- Store it for 10 – 14 days and decant.
- ▼
- Fill in pre-sterilized bottles and cork.

## **SESSION 2: SEED TECHNOLOGY AND PROPAGATION**

Chair: James Kimondo and Dr. Zenroku Oginosako

### **1. Seed collection and handling (Lecture and Practical).**

By: Dr. Benard Muok, Kenya Forestry Research Institute (KEFRI), Kitui Centre.

#### **Preparation for Seed Collection**

The maturation, quantity and quality of each developing seed crop should be monitored through regular observation at potential collection sites to indicate when collection of seed is likely to be worthwhile and to provide information on the quantity and quality of a season's seed crop. The observations should be widespread to identify the best sites for collection. Ten fruits per crown in at least 10 trees may be picked to test for maturity. Fruits are cut open for inspection.

Signs of maturity depend on the types of fruits. Normally, fleshy fruits turn from greenish to yellow, orange, red, brown or black and the pulp softens. Pods, capsules, and cones turn brown or black. Normally the inside of the seed (endosperm and cotyledons) becomes firmer.

#### **Before collection**

1. Decide on the purpose for which germplasm is required.
2. Find out if suitable and well-documented germplasm is already available from other sources. Inform others of your plans, to avoid duplication of efforts in collecting from the same area.
3. Develop a collection strategy- determine the where, when and how of collection.
  - Where - find out the geographical and ecological areas where a species grows and from what areas it can be collected (literature, herbaria, field exploration).
  - When - decide on the best time for collection. This may require a prior visit to a site to identify the period when seed is mature. Herbarium specimens often give dates of fruiting or collection.
  - Trees may seed only in certain years and the timing of seed production may also vary between years and regions. For species with a prolonged fruiting season, more than one sampling time might be needed to avoid collecting only the early fruiting trees.
  - How - estimate the quantity of seed required from the collection, to help determine the appropriate sampling strategy. In addition, decide if seed from individual trees should be kept separate during collection or bulked to form a single population sample. For research trials, individual tree collections are sometimes needed, while in other cases a bulk

collection from a population suffices. If material is being collected for immediate distribution to farmers or other users, a bulked collection strategy may make handling easier.

4. Find out the requirements for handling seed of a species being collected, including necessary seed treatments to ensure maximum seed viability. If seed is orthodox and kept under the appropriate storage conditions after collection, it may remain viable for many years before being planted. If seed is recalcitrant, however, it is necessary to prepare for immediate planting after collection.
5. Ensure that all necessary equipment for collection is available. Collection from trees may require specialist tools, such as pruning saws and tree-climbing equipment. Use open-weave collection bags rather than plastic ones, to allow aeration.
6. Ensure that the necessary permission for collection is obtained. If collections are to be from communal or private land, it is necessary to obtain the permission of the head of the community or the land-owner. For large-scale collections, permission must also be sought from the relevant government bodies. If collections cross national boundaries, permission for the export of germplasm between countries may be required.

### **Methods of Collection**

Large fruits or seeds which are shed when mature can easily be picked from the ground (e.g. those of *Vitex doniana*, *Sclerocarya birrea*, etc). Some of the species produce fruits that have to be picked from the tree crowns e.g. *Adanasonia digitata*. The crown of short trees can be reached from the ground using a long rod with a hook at the end so that branches can be bent and shaken. Another technique is throwing a rope with a weight at the end over a branch and then shaking the branch by pulling the ends of the rope.

Tall trees must be climbed for harvesting. This requires equipment, like ladders fastened to the bole of the tree. Safe climbing is important and it is essential that the climber remains secured by a rope attached to the tree while working in the crown. The Kenya Forestry Seed Centre provides instruction on climbing techniques.

If branches are to be shaken and fruits collected from the ground, it is advisable to spread sheets or nets on the ground. Large branches or whole trees must never be cut just to harvest seeds. This will ensure future seed supplies. Cutting of branchlets should be done with care since the flower buds for the next fruit generation are often cut off at the same time.

Fruits should never be put into polythene bags or plastic containers since this leads to overheating and hence loss of viability. Hessian sacks provide enough aeration for the initial drying of the fruits or seeds. An important data about a seed collection should be recorded. These include species name, date of collection and locality. Recording details on the environment of the collection site helps to match the species or provenance with proposed planting sites.

## **During collection**

To develop a sampling strategy-to ensure representative sampling of a population, the following guidelines should be adopted:

- Number of trees sampled and their selection - collect seed from at least 30 trees. If possible, collect from many individuals. Normally only those trees producing reasonable quantities of seed are chosen.
- Collection from crown - for each tree, sample different points in the crown, especially if the species is insect pollinated. This is because individual pollinators carrying pollen from different potential fathers may visit only part of a tree crown. So seeds from different points in the crown may be different genetically. If it is not possible to sample directly from the tree canopy, seed or fruit that has fallen naturally and is lying underneath trees may be collected.
- Spacing - ensure a reasonable spacing between sampled trees to reduce the likelihood of collecting closely related individuals. Ideally, individual trees should be spaced by a distance greater than that associated with normal seed dispersal – usually at least 50 m apart.
- Bulking of seed – If seed from individual trees is bulked during collection, each tree should contribute roughly the same amount of seed. Bulking can always be done later so it may be worth keeping seed from individual trees separate.
- A pragmatic approach - although the above represent ideal sampling criteria for a population, be pragmatic and realistic when in the field.

Ensure that, wherever possible, physiologically mature seed is collected. Otherwise, the viability of seed may be very low.

Do not collect so excessively from a population that its survival through natural regeneration is threatened.

For tree species with associated microsymbionts, take soil or root samples-or both - during seed collection. This is particularly important for nitrogen-fixing legumes with root nodules containing Rhizobium or Bradyrhizobium.

Document the work - ensure that accurate and adequate records are kept during collection. A collection form designed prior to collection is useful. Documentation is essential, for example, in relocating populations that trials show to have useful characteristics and for identifying gaps in conservation collections. As a minimum, the following should be recorded for a population:

- Species name
- Collection date
- Individuals carrying out the collection

- Population location; including name of location and directions to reach the site (where possible, accurate latitude and longitude measurements should be recorded from maps or by using a Global Positioning System receiver).
- number of trees collected from at each site
- the approximate average distance between trees
- a unique identifier for each collected sample (normally a number, which should be used to label seed during and after collection).

Other data that should be recorded for research and conservation collections include:

- Altitude, soil type and depth of water table for dry areas (the latter can be determined from a well near the collection site).
- Morphological characteristics of trees in the population.
- Density of trees in the collected stand.
- Status of the population (natural, naturalized)
- Abundance of the species in the area
- Type of vegetation (primary or secondary).
- Associated species.
- Human disturbance (if any)
- Local guides.
- Local names of the species.
- Maturity of collected seeds.
- Presence of any pests or diseases.

## **Extraction and drying**

### **Extraction**

The commonest methods of extraction are depulping, air drying and threshing. Depulping involves soaking fruits in water for up to 2 days to soften the pulp so that it can be separated from the seeds by squeezing or washing through a sieve. Fruits with sticky pulp are dried and then pounded in a mortar. All pulpy fruits require urgent treatment since biochemical changes in the pulp quickly reduce seed viability, unless the pulp is removed.

Air-drying is done with cones or capsules. These are first dried until the scales or valves open and the seeds become detached from their placenta. Seeds in pods, like those of *Acacia* spp or *Albizia* spp, are dried in the sun until the pods release the seeds or are ready to be threshed in a bag.

Extraction of seeds that need to be cut off the pod and sticky parts, such as in *Prosopis* spp, is extremely tedious and time consuming. It is quicker to use a meat mincer. The pods are first sun-dried, then broken into small pieces and soaked in water for a day, and finally minced. The seed-pod mixture is then sun-dried and the seeds are separated by slight pounding or rubbing.

In small-scale nurseries, biological methods, such as the use of termites or small ruminants, can be adopted. For example, pods of *Prosopis* spp are covered with grass and kept moist for a few

days. Termites then eat the pods leaving behind the seeds. Seeds of species like *Balanites aegyptiaca* and *Melia volkensii* germinate in “boma” dung after passing through the digestive system of livestock.

### Seed Drying and Cleaning

The moisture content of seed following collection varies considerably with species. Wet fleshy fruits, like those of *Dobera glabra* or *Salvadora persica*, have high moisture content, even after removal of the pulp. Drying of seed may be done in two or three stages. As a general rule, seed of various species may be dried as follows:

- Thick-coated seeds, like those of legumes, are dried in the sun for 2 - 7 days.
- Seeds with thinner coats or small seeds (e.g. *Eucalyptus* spp) can be dried in shorter periods.
- Exposure to excessively high temperatures must be avoided, particularly for small or thin-coated seeds.
- Fresh seeds with high moisture content should be pre-dried in the shade before exposing them to the sun.

When drying in the sun, seed should be stirred and turned frequently to promote aeration and the fruit or seed should be protected from rain, birds, rodents and insects. Recalcitrant seeds, like those of *Dobera glabra* and *Boscia* spp, lose viability on drying and should be sown immediately after collection. After the seed has been dried, it should be cleaned to remove most or all material other than viable seeds. It is advisable to separate insect-attacked seeds from clean seeds by floating on water or handpicking before storage.

### Seed storage

Maintenance of viability during storage depends on relative humidity and storage temperature, the physiological state and moisture content of the seed and on the type of species. The stored seed must be fully ripened, properly dried (except for recalcitrant species), and free from mechanical damage, insects and fungi.

Storage should be in airtight containers, like glass, plastic bottles with screw lids, plastic drums or sealed thick Polythene bags.



Participants are trained practically on seed collection and handling at the workshop.





Seed should be stored in the coolest available place, preferably in a cold store or a refrigerator (at 4°C). Slight dusting with low-toxicity insecticides, such as Pyrethrin, may be necessary before storage. If possible, stored seed lots should be tested for moisture content, purity, weight and germination capacity. Results of germination tests will give the number of seedlings that can be expected from the seed lot.

### **Presowing treatments**

Seeds of many tree species germinate readily when subjected to favourable conditions of moisture and temperature. However, some species tend to remain dormant even then. Where persistent dormancy is a problem, pre-treatment is essential. In some species, pre-treatment gives only an increase in the percentage of seeds that germinate, while in others the main benefit is faster germination. The decision on whether or not to pre-treat may depend on the species, provenance, seed year, length and conditions of storage and on local nursery conditions.

Seed coat dormancy is the most common type of dormancy in dryland species. The main pre-treatment methods to overcome this are mechanical and soaking in water.

### **Mechanical scarification**

This is one of the simplest and most direct methods and involves cutting, chipping off or burning a small hole on the coat of each seed (Dipping). It can be done with nail clippers, fine pliers, knives or sand paper. Another effective tool is a red-hot wire. This is carefully pressed on the seed coat to burn a tiny hole. A small scar at one end of the seed indicates where the seed was attached to the pod or fruit and where the embryo's radical is found. As the radical must not be damaged, it is best to nip the seed at the side away from the scar.

Pre-treatment of large quantities of seed by tumbling them with gravel in a concrete mixer is likely to damage the seeds. It is better to scarify the seeds individually if possible. This is best suited for larger and more refractory seeds such as those of *Delonix regia*. The effect of physical scarification may be reinforced by soaking in cold water before sowing.

### **Soaking or immersion in water**

In some species, softening the seed coat can also be achieved by soaking the seed in 4 - 10 times its volume of either cold or hot water, for a day or so.

**Cold Water :-** Some seeds e.g. *Adansonia digitata* respond well to soaking for 24 hours at room temperature. Soaking results in more rapid inhibition than can be achieved in a moist nursery bed. Some species may require longer periods of immersion.

**Boiling Water:-** The seeds are immersed in boiling water which is then allowed to cool gradually for up to 24 hours. Seeds which are swollen after imbibing water are ready for sowing. The procedure may be repeated for seeds that have not swollen. This pre-treatment is particularly useful for *Tamarindus indica*.

For species with seed that is damaged by boiling, pre-treatment by soaking in water at 80°C to 90°C is recommended.

### **Other pre-treatment methods**

Other methods are soaking in acid, scorching or roasting on a fire, and collecting the seed after it has passed through the digestive system of ruminants. *Sclerocarya birrea* seed is treated by soaking in cold water over night after which the operculum is removed by a sharp tool.

### **Seed sowing**

Direct sowing into tubes is possible where seed germination is reliable, especially if the seed are large, e.g. *Balanites aegyptiaca*. In most cases the seed are first sown in beds or boxes. The seed is usually covered with a thin layer of sand.

### **Pricking out:**

1. Carefully wet the soil of the seedling box or seedling bed to allow easy removal of the plants;
2. Lift the seedlings with a little shovel or a flat piece of wood. Select only healthy strong seedlings;
3. Always hold the seedlings by their leaves - never on their stem which will not recover if pressed;
4. If roots are too long, prune them with a sharp knife;
5. Place the seedlings into a flat recipient with water and cover with a moist cloth or straw;
6. Using a sharp stick or a dibbler, prepare a hole in the container that is big enough to accommodate the roots without bending them;
7. carefully insert the seedling into the hole and lift it slightly to allow the roots to straighten;
8. close the hole by pressing the soil gently against the roots so that the seedling sits firmly in the container;
9. Water and put the containers in a shaded area.

### **Watering**

Watering is normally done twice a day (early morning and late afternoon). Watering should be avoided during the midday as it may result in injuries to the seedlings when water is heated by the sun.

### **Hardening off**

Hardening off is a process of preparing the seedlings for field conditions. This can be achieved by removing the shade (if any) and reducing watering for 2 to 4 weeks before planting in the field. Hardening off reduces the initial shock after planting and increases survival rates.

## **2. Vegetative propagation techniques (Lecture and Practical).**

By: Dr. Benard Muok, Kenya Forestry Research Institute (KEFRI), Kitui Centre.

### **Propagation by cuttings**

A cutting is a piece of the mother tree (a scion). The rooted cutting will have the same characteristics as the mother tree. Cuttings ensure raising seedlings which are true-to-type with the same quality and yields. Rooted cuttings are used as rootstock for grafting or for planting on farm.

- Cuttings root best if they are absolutely fresh. It is advisable to prepare the seedbed before collecting cuttings.
- Plan the collection and planting of cuttings to be done on the same day.
- Cuttings need extremely frequent watering, water twice a day for a period of 3 weeks.

### **Collection of cuttings**

Selection of the mother tree as a source tree for cuttings:

- It has to be an adult tree, clean and free of pest and disease and to be known for good quality fruits and yield.

Selection of the branches for cuttings (for picture see module 'grafting"):

- A cutting should have a diameter of a small finger and not be thicker than a thumb.
- A cutting should have at least 4 bud eyes
- One scion branch can give you several cuttings.
- Select middle branches which are exposed to sun.
- You need a pruning secateur to do a smooth cut on both ends.
- Label the cuttings.
- Transport cuttings in a polybag with little water inside.
- Always keep cuttings under moist conditions.

### **Planting of cuttings**

The cutting is placed in an angle of 45 degree in the soil, at least one bud eye facing the sunlight. The soil can be very sandy, as this eases the root production. In a dry area or in dry season, cover three bud eyes with soil and construct a shade roof:

- Make sure watering is done twice day, this is most important for rooting of cuttings.
- The straight cut at the top minimizes loss of water and drying.
- The slanting cut at the bottom has a large diameter for root formation.
- Never plant cuttings upside down.
- To avoid evaporation, you can plant cuttings in a nursery bed which you cover with a transparent sheet of polyethylene. Drill holes in the polyethylene with a wooden stick first and insert the cuttings.

- If successful, your cuttings start to sprout after three to four weeks.
- If sprouted and rooted, transplant cuttings into containers or plant directly on farm. If cuttings are planted they need the same soil mixture as seedling plants.

## **PRACTICAL 1: Preparation and planting of a cutting**

Inputs: Hoe, shovel, pruning secateur, fruit seedling

**Step 1:** Seedbed preparation. Fertile, light soil, make sure you add sand, especially in heavy top soil types and water the seedbed.

**Step 2:** Collection of cuttings as described above.

**Step 3:** Planting in the seedbed.

**Step 4:** Watering, mulching



Workshop participants learning how to collect and plant cutting. Cuttings ensure raising seedlings which are true-to-type with the same quality and yields.



## **Layering**

Layering is often used in species that are particularly difficult to root from cuttings, as the intact stems allow a continuous supply of water, nutrients and plant hormones to the place of root development. Dehydration, a common problem in cuttings, is prevented, as is nutrient leaching as occurs often under mist propagation. As layering beds are often used for many years, utmost hygiene has to be practiced to prevent the spreading of pests and diseases, especially nematodes and viruses. As layering methods are often used with species that are otherwise difficult to root, it can take several months until roots have formed on the layer.

The most common layering techniques for agroforestry trees include simple layering, air layering and stooling. In tropical fruit propagation, air layering plays the most important role.

## **How to do stooling**

- Mother plant to be still small, up to 1m.
- Prune the mother tree back to 30 cm (1 ft) above soil level. Water daily; add manure to your topsoil.
- If fresh sprouts develop, cover the lower part of a rootstock stem with soil (stooling). Continue to water the mother plant.
- Heep a 2<sup>nd</sup> and 3<sup>rd</sup> layer, if the sprouts grow taller.

- 3 - 4 month after heaping soil, remove the soil carefully and harvest the rooted shoots. Transplant in container or nursery bed.

### How to do layering

- You bend a branch of the mother tree down to the soil.
- Use a wooden triangle or two sticks for bending.
- Cover the rootstock branch with soil.
- Watering, mulching.
- The branch will develop roots and start sprouting.
- After 3 - 4 month, you can separate the rooted sprout from the mother tree.



Workshop participants learning how to do layering. Layering is often used in species that are particularly difficult to root from cuttings.



### How to do air layering

- Select a healthy, clean branch of 1 cm diameter.
- Do girdling: Remove the bark all around that branch, maybe 4 - 5 cm wide.
- Use rooting material, which is soft and keeps moisture: e.g. sawdust, moss, compost.
- Water sufficiently.
- Wrap the girdled branch in a transparent Polythene sheet and fill with rooting material.
- Close the Polythene very tight around the branch. Close the ends directly on the branch.
- The rooting material shall never dry out. Continue watering.
- Observe twice a week.
- If roots developed under the transparent polyethylene cover, cut the branch below the Polythene cover which first remains as it is.
- Transplant immediately after cutting into containers. Remove the polyethylene cover. Do not damage the tender roots.
- Plant at the same height as the coverage had been.
- Use fertile, clean soil media only.

### Principles and techniques for grafting

Grafting, the technique of combining two or more different plants, has been known to us for many centuries. Initially, grafting was practiced on culturally important trees, as the olive and citrus. It is a viable option to domesticate several under-utilized indigenous fruit tree species.

## Definitions

The following broad definitions are needed to understand grafting and budding techniques and their underlying principles:

- **Grafting:** the technique of connecting two pieces of living plant tissue together so that they will unite and form a functional plant.
- **Budding:** a special form of grafting in which the scion consists of one or several buds. It is a more economical form of grafting as more scions can be produced from a single tree.
- **Scion:** the aerial part of a tree that forms the crown of the new plant. This part contains the dormant buds of the tree whose desired characteristics that need to be multiplied.
- **Rootstock:** the below-ground or lower part of a tree, sometimes including part of the stem and some branches that will form the root system of the new plant. This part may also contain dormant buds, which should not be allowed to develop in the new plant since they do not have the desired characteristics that need to be multiplied.

## Reasons for grafting and budding

The following are the main reasons why you may want to consider grafting or budding agroforestry trees:

- To multiply a tree that cannot be multiplied through sexual or other asexual propagation methods.
- To obtain a tree that combines both the good characteristics of one tree and the rootstock of another one.
- To decrease the amount of time that a tree needs to attain maturity (flowering, seeding).
- To rejuvenate older trees through the use of young, improved material from another one.
- To repair damage caused to certain parts of a tree.
- To detect viral diseases

## Advantages of Grafting and Budding

- Uniformity of the cultivar.
- Dwarfing effects on fruit tree.
- Early fruiting (mostly 3 - 4 years).
- Desired cultivar, true to type.
- Grafting of old trees (top working) in order to react on market trends.

Grafting and budding are common ways to get the actual marketable cultivars.

## Disadvantages of Grafting and Budding

- Fruit trees remain longer in nursery
- Not 100% take guaranteed for grafted/ budded trees
- Requires some inputs.
- Requires special skills

- One has to get improved scions
- Requires proper management and time schedule

In order to have good achievements, mind the following points:

- Healthy seedling trees, free of pests and diseases.
- Thickness of a pencil at 25 cm above the ground.
- Vigorous in growth.
- Single stem rootstocks, watering and weeding starts a week before grafting or budding.

### **Incompatibility**

Problems of graft incompatibility are often cited as the most severe hindrance to full acceptance of grafting and indeed they occur and need to be taken into account (Feucht, 1987). A general rule states that the more graft unions are successful the more botanically closely related the partners are.

Often, incompatibility symptoms do not show immediately; they can appear as late as many decades after the union was formed when in a heavy storm the trunk- breaks at the point of the graft union. The most common incompatibility, symptoms are the following:

- Failure to form a successful graft union in a high percentage of cases.
- Early defoliation of deciduous plants, decline in vegetative growth due to shoot die-back and general ill-health of the plant.
- Premature death of trees after a few years or while still in the nursery.
- Marked differences in growth rate or vigour between scion and rootstock; overgrowth at, above, or below the graft union.
- Differences between scion and rootstock at the onset of vegetative growth after dormancy due to drought or low temperatures.
- Graft components break apart cleanly at the graft union.

Apart from breakage, isolated cases of the above symptoms are not indicative of incompatibilities.

## **PRACTICAL 2: Grafting**

### **Prerequisites**

The following tools and materials are needed for this practical:

1. Good quality, sharp grafting or budding knives. Any sharp knife may do but the higher expense of a special grafting knife may pay in the long run in terms of durability and consistent quality of the cuts. Grafting knives are available for right-handed and left-handed people. Budding knives with a specially curved blade and a tool to lift the bark flap for T-budding are available as are special double bladed-knives for patch budding. In

order to ease the fitting of scion and rootstock cuts, special tools have been manufactured that cut a notch into the scion and a corresponding groove into the rootstock. These tools only operate well when scion and rootstock are of approximately the same diameter. For softer tissue woody materials, surgical scalpels or razor blades can also be used but will require more caution on behalf of the users.

2. A fine-grained sharpening stone is needed to keep the blades of the grafting and budding knives sharp after repeated cutting of woody material.
3. Surgical spirit to disinfect the knives.
4. Secateurs, hand sprayers and plastic bags to collect scions.
5. Cool box with ice packs for short-term storage of the scions.
6. Different types of grafting/budding wraps (polyethylene strips, raffia, latex bands, self-adhesive or degradable bands),  $\pm$  1 cm wide.
7. Special wax or white latex paint to cover the grafting/budding union as to avoid desiccation of the tissues.
8. Small (10 x 20 cm) transparent polyethylene bags to cover the top part of small seedling grafts, and fine string.

A series of potted seedlings of selected indigenous fruit trees to be used as rootstocks, scions and buds.



Workshop participants learning how to do grafting. Grafting decreases fruiting time to mostly 3 - 4 years.



## 1. Sharpening grafting/Budding knives

A fine-grained sharpening stone with a flat surface should be used. The stone is wetted with water, or, for better results, with oil thinned with paraffin. The blade of the knife is pulled at an angle of about 30 degrees over the stone until a sharp edge is obtained. If the knife has been very blunt, a medium-grain stone can be used initially, using a fine-grained one for finishing off. The whole width of the stone should be used so that its surface remains flat.

### 1. Scion Selection

- From the desired cultivar.
- From healthy mother tree, free of pests and diseases.
- Mature tip of a shoot (woody, not soft) preferably with pushing eyes.
- Similar diameter as the rootstock (pencil thick).
- Cut scions of 15 - 20 cm length in order to allow cuffing back during grafting.
- A scion has to have 3 - 4 bud eyes for successful grafting.
- Remove all leaves to reduce evaporation.



- Label all scions immediately after cutting with type of tree and cultivar.
- For transport store scions with water, cool and shady (best in a cool box).
- Best success rate in grafting/ budding is achieved if scions are fresh.

### Cleanliness

- Clean tools and hands frequently, before and during the work.
- Avoid contact of hands and scions with soil while grafting.
- Areas of cut should never be touched.
- Cut scion and rootstock by single clear cuts.

### Care

- Watering and weeding of the rootstocks is done one week before grafting
- Get everything prepared for grafting before you get the scions
- Use fresh scions only (best if cut on the same day)
- Transport scions with water, in wet paper, banana leaves and polybags.
- Do the grafting operation in the shade.
- Scions have to be labelled, type of tree, cultivar and origin.

## 1. Collecting scions and budwood

From a suitable mature tree in the surrounding, collect young, vigorous shoot tips of about 20 cm. Remove all leaves and the tip, collect in a small plastic bag in which you have sprinkled some water, label carefully with species name and cultivar or clone number and immediately store in the cool box.

For the purpose of these exercises, scion wood can also be collected from seedlings.



Workshop participants learning how to do scion selection and collection. Best success rate in grafting/ budding is achieved if scions are fresh.



## 2. Top wedge grafting

- a). Using a sharp grafting knife, top the seedling stock where it is about pencil thickness and about 20-30 cm above the soil line.
- b). Cut a vertical slit, 2.5 cm down through the remaining stem, using a very thin flat blade knife, taking care to avoid splitting the stock below the cut.
- c). Take a scion of the same thickness and cut the basal end to a tapered wedge shape slightly longer than the slit in the stock. Insert the wedge firmly into the slit, matching the vascular

cambia of both stock and scion. To allow for good callus formation, it is important that a small semi-circle of cut scion is visible above the rootstock. This semi-circle is called a 'church window'.

- d). Bind the graft firmly with grafting tape or polyethylene strip, making sure that the scion does not slip during tying in.
- e). Cover the scion and several centimetres of rootstock below the union with a transparent polybag in which you have sprinkled a few drops of water. Tie tightly around the stem. Cut a small corner off the bag and blow up like a balloon. Then twist the corner closed and tie with a small piece of string. Doing this increases the humidity and CO<sub>2</sub> levels inside the bag, and also prevents the bag from clinging to the scion, thus avoiding possible infections.
- f). Place the grafted plant in shade and keep well watered. Regularly remove all the shoots that develop below the graft.
- g). When the scion shoots begin to grow, gradually ventilate (cut slits) and then remove the bag.

#### **4. Whip and tongue grafting**

- a). Using a sharp grafting knife, top the seedling stock where it is about pencil thickness and about 20-30 cm above the soil line.
- b). Make a slanting cut of about 2.5 - 6cm into the rootstock.
- c). Make a similar cut on the scion.
- d). On both cuts, a reverse cut is made about one third of the distance from the tip. It should be about half of the length of the first cut and should be parallel to it.
- e). Rootstock and scion are then inserted with the tongues interlocking and matching the cambium layers well.
- f). Bind the graft firmly with grafting tape or polyethylene strip, making sure that the scion does not slip during tying in.
- g). Cover the scion and several cm of rootstock below the union with a transparent polybag in which you have sprinkled a few drops of water. Tie tightly around the stem. Cut a small corner off the bag and blow up like a balloon. Then twist the corner closed and tie with a small piece of string. Doing this increases the humidity and CO<sub>2</sub> levels inside the bag and also prevents the bag from clinging to the scion, thus avoiding possible infections.
- h). Place the grafted plant in shade and keep well watered. Regularly remove all the shoots that develop below the graft.
- i). When the scion shoots begin to grow, gradually ventilate (cut slits) and then remove the bag.

#### **5. Approach grafting**

- a). Select two seedlings of similar size.
- b). Cut a slice of bark and wood 2.5-5cm long from both stems at the point where the union is to form. This cut should be the same size and form in both partners to allow for a good match of the cambial layers. It should be smooth and as flat as possible.

- c). Bind the union together and wax, or wrap tightly with parafilm.
- d). Keep the two plants well watered and protected until the graft has succeeded.
- e). After a solid union has formed, which can take several months, the rootstock is cut above the union, and the scion below it to complete the graft.

## **6. T-budding**

- a). Select a healthy seedling with a smooth bark. T-budding works best if the bark slips easily off the wood
- b). Make a vertical cut into a smooth part of the rootstock and then a horizontal cut above it to form a T.
- c). Slip the bark open at the corners
- d). Prepare a budwood by cutting all leaves off a small branch but leave 1cm of the leafstalks for easier handling of the buds.
- e). From the budwood, slice off a bud starting about 1cm below the bud and end 2.5 cm above it. Make a horizontal cut at the end and slide the shield off the wood. This shield should be as thin as possible but should still be firm.
- f). Insert the shield into the T by pushing it downwards under the bark flaps.
- g). Tie the bud in with grafting tape or parafilm, making sure that you leave the bud exposed.
- h). After the bud has healed in, cut the rootstock off above the bud.
- i). Remove any growth from below the bud.

## **7. Patch budding**

- a). Select a stockplant with a diameter of up to 10cm on which the bark slips easily off the wood.
- b). Using a double-bladed knife, make two parallel horizontal cuts of about 2.5cm length.
- c). Connect these with two vertical cuts using a single bladed knife and remove the piece of bark.
- d). Prepare a matching piece of bark from your budstick.
- e). Slide the bud carefully off the budstick sideways to ensure that the woody core of the bud does not break off.
- f). Insert the patch into the prepared rootstock. It is very important that the pieces match snugly at the top and bottom end, so that vascular tissue can form.
- g). Tie in firmly to make sure that there are no air pockets under the patch, which would dry out the patch. Leave the bud exposed.
- h). After the bud has healed in, cut the rootstock off above the bud.
- i). Remove any growth from below the bud.

### 3. Tree establishment and management (Lecture and Practical).

By: Mr. James Kimondo, Kenya Forestry Research Institute (KEFRI), Kitui Centre.

#### Introduction

Trees and shrubs, just like other agricultural crops, require to be tended to produce to their highest potential. This process starts right from the time of collecting the planting germplasm to the crop husbandry in the field. For fruit production, the seeds are collected from the trees with the right characteristics such as heavy crown, appealing taste, prolific seeders among other desirable traits.

#### Source of planting material

- Seedlings raised from seed
- Rooted cuttings of stem, roots or suckers

Before planting, these seedlings must be prepared for the field conditions through reduction of water, shade and the general growth vigour – Hardening off.

#### Site preparation

- Site preparation for trees and shrubs should be considered as much the same way as site preparation for other agricultural crops.
- Each planting spot should be clear of other plants (weeds) to prevent competition for moisture.
- The extent of site preparation for any given condition depends on the prevailing circumstances.



Prepared sites; Site preparation for trees and shrubs should be considered as much the same way as site preparation for other agricultural crops.



#### Planting pits

An adequate planting hole should be dug. In an ideal condition, the hole need only be big enough to accommodate the root ball. However, this condition which calls for well structured, fertile and deeply rootable soil is rarely available in the dry areas. The soil is usually poor and needs to be improved through deep cultivation and addition of manure or some good top soil. Therefore, a big deep hole is required then.

## Handling of seedlings

- Seedlings are normally delicate and require proper handling as they are transported from the nursery to the planting site.
- The root ball should be maintained as intact as possible so that the roots are not exposed to the atmosphere until at the time of planting.
- Avoid holding the seedlings by their shoots as this normally leaves the roots hanging freely thus loosening the soil, which finally falls off.
- It is also important to ensure that the handling of seedlings is minimized.
- As such, only seedlings to be planted at a particular time are to be moved from the nursery.



Participants practice seedling handling. Seedlings are normally delicate and require proper handling as they are transported from the nursery to the planting site.

## Planting time

- Planting of seedlings should be carried out after adequate soil moisture build-up.
- To check this in the field, one needs to hold some soil in the hand and press as hard as possible.
- Planting is normally done in the short rains mainly because of the short duration after the rains. The period after long rains is approximately five months, while that after short rains is only three months.
- This brief dry period after the rains affords the seedlings time to utilize the limited available soil moisture before the onset of the next rains.

## Management

### Weeding

- Soil preparation kills weeds and makes working of the soil easy.
- Improves penetration of the soil by air and water, especially if any existing hardpan is broken.
- In addition, it is done to conserve water.
- The activity before rains improves infiltration while the one after the rains forms a mulch layer on the surface that protects the water below.
- It removes the developing vegetation on the site.



Weeded lands; weeding improves penetration of the soil by air and water, especially if any existing hardpan is broken. It is also done to conserve water.



### Crown management

- Fruit trees unlike trees for other uses such as timber must be managed in a different technique.
- For production of timber, a straight thick trunk is necessary to concentrate biomass which can then be processed.
- For fruit production, extensive branching is an important factor. These are the sites where flower develop for subsequent fruit production.
- Further, the height of a tree influences the harvesting of the fruits. Trees that are generally short allow harvesting of fruits from the ground.



Left, timber specie and right, fruit specie. For timber production, a straight thick trunk is necessary, while for fruit production, extensive branching is an important factor.



### Pest and diseases

- These are also some problems that may affect the fruit trees (*Sclerocarya birrea*)



A disease affecting the stem of *Sclerocarya birrea*. Such diseases need to be controlled for sustainable production of fruits from these trees.



## **SESSION 3: STUDY TOURS**

Chair: Dr. Benard Muok and Mr. Parnwell Simitu.

### **Introduction**

In order to expose participants to the practical utilization and commercialization of IFTS, the workshop organizers arranged four study tours as follows. A tour to Kamurugu Agricultural Development Initiatives (KADI), Kamurugu farm center, a grassroots support organization in Mbeere district, with a mission to enhance potentiality of the local small farmers to address poverty and design sustainable strategies to improve house hold livelihood. The participants here got practical exposure on mango and honey processing. Kithanga women group of Embu district was the other processing enterprise visited. Started in 1996 with 28 members, the group is involved with various fruit processing activities such as making juice and soap from *Persea americana*. Also visited was a business woman who adds value to IFTS products before she sells them. Participants further visited a farmer who has domesticated indigenous trees including fruit trees. This visit was important as it exposed participants to the reality that IFTS are domesticated just like any other fruit trees.

The objectives of the study tours were thus:-

- To practically demonstrate and train participants on fruit processing using local fruit processing industry i.e. Kamarugu farm centre.
- To train participants on fruit processing through demonstrations by local farmer group experienced in fruit processing.
- For participants to learn on aspects of value addition of IFTS through demonstration of practical work by a Kitui business woman.
- And participants to learn on how IFTS can be domesticated.

### **Tour number 1: Kamurugu Agricultural Development Initiatives (KADI)**

By: Kamurugu staff.

Kamurugu community resource center that was visited by the participants is owned and managed by Kamarugu Agricultural Development Initiative (KADI). The following is brief background of the organization.

#### **Vision**

To become a leading organization in facilitating development transformation in semi-arid areas of Kenya.

KADI is a grassroots of support organization in Catholic Diocese of Embu. KADI operates in Mbeere District with its administrative office at Iriamurai in Mbeere. KADI works with all

interested members of the community, especially small-scale farmers, regardless of their political, religious or social affiliations.

The mission of KADI is to enhance potentiality of the local small farmers to address poverty and design sustainable strategies to improve household livelihood through the following approaches;

- Strengthening the organizational capacity of CBO's
- Making accessible high quality fruit tree seedlings and other seedlings suitable for semi arid areas.
- Promoting agri-business activities like fruit production, processing, beekeeping and marketing.
- Facilitating information and technology transfer to improve food security and income.
- Establishing linkages with other organization in order to increase possibilities of productive choices and reducing production and marketing factors in agriculture and livestock.
- Promoting environmental conservation activities.

The mission of KADI focuses on thematic areas, which have to be addressed, while respecting the dignity of the people involved. KADI underlying value is respect, commitment and honesty in realizing and fostering human dignity.

## **KADI sectors**

### **Community development (CD)**

The purpose of community development department is to facilitate the community to realize their own potential, enabling the small-scale farmers understand the cause of poverty, food insecurity and together design viable sustainable strategies to address issues hindering their sustainable livelihood. It aims at working towards social development transformation to practically reduce poverty.

### **Specific Objectives**

- Provide various training on CBO organization development, leadership and projects initiation, planning, monitoring and evaluation.
- Facilitate community learning and ownership of development.
- Facilitate Participatory Rural Appraisals (PRA) as a way of strengthening ability of communities to identify their needs and plan for their community action plans
- Advocacy and social transformation.
- Hold for and to raise awareness and consciousness.
- Disseminate information and desired technologies to farmers
- Promote modern beekeeping activities.
- Promoting environment conservational activities
- Promoting relevant agri-business activities to diversify farmers production options
- To work closely with production sectors in products development and market demands.
- To promote KADI products and services.



## **Marketing department**

The purpose of this sector of community development is to break new grounds in service and market development for KADI and community products and services. The marketing sector links up KADI products and services with potential customers/clients.

### **Objectives**

- To work closely with production sectors in products development and market demands
- To promote KADI products and services

### **Social marketing**

The purpose is to strengthen and establish new network and collaboration with other organization with similar intentions or mission.

- To promote the mission and cause of KADI to potential development partners
- Promote and facilitate KADI internal learning.

### **Gitaru farm**

The purpose of the farm is to produce and support other departments. They grow crops like high quality papaws, Bananas, Oranges, Mangoes and Beekeeping.

### **Tree nursery**

The purpose of this department is to raise quality fruits and tree seedlings to support fruits production industry in Eastern and Kenya at large. To provide good tree species, especially multipurpose trees for environmental conservation to make accessible new fruit tree seedlings to the farmers.

To support other sectors of KADI through sale of seedlings. The nursery is established and has been certified by HCDA- Horticultural Crops Development Authority. The nursery produces high quality seedlings. The varieties produced are true type. Some of the fruit species produced are:-

***Mangifera indica***: Tommy Atkins, Kent, Keitt, Ngowe, Apple, Sabine, Haden, Vandyke, and other types like Maya, Alphonzo, Sensation, Kingstone, and Parvine are grafted on order.

***Citrus sinensis***: Washington navel, Valencia late, Tangerines, Lemons, and bananas.

***Carica papaya***: Solo Sunrise, Solo Kapoho

***Persea americana***: Fuerte, Hass, Booth 7 and 8

Other seedlings for timber, fodder and ornamentals like *Grevellia robusta*, *Melia volkensii*, *Azadirachta indica*, *Senna siamea* and *Calliandra calorthursus* are raised in the nursery.

**Macadamia**: MRG 20, KMB 3, EMB 1, KRG 15

**Tissue culture bananas**: Williams, Giant Cavendish, Chinese Cavendish, and Grand naine

### **Kamurugu farm center**

The purpose is to become a community development resource center that acts as a cost and benefit strong center. The objectives of the center are;

- Production of fruits especially mangoes on cost recovery basis.
- A training center through demonstration of practical work on production, harvesting and post-harvesting handling.

- To act as fruits production, collection and packaging center.
- Experiment on new technologies in fruits production.

### **Achievement of KADI**

It started as a project in 1991 with three self-help groups and by the year 2000 had over 70 CBO's spread in Mbeere District and now clustered as per common interest. Has established honey refinery to add value to honey now available in market.

As part of community development, KADI has been organizing training on:

- Establishment and management of orchards
- Harvesting and post harvest handling
- Grafting and top-working
- Fry land farming techniques e.g. seed bulking and banking
- Leadership training
- CBO development dynamics
- Soil and water conservation
- Environmental conservation
- Domestication of indigenous fodder plants
- Established community resource center at Kamurugu farm

The nursery of KADI is one of the leading fruit tree seedlings nurseries in Kenya. It produces high quality seedlings for mangoes. KADI has distinct competences in mango production from seedlings to fruit trees.

### **Other achievements**

- Trained over 5000 farmers in fruit trees production and management
- Over 1000 farmers trained on grafting and budding.
- Identification and documentation of indigenous fodder, food and medicinal plants
- Identified at least 5 indigenous fodder plants now being domesticated by farmers
- Facilitated CBO's to start small fruit processing activities
- Facilitated some CBO's to start seed and food banks
- Trained 300 bee keepers on good practice harvesting and handling of honey
- Facilitated establishment of 13 community based tree nurseries
- Trained 50 Artisans on modern beehive manufacturing

### **Kamurugu community resource center**

#### **Mango and honey processing center (Practical).**

The participants were introduced to the center and taken through the activities of the center including mango processing, beekeeping and honey processing, tree establishment and management, goats breeding, agribusiness management and capacity building.



Left; participants are introduced to Kamurugu community resource centre, while right; they are learning on tree establishment and management.



## Mango processing (mango drying)

### Ingredients

Mango (ripe but not over-ripe)  
Lemon juice or any other preservative  
Food color (optional)  
Water

### Equipment

Slicing knives or chopper  
Drying racks  
Bowls or basins  
Teatowels



Participants learn mango production at Kamurugu farm; the farm is a mango producing and processing centre.

### Procedure

- Collect all the necessary materials and ensure they are ready for use.
- Clean up the fruits and dry them
- Remove all bruised parts
- Peel thoroughly
- Slice the fruits into 3-4mm thick slices
- Prepare lemon-water solution at the ratio of 1:4
- Dip the mango slices into the lemon solution or any other desired preservatives (for 1 min)
- Lift out the slices and spread on the drying racks
- Monitor the drying of your product and keep turning the slices to ensure uniform drying
- Once dry, leave the crisps to cool overnight
- Sort the crisps as per their grades
- Pack and label as desired, ready for market or consumption

NB: During selection of mangoes, the following needs to be done;

- Check on the fibres level of the fruits and find out the tastes of your customers.
- The period between harvesting of product and processing should be kept to the minimum as long storage means further ripening hence deterioration in viability of the product.

- The dried product should be stored in air-tight papers/containers and in dark area (direct light changes the color of the product).
- Store product in a freezer at a temperature between  $-4$  to  $-10^{\circ}$  C (for longer shelf life-over 2 years) or at room temperatures (for short storage-atmost 6 months)



Participants are trained on mango and honey processing at kamurugu centre.



This product is marketed by middlemen and there is good market for them. Last year 300kg of this product was sold, and up to June this year, they had sold 1 tonne of the product, needless to say the demand of this product is increasing year by year.

## Honey processing

### Procedure

- Separate honey combs from liquid part (extraction)
- Prepare water in a double boiler and heat up your honey to  $45^{\circ}$  C
- Hold honey at this temperature for an hour; stir oftenly to ensure uniform temperature
- Using a honey centrifuge or a piece of white cloth, sieve the warm honey
- Leave the honey to cool in settlement tanks for a period of 3 days. This ensures that all poller particles float on the surface, and at the same time allows honey to cool.
- Scoop out the scum(foam) that forms on the surface(optional). However, if you are to pack your honey from a bottom outlet, you need not scoop out the scum since after draining honey, it will be left in the settlement tank.
- Pack and label
- Market or store.



### Points to note:

Honey crystallization is “normal” and should not be mistaken for low quality. Incase of crystallization, warm the honey by dipping the jar in warm water.

Honey is a preservative and therefore does not expire. However, expiry date is indicated on the jar just for formality.

Honey processing equipments at the Kamurugu centre. Honey is a valuable source of food and nutrition in the drylands.

## Tour number 2: Kithanga Women Group, Embu District

### Fruit processing women group (Practical).

By: Mrs Njeru, Group chairlady.

Participants were introduced to the group, and the group activities. The group was started in 1996, with 28 members. It is engaged in fruit processing such as juice and soap making using *Persea americana* among other activities. The group chairlady explained to the participants on soap making from *Persea Americana* (Avocado), a valuable fruit tree in the district. The group also served participants with fruit juice they had made from the *Persea americana*.



Left, group chairlady introduces the group to participants, while, right, the group secretary serves participants with fruit juice made by the group.



### Fruit processing (soap production using Avocado)

#### Ingredients

Cooking oil 4kgs  
Coconut oil 6kgs  
Avocado 8-10 pieces  
Lemongrass 20g  
Caustic soda 50g

#### Procedure

- Melt cooking oil e.g tily
- Add coconut oil to the melted cooking oil
- Add caustic soda to the above mixture
- Prepare lemon juice and add to the above
- Boil lemon grass and use that water for scenting the soap
- Allow the mixture to set in a metallic tray
- Shape your soap as you desire

N.B

The above quantities (ingredients) will produce 85 soap pieces (each weighing 100 grammes)

This soap is medicinal and has been proved to treat many skin diseases including facial pimples.



Women group members display the soap made from avocado soap. This soap is medicinal and is effective especially on skin diseases. IFTS are known to produce the same products.



## Tour number 3: Kitui Baobab processing business woman

By: Rukia, a Kitui baobab products business woman.

### Practical

Participants visited a business woman, Rukia in Kitui town. She adds value to baobab fruits before she sells them. It is here where the participants learned on aspects of value addition of IFTS through practical demonstration by the business woman. She makes and sells juice and colored dry fruits, locally called “mabuyu” from fruits of tree.

### Baobab processing (juice making)

#### Ingredients

Water-1 mug  
Sugar-1/2 kg  
Source of heat  
Flavour



Photos; a business woman demonstrates to participants on how to make juice from baobab fruits. Baobab fruits are rich in vitamin C and B2.



#### Procedure

- Soak fruits for 8 hours
- Squeeze, sieve and add water first to lighten
- Pour a mug of water into the sufuria
- Dissolve ½ kg of sugar in water less than 1 litre
- Stir the mixture until it dissolves while still boiling
- Let it boil until it becomes syrup
- Add dissolved baobab fruit to the syrup
- Add flavour e.g passion, strawberry, vanilla etc
- Stir the mixture
- Let the juice cool.



Left, the businesswoman serves juice from baobab, while, right, a participant enjoys the juice. Baobab fruits are important source of both food and nutrition in the drylands.



## Baobab processing (Mabuyu making)

### Ingredients

Baobab fruits/powder  
Water  
Sieve  
Food color  
Sugar



Left, Businesswoman demonstrates baobab fruit value adding, while, right, a participant tries his hand on baobab processing.



### Procedure

- Add food color to the boiling sugar, which should be sticky
- Add baobab powder
- Pour the sliced fruits to the mixture in the sufuria
- Add sugar and baobab powder to make them dry so that they don't stick together
- The product "mabuyu" is ready for use or sell
- They are then packed in various sizes for selling

N.B

The product is packed for different prices such as for kshs 1, 5, 10 etc.

The business woman makes an average of kshs 300 a day from this business

The woman buys the fruits from middlemen.



Baobab products- they are rich in Vitamin C, B2 and fetch a significant profit in the market.





## Tour number 4: IFTS domesticating farmer-Katulani, Kitui district

By: Mr. Mataka, IFTS farmer.

In order for participants to learn on how IFTS can be domesticated, a visit to a farmer who had planted both indigenous fodder and fruit trees with the assistance of SOFEM project was organized. The Kenya Forestry Research Institute (KEFRI) in collaboration with Japan International Corporation Agency (JICA) launched this regional training course in 1995 on a Social Forestry Extension Model (SOFEM) to promote social forestry in Africa. The project aim was to equip the inhabitants of the semi-arid areas of Kenya with appropriate techniques for planting and managing trees through establishment of farm forests by the local residents. One of the expected outputs was to develop an appropriate method of farm forest establishment with the initiative of the local residents through practical training of farmers and extension agents. The trained farmers were expected to act as models and facilitated to act as extension agents. The project has led to domestication of indigenous fruit trees in Kitui, where 10 indigenous fruit trees have been developed while indigenous knowledge on management of wild fruit trees has initiated intensive studies on domestication. The project has also made good progress in the development of high value timber and wood carving tree species. Technologies have been developed for propagation and management of *Melia volkensii* and *Dalbergia melanoxylon*.

The farmer explained to participants at length on domestication of these species, emphasizing on their value, an aspect he said has eluded many dryland dwellers. He said he was still testing the fruiting time, which was surprisingly short like *sclerocarya birrea* which had fruited within five years after grafting. He said termite damage is a big problem to the domestication of these species in his farm and explained how he will rise above that challenge and harvest the trees after ten years. He challenged participants to also start domesticating the trees, which he said had a lot of “hidden value”.

The following are the species at his farm:-

### Fruit species

*Mangifera indica*  
*Citrus sinensis*  
*Psidium guajava*  
*Sclerocarya birrea*  
*Zizyphus mauritana*  
*Annona senegalensis*  
*Vangueria rotundata*  
*Tamarindus indica*

### Fodder species

*Prosopis juliflora*  
*Melia volkensii*  
*Leucaena leucocephala*  
*Prosopis pallida*



An IFTS farmer teaches participants how to plant IFTS. These species can be domesticated just like the exotic fruit species. Their domestication leads to sustainable utilization and commercialization.



## SESSION 4: PROCESSING AND MARKETING

Chair: Dr. Zenroku Oginosako (ICRAF) and Mr. James Kimondo (KEFRI).

### Processing and value adding of indigenous fruit tree products of drylands of ECA (Lecture and Practicals)

#### 1. Processing and value adding of IFTS products (Lecture and Practical).

By: Remen Swai (ICRAF Tanzania) and Bernadetha Kimata (ARI-Tumbi, Tabora Tanzania)

##### Introduction

Forests, bushland, woodlands and homestead farms are important sources of non-timber products including indigenous fruits. These fruits have from time immemorial played a vital role in the livelihood of people, especially those living in semi-arid and arid regions of East and Central Africa. Most of these fruits are normally available during dry season when there is food shortage and make a significant contribution to the diet and income of the rural communities. The most common and abundant indigenous fruits in drylands include *Adansonia digitata*, *Tamarindus indica*, *Sclerocarya birrea*, *Berchemia discolor*, *Flacourtia indica*, *Strychnos cocculoides*, *Parinari curatellifolia* and *Vitex mombassae*.

To date, unfortunately, indigenous fruits are mostly gathered from the wild and are largely a subsistence product. Utilization of indigenous fruits has not been fully exploited in drylands of ECA where they are abundantly available. Utilization is limited by lack of knowledge on their values and postharvest handling. Many local communities are not aware of their values and technologies for processing and handling them. In Tanzania for example, it is estimated that human beings use only 10% of the fruits potential in the Miombo woodlands and the rest goes to waste, due to the poor markets and rudimentary processing technologies. Studies carried out in Tanzania show that small scale fruit processors are aware of the existence of indigenous fruits and are willing to process them when available in adequate quantities. On the other hand, consumers attach greater utility value to indigenous fruits because they are natural “i.e. free from chemicals, thus have greater potential in trade and contribution to nutrient supplement.”

The following is the description of the above mentioned common and abundant indigenous fruits in dry lands with their uses and processed products.

##### *Adansonia digitata*

##### Common names

Tanzania: olmesera (Maasai) mwanda / mwandu (Sukama), mpole (Gogo, Nyasa, Luguru), gendaryandi (Iraqi), mramba (Pare) mkonda (Hehe, Sangu)

Kenya: mbuyu (Digo, Giriama), muyu (chonyi, Giriama, kambe), muramba (Embu, Mbeere, Tharaka), olmesera (Maasai)

Somali yag (Som)

Ethiopia: bamba (Am/T), hemmer, dumma (T), dima, dema (Am/T/Sodo)

English: baobab  
French: calebessier du Senegal, pain de singe  
Swahili: mbuyu

## Uses

**Food:** The leaves contain high levels of vitamin A, calcium, magnesium and iron

Food: Young leaves are commonly used as vegetable in soups, in fresh, dried or powdered form. The powder is added to tea, porridge, and soup and sometimes mixed with staple foods as a seasoner. The fruit pulp has exceptionally high contents of vitamin C. It is either eaten raw or is mixed with water and sugar to make refreshing acid-tasting drinks. Seeds are eaten raw or may be dried, ground to a flour and added to soup and stews. The fruits are normally available during the dry season and therefore it is good source food during drought and famine periods.

**Fodder:** Leaves provide a valuable source of forage when the tree is still green

**Apiculture:** Flowers produce a lot of pollen and nectar. Beehives are hung on baobab branches for honey production.

**Medicinal:** Pulp is used in the treatment of fevers and dysentery. Leaves and roots treat malaria and soars.

**Others:** Barks give strong fibre and ropes; firewood, gums, resins, dyes, utensils etc.

## Processing to high value products

### *Adansonia digitata* Juice

#### Ingredients

- 1.5 cups of ripe fruit pulp
- 0.25kg sugar
- 0.25 cup lemon juice
- 0.75 litre of water

#### Preparation

- Sort the fruits to remove dirt and plant debris, cut and remove the hard skin.
- Extract pulp from ripe fruits by using hot water (soak for sometimes then sieve through 800 micron sieve)
- Extract lemon juice
- Prepare rind from lemon fruits using grater
- Dissolve sugar in warm water, add rind and strain through a cheese cotton muslin cloth
- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for one to five (1-5) minutes

- Pasteurise the juice below boiling point less than a minute
- Pour the juice in sterilised jars and heat for 5 minutes with loose lid and tight after cooling

### **Adansonia Jam**

#### Ingredients

- 1 cup of ripe fruit pulp
- 1 cup of sugar
- 0.25 cup lemon juice
- 2 cups of water

#### Preparation

- Sort the fruits to remove dirt cut and remove the hard skin.
- Extract the pulp from ripe fruits by using hot water and filter it
- Extract lemon juice by squeezing
- Dissolve sugar in warm water and strain to remove impurities. If while sugar is used there is no need of straining
- Boil all ingredients and boil until thick, stir the mix frequently
- Drop a little jam on a plate with cold water; if a drop remains whole, the jam is ready. Otherwise it needs longer cooking or taste by placing a drop of jam on a prism of refractometer to the required total soluble solids for jam (69%) brix.
- Pour the hot jam into sterilized glass bottles tight the lid label and store.

### **Adansonia Wine**

#### Ingredients

- 1kg ripe fruit pulp
- 1kg of sugar
- 1 orange
- 2 lemons
- 1 teaspoonful of yeast
- 3 litres of water

#### Preparation

- Sort the fruits to remove dirt and those with physical signs of or infection, discolouration
- Extract the pulp from fruits by using hot water (soaking in hot water for sometimes then sieve through 800 micron sieve).
- Extract orange and lemon juices.
- Prepare wine yeast by mixing one teaspoonful yeast, the spoonful sugar, lemon juice extracted from half lemon fruit and 125mls of warm water. Mix well and leave for rising.
- Dry heat 4 tablespoonfuls of sugar until it changes the colour to brown and add it to the fruit juice.

- Pour all ingredients into plastic container and cover it store in a place where it will not be disturbed.
- Stir once every day for 8 days.
- Filter the mixture and transfer the juice into a fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, allowing carbon dioxide to escape while preventing oxygen to enter the vessel.
- Store it for 10 – 14 days and decant.
- Fill it in pre-sterilised bottles and cork.

## **Baobab Vegetable**

### Ingredients

- Baobab leaves
- Salt
- Onion
- Cooking oil

### Preparation

- Sort the leaves in order to have good quality vegetable
- Wash the vegetables
- Cut them into small pieces using a sharp knife on a chopping board
- Slice the onion into small pieces
- Add oil into cooking pan
- Add onion and stir
- Add vegetable, stir and cover with lid
- Let it cook for 3 minutes then put the cooking pan off from the fire and serve

## ***Tamarindus indica***

### **Common names**

Kenya: roka (Borana, Sanya) muthithi (Embu, Mbeere, Meru, Tharaka), oron, oron (Marakwet, Pokot) epeduru (Turkana), oloisijoi (Maasai)

Uganda: e/apeduru, (Buk/Kmj/Ts) iti (Bar/Md) chwa (A), pitei (Kk/Ach)

Ethiopia: hemor, humor, humar, komar, tommar (Am) aradeb (T), b/roka, rucahu, dareho, dindie, ghroma, gianko, omar (G/O)

Somalia: hamar, rahkai

Tanzania: oloisijoi, masamburai, olmasumoei (Maasai) msisi (Gogo, Nyamwezi, Benda), ank'a (Sandawi), bushishi, nshishi (Sukuma) mkakyi, moya (Chagga)

English: tamarind

French: tamarin

Swahili: ukwaju, mkwaju

## Uses:

**Food:** Fruits are edible. The pulp, which is eaten raw, has a strong acid taste. The pulp is also dissolved in water and the resulting solution used for preparing porridge or added to stews and various foods or used in beer preparation. Immature green pods and leaves are chewed or cooked as a vegetable. Seeds are fried and eaten.

**Medicinal:** Leaves are chewed or pounded and used as medicine for treatment of diarrhoea, dysentery, stomachache, malaria, sore throat and fever, or used as laxative. Boiled bark used for treatment of gonorrhoea. Root decoction is used as a remedy for asthma, leprosy, liver disease, rheumatism boils, fever, hookworms and ulcers. Pounded seeds are used as remedy for dysentery.

**Other:** Fuelwood, charcoal, timber, fodder for goats and camel. Tree is used for shade as a windbreak, firebreak, ornamental and source of bee forage.

## Processing to high value products

### Tamarindus juice

#### Ingredients

- 1.5 cups of ripe fruit pulp
- 0.25kg sugar
- 0.25cup lemon juice
- 0.75 litre of water

#### Preparation

- Sort the fruits to remove dirt and plant debris
- Extract pulp from ripe fruits by using hot water (soak for sometimes then sieve through 800 micron sieve)
- Extract lemon juice
- Prepare rind from lemon fruits using grater
- Dissolve sugar in warm water, add rind and strain through a cheese cotton muslin cloth
- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for one to five (1-5) minutes
- Pasteurise the juice below boiling point less than a minute
- Pour the juice in sterilised jars and heat for 5 minutes with loose lid and tight after cooling label and store.

### For a richer beverage

- Shell a quantity of tamarindus and cover them with a hot sugar syrup
- Allow to stand for several days (with or without seasoning like lime, slices, pepper or ginger)
- Dilute as desired with ice water and strain.

### Tamarind jam

#### Ingredients

- 1 cup of ripe fruit pulp

- 1 cup of sugar
- 0.25 cup lemon juice
- 2 cups of water

#### Preparation

- Sort the fruits to remove dirt and those with physical signs of discolouration or infected
- Shell the fruits
- Wash the fruits using tape water
- Soak the fruit in ‘just enough’ water until the pulp can come out easily. Shake vigorously then strain out the pulp. (or boil the fruits while stirring until you get a smooth pulp then sieve)
- For every cup of juice, add cup of sugar
- Bring the mixture slowly to boil and simmer while stirring until sugar dissolves. Then let the mixture boil rapidly while stirring to prevent burning. When thick, test for setting (69% brix) TSS using Refractometer.
- Pour the hot jam into clean sterilised jars, seal and cover.
- Label and store

### **Tamarind butter**

#### Preparation

- Sort the fruits
- Shell a quantity of tamarind
- Wash the fruits
- Add an equal amount of sugar
- Cover with water and boil for a few minutes while stirring until shows that the pulp has loosened from the seeds
- Strain through a sieve. The strained pulp appears like apple butter and can be stored under refrigeration for use in cold drinks, as a sauce for meat, poultry, plain cakes or puddings

### **Foamy ‘tamarind shake’**

- Stir the sauce (1b) into some amount of dark brown sugar (desired taste)
- Add a tablespoonful of the mixture to a plain carbonated beverage and whip in an electric blender.

### ***Sclerocarya birrea***

#### **Common names**

Kenya: didisa (Borana), mfula, fula (Chonyi, Giriama), mng’ongo (Digo) muuwa, mauwa (Kamba), ong’ong’o, ng’ong’o (Luo), olmang’uai (Maasai)

Tanzania: mng’ongo (Nyamwezi), ng’ongo (Sukuma) olmang’oi (Arusha) omongwe (Kurya), gulgurchandi (Iraqw, Goro)

Uganda: enaimu (Kmj), ijakait (LnG)  
Ethiopia: kumal, gameles (Am) abengul (T)  
English: morula, marula, cider tree, cat thorn, maroola nut  
Swahili: mng'ongo, nmng'omng'o, mongo, mungango

### Uses

**Food:** All parts of the fruit of are edible. The vitamin C content of the fruit 160mg/100g, which is 3 to 4 times that of the orange. The seeds are high in fat (56-61%), protein (28-31), citric acid (2.02%), malic acids and sugar, phosphorus, magnesium, copper, zinc, thiamine and nicotinic acid. The pulp can be consumed raw or boiled into a thick, black consistency and uses for sweetening porridge. The fruit is an excellent conserve and makes a delicious amber-coloured jelly. The favour of the pulp has been described as pleasant, sour-sweet, guava likes and tart. The nuts described as a delicacy, are commonly used to supplement the diet during winter or drought periods in countries such as Tanzania and Zambia, as the oil in the seed is rich in protein. Protein contents of 54-70% have been reported for de-fatted nuts. They are mixed with vegetables or meat or may be pounded and made into a cake before consumption.

**Fodder:** The fruits are eaten by cattle and goats and a wide variety of game animals, including, elephants. Although the leaves are said to be slightly poisonous, in time of drought when there is no grazing, livestock owners will lop branches off the tree to use the leaves as fodder.

**Fibre:** A relatively good quality rope can be from the inner bark.

**Timber:** Wood is light reddish-brown to whitish with no definite heartwood, soft and light (air-dry 560kg/cubic m). As trees attain large diameters, the wood is preferred for mortars, pestles, bowls and various local crafts, saddles, furniture and heavy crates. In South Africa, commercial utilisation of the wood was halted in 1962 when the tree was officially declared a protected species throughout the country.

**Gum/resin:** The gum that exudes from the tree is rich in tannin and is sometimes used in making ink by dissolving it in water and mixing in soot.

**Lipids:** The nuts yield oil with a quality and fatty acid composition comparable to oil live olive oil but with a stability that is 10 times greater. A non-drying oil that burns like candle comprises 56% of the seed. The walnut like stone contains up to 6% edible oil (1 t of fruit yields 60 of oil), which is occasionally sold on the local market. The oil from the seeds has preservative properties and, if dried and stored in a cool place, meat treated with it is said to keep up to a year. Zulu women of South Africa use the extracted oil as a cosmetic.

**Medicine:** Bark of *S. birrea* is used to treat a variety of ailments, notably fever, boils and diarrhoea. Together with butter, it is applied as an ointment for headache and pains of the eyes. It is claimed that blood circulation is aided by a steam bath of extracts of *S. birrea* mixed with extracts from other plants and roots. Steam from the bark is also used to treat eye disorders. Bark decoction, when mixed with other medicinal plants, treats various infections such as malaria, syphilis, leprosy, hydropsy, dysentery, hepatitis and rheumatism, and is a laxative. Leaves, bark



and roots are used externally (as a rub) for snakebite, and internally (as a beverage) for toothache. It has occasionally been used in veterinary medicine.

**Other uses:** The tree is a host to the edible mopane caterpillar, provide shade or shelter, live fence

### **Processing to high value products**

#### **Marula fruit juice**

##### Ingredients

- 1.5 cups of ripe fruit pulp
- 0.25kg sugar
- 0.25cup lemon juice
- 0.75 litre of water

##### Preparation

- Sort the fruits to remove dirt, damaged and infected ones
- Wash the fruits using sterilized water
- Extract the juice
- Make sugar syrup
- Mix well
- Add lemon juice to taste and boil for five minutes
- Cool in freezer

#### **Marula fruit Wine**

- Sort the fruits to remove dirt, damaged and infected fruits
- Wash the fruits
- Fill container half with cleaned fruits and add warm water to just cover the fruits
- Allow it to stand for 2-4 days
- Fruits are squeezed back into container and skins and stones removed
- Leave it for 7 or more days in airtight container to ferment.
- Sugar or honey speeds up process if added
- If air bubbles stop, means it is ready
- Strain it through a sieve and store in a cool place it is better if drunk when chilled.

### **Flacourtia indica**

#### **Common names**

Ethiopia: meneda (Am), huda, hudaferda, akoko (O/G)

Kenya: mdungatunga (Digo, Chonyi, Kamba), kiathani, kikathani (Kamba), tungururwa(Mbeere) mutuhaco, muroro (kikuyu)

Tanzania: mpukuswa (Sukuma, Nyamwezi) msambuchi (Chagga), mtundukarya (Rangi), sokhaimo (Iraqi)

Swahili: mchongoma, mgovigovi, mkingiri  
English: governor's plum, Indian plum, Madagascar plum  
French: prunier de Madagascar

## Uses

**Food:** The fruit is soft, sweet and reddish purple in colour when ripe and eaten raw. Pulp can be made into jams, juice, wines, jellies and pies.

**Medicinal:** Leaves, barks and roots are used to treat stomach ache, cough, asthma and gonorrhoea.

**Fodder:** Leaves are good fodder for goats

**Others:** Timber, firewood, farm tools and live fences

## Processing to high value products

### *Flacourtia indica* juice

#### Ingredients

- 1kg fruit pulp
- 0.5kg sugar
- 1.25g lemon juice
- 1 teaspoonful lemon rind
- 3 litres of water

#### Preparation

- Sort the fruits to remove dirt and fruit with physical sign of discolouration or infected ones
- Wash the fruits using clean sterilized water
- Extract the fruits pulp using mortar and pestle
- Extract lemon juice by squeezing
- Prepare lemon rind using grater
- Dissolve sugar in warm water, add rind and strain through a white cotton cheese muslin cloth
- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for 1 to 5 minutes
- Pasteurise the juice below boiling point less than a minute
- Pour the juice in clean sterilized jars and heat for 5 minutes with loose lid and tight after cooling

### *Flacourtia indica* jam

#### Ingredients

- 1000g fruit pulp
- 680g sugar
- 670g lemon juice
- 80g Pectin

- 11g citric acid
- 3 litres water

#### Preparation

- Sort the fruits
- Wash the fruits to remove dirt (using tap water)
- Extract lemon juice by squeezing
- Extract the pulp from the fruits and using mortar and pestle
- Add white sugar or (dissolve brown sugar in water and strain to remove impurities )
- Boil all ingredients while stirring frequently until the required consistency is reached.
- Add Citric Acid when Jam is near to set.
- Taste jam setting by using refractometer to required TSS (69%) brix. Or (drop a little jam on a plate with cold water, if a drop remains whole the jam is ready and if it spreads it needs longer cooking.
- Pour the hot jam into sterilized glass bottles, tight the lid let it cool label and store.

#### ***Flacourtia indica* wine**

##### Ingredients

- 2kg fruits
- 2kg sugar
- 1 orange fruit
- 6 litres water
- 4 lemon fruits
- 1 cup of tea
- Wine yeast

##### Preparation

- Sort the fruits to remove dirt
- Wash the fruits (using tap water)
- Extract the pulp from fruits by using hot water
- Extract lemon and orange
- Prepare wine yeast
- Dry heat 4 tablespoonfuls of sugar until it changes brown colour then add it to the fruit juice
- Pour all ingredients into plastic container and cover it.
- Store in a place where it will not be disturbed
- Stir once every day for 8 days
- Filter the mixture and transfer the juice into fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, to allow carbon dioxide to escape while preventing oxygen to enter the vessel.
- Store it for 10 – 14 days and decant
- Fill it in pre-sterilized bottles and cork
- Label and store.

## *Parinari curatellifolia*

### Common names

Kenya: omoraa (Kisii), mutaburu (Kuria), ongoro (Luo) ol'malakuroi (Maasai), mura, maura (Mbeere)

Uganda: angili (Bar/kk)

Tanzania: mbula (nyamwezi, Benda, Matengo, Zaramo Mnazi pori (Sukuma, Nyamwezi)

English: mabola plum, sand apple, fever tree, cork/hissing tree

French: parinaire

Swahili: mbula, mbura

### Uses

**Food:** Fruit pulp is sweet with strong pineapple flavour and rich in vitamin C. The pulp can be processed into beverages and cakes or dried for preservation kernels are rich protein and edible oil. They are eaten fresh or after roasting. Roasted kernels are pounded to a paste. Which is added to green leafy vegetable soup.

**Medicinal:** Barks are used to treat pneumonia, are troubles, stomach pains, diarrhoea, dysentery. Roots are used to treat cataracts, colic and cough.

**Fodder:** Leaves and fruit

Beekeeping: Flowers have abundant nectar and pollen. Barks are used for making beehives.

**Other uses:** timber (building rafters, furniture) poles, firewood, charcoal, shade, and ornamental

### Processing to high value products

#### *Parinari curatellifolia* juice

##### Ingredients

- 1kg fruit pulp
- 0.5kg sugar
- 1.25g lemon juice
- 1 teaspoonful lemon rind
- 3 litres of water

##### Preparation

- Sort the fruits to remove dirt and fruit with physical sign of discolouration or infected ones
- Wash the fruits using clean sterilized water
- Extract the fruits pulp using mortar and pestle
- Extract lemon juice by squeezing
- Prepare lemon rind
- Dissolve sugar in warm water, add rind and strain through a white cotton cheese muslin cloth

- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for 1 to 5 minutes
- Pasteurise the juice below boiling point less than a minute
- Pour the juice in clean sterilized jars and heat for 5 minutes with loose lid and tight after cooling

### ***Parinari Curatellifolia jam***

#### Ingredients

- 1000g fruit pulp
- 670g sugar
- 66g Pectin
- 14g citric acid
- 1.25g lemon juice
- 3 litres water

#### Preparation

- Sort the fruits
- Wash the fruits to remove dirt (using tap water)
- Extract lemon juice by squeezing
- Extract the pulp from the fruits and using mortar and pestle
- Add white sugar or (dissolve brown sugar in water and strain to remove impurities)
- Boil all ingredients and boil while stirring frequently until the required consistency is reached.
- Taste jam setting by using refractometer to required TSS (69%) brix. or drop a little jam on a plate with cold water, if a drop remains whole the jam is ready and if it spreads it needs longer cooking.
- Pour the hot jam into sterilized glass bottles, tight the lid let it cool, label and store.

### ***Parinari curatellifolia wine***

#### Ingredients

- 2kg fruits
- 2kg sugar
- 1 orange fruit
- 6 litres water
- 4 lemon fruits
- 1 cup of tea
- Wine yeast

#### Preparation

- Sort the fruits to remove dirt
- Wash the fruits (using tap water)
- Extract the pulp from fruits by using hot water
- Extract lemon and orange
- Prepare wine yeast

- Dry heat 4 tablespoonfuls of sugar until it changes to brown colour then add it to the fruit juice
- Pour all ingredients into plastic container and cover it.
- Store in a place where it will not be disturbed
- Stir once every day for 8 days
- Filter the mixture and transfer the juice into fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, to allow carbon dioxide to escape while preventing oxygen to enter the vessel.
- Store it for 10 – 14 days and decant
- Fill it in pre-sterilized bottles and cork
- Label and store.

### ***Strychnos cocculoides***

#### **Common names**

Kenya: kyaе, kimee (Kamba), kukughо (Pokoti), mujaje (Kamba), mangura, mangula (Chonyi)

Tanzania: mtonga, mumilwa (Nyamwezi), mdonga, mtongawili (Mate), mnywewa (Hehe)

English: corky bark, monkey orange, bush orange

Swahili: mtonga, kikwakwa, mpapa

#### **Uses**

**Food:** The ripe fruit has sweet – acid taste juice rich in vitamin C, is sucked and seeds discarded. The juice is also extracted and made into beer.

**Medicinal:** A root decoction is used to treat gonorrhoea and pounded leaves put on sores

**Other:** Firewood, building poles, tool handles

#### **Processing to high value products**

##### ***Strychnos cocculoides* juice**

###### **Ingredients**

- 1000gm fruit pulp
- 500gm sugar
- 125g lemon juice
- 1 teaspoonful lemon rind
- 3 litres of water

###### **Preparation**

- Sort the fruits to remove dirt and fruit with physical sign of discolouration or infected ones
- Wash the fruits using clean sterilized water

- Extract the pulp cutting the hard skin and remove then use mortar and pestle to loosen the pulp
- Extract lemon juice by squeezing
- Prepare lemon rind
- Dissolve sugar in warm water, add rind and strain through a white cotton cheese muslin cloth
- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for 1 to 5 minutes
- Pasteurise the juice below boiling point less than a minute
- Pour the juice in clean sterilized jars and heat for 5 minutes with loose lid and tight after cooling

### ***Strychnos cocculoides* jam**

#### Ingredients

- 1000g fruit pulp
- 630g sugar
- 80g Pectin
- 10.8g Citric acid or 1.25g lemon juice
- 3 litres water

#### Preparation

- Sort the fruits
- Wash the fruits to remove dirt (using tap water)
- Extract lemon juice by squeezing
- Extract the pulp cutting the hard skin and remove them use mortar and pestle to loosen the pulp
- Add white sugar or (dissolve brown sugar in water and strain to remove impurities)
- Boil all ingredients while stirring frequently until the required consistency is reached.
- Add Citric Acid when Jam is near to set.
- Taste jam setting by using refractometer to required TSS (69%) brix. Or (drop a little jam on a plate with cold water, if a drop remains whole the jam is ready and if it spreads it needs longer cooking.
- Pour the hot jam into sterilized glass bottles, tight the lid let it cool label and store.

### ***Strychnos cocculoides* wine**

#### Ingredients

- 2kg fruits
- 2kg sugar
- 1 orange fruit
- 6 litres water
- 4 lemon fruits
- 1 cup of tea
- Wine yeast

#### Preparation

- Sort the fruits to remove dirt

- Wash the fruits (using tap water)
- Extract the pulp cutting the hard skin and remove them use mortar and pestle to loosen the pulp
- Extract lemon and orange juice by squeezing
- Prepare wine yeast
- Dry heat 4 tablespoonfuls of sugar until it change colour to brown then add it to the fruit juice
- Pour all ingredients into plastic container and cover it.
- Store in a place where it will not be disturbed
- Stir once every day for 8 days
- Filter the mixture and transfer the juice into fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, to allow carbon dioxide to escape while preventing oxygen to enter the vessel.
- Store it for 10 – 14 days and decant
- Fill it in pre-sterilized bottles and cork
- Label and store.

### *Vitex mombassae*

#### **Common names**

Kenya: mkalijote (Boni), fudu, mfudokoma, mfudu, (Chonyi), fudumazi, mfudukoma (Digo), mfududu, mfudukoma, mfudu (Giriana Pokomo)

Sudan: unrugulguh (Chad, Ar), abdugulgul zeitun, kurain (Am), kluruf, tidogi, madimu (Nb) konink (Dk)

Tanzania: Tlambau (Iragw), olupuri (Maasai) msungwa (Kerewe), msungwi (kimb) mntalali (Nyamwezi) msungwi, mgukubi (Sukuma), mchumbau (Rangi) msasati (Hehe)

English: smelly – berry

Swahili: mfundu maji, mntalali, mvumba, mgege, mbwanga

#### **Uses**

**Food:** Fruits are edible. Fruit pulp is juicy when ripe and eaten raw. It is also dried and stored for future use.

**Medicinal:** Fruits used to cure cough. Root decoction is used to stop vomiting and cure infertility.

**Other:** Fuel wood, fodder, bee forage and shade.

#### **Processing to high value products**

##### *Vitex mombassae* juice

###### Ingredients

- 1kg fruit pulp



- 0.5kg sugar
- 1.25g lemon juice
- 1 teaspoonful lemon rind
- 3 litres of water

#### Preparation

- Sort the fruits to remove dirt and fruit with physical sign of discolouration or infected ones
- Wash the fruits using clean sterilized water
- Extract the fruits pulp using mortar and pestle
- Extract lemon juice by squeezing
- Prepare lemon rind
- Dissolve sugar in warm water, add rind and strain through a white cotton cheese muslin cloth
- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for 1 to 5 minutes
- Pasteurise the juice below boiling point less than a minute
- Pour the juice in clean sterilized jars and heat for 5 minutes with loose lid and tight after cooling

#### ***Vitex mombassae* jam**

##### Ingredients

- 1kg fruit pulp
- 655g sugar
- 80g Pectin
- 11g citric acid
- 3 Ltrs water

#### Preparation

- Sort the fruits to remove dirt
- Wash the fruits to remove dirt (using tap water)
- Extract lemon juice by squeezing
- Extract the pulp from the fruits by boiling for 5 five minutes then use mortar and pestle to loosen the pulp.
- Add white sugar or (dissolve brown sugar in water and strain to remove impurities
- Boil all ingredients and boil while stirring frequently until the required consistency is reached.
- Add Citric Acid when Jam is near to set.
- Taste jam setting by using refractometer to required TSS (69%) brix. Or (drop a little jam on a plate with cold water, if a drop remains whole, the jam is ready and if it spreads it needs longer cooking.
- Pour the hot jam into sterilizes glass bottles, tight the lid let it cool, and store.

#### ***Vitex mombassae* wine**

##### Ingredients

- 2kg fruits
- 2kg sugar
- 1 orange fruit
- 6 litres water
- 4 lemon fruits
- 1 cup of tea
- Yeast

#### Preparation

- Sort the fruits to remove dirt
- Wash the fruits (using tap water)
- Extract the pulp from fruits by using hot water
- Extract lemon and orange
- Prepare wine yeast
- Dry heat 4 tablespoonfuls of sugar until it changes colour to brown then add it to the fruit juice
- Pour all ingredients into plastic container and cover it.
- Store in a place where it will not be disturbed
- Stir once every day for 8 days
- Filter the mixture and transfer the juice into fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, to allow carbon dioxide to escape while preventing oxygen to enter the vessel.
- Store it for 10 – 14 days and decant
- Fill it in pre-sterilized bottles and cork
- Label and store.

### ***Berchamia discolor***

#### **Common names**

Kenya: kisanawa, kisaaya, mzeeya, (Kamba), jajab, jajab (Borana) muchukwo (Pokot), mkulu (Kambe, Chonyi, Giriama), muchukwa (Marakwet), muthwana (Mbeere)

Tanzania: mgandu (Gogo, hehe), nyahunmbu (luguru) njerenje (Matengo, Yao)mkelienge (Ngindo) mkuni (Nyamwezi), okoo,ooko, thokoi (Sandawi)

Somalia: deers, dheen-de roo, kor'guba

English: Bird plum, brown ivory, wild almond

Swahili: mkulu, mnago

#### **Uses**

**Food:** Fruits are edible. They are sweet and very much favoured by children, herdsman and farmers to assuage hunger. Ripe fruits can be soaked in water, squeezed and juice drunk or used for making porridge

**Medicinal:** Bark infusion used for enlarged spleen and diarrhoea. Ground up fruits used for sore throat and tonsillitis

**Other:** The wood is used for timber, tool handles pestles, fuel, poles and gunstocks. Tree used for suspending beehives

## **Processing to high value products**

### **Berchamia fruit juice**

#### **Ingredients**

- 1.5 cups of ripe fruit pulp
- 0.25kg sugar
- 0.25cup lemon juice
- 3 litre of water
- Rind 1 teaspoon

#### **Preparation**

- Sort the fruits to remove dirt
- Wash with clean and sterilized water
- Extract the pulp from ripe fruits by using mortar and pestle then strain through a sieve
- Extract the lemon juice
- Prepare rind from lemon fruit (using grater)
- Add white sugar (or dissolve brown sugar in warm water and add rind then strain through a cheese cotton muslin cloth)
- Add extracted juice to the sugar syrup, mix well and add in the lemon juice and boil for one to 5 minutes
- Pasteurise the juice below boiling point less than a minute
- Pour the juice in sterilised jars and heat for 5 minutes with loose lid and tight after cooling.

### **Berchamia fruit jam**

#### **Ingredients**

- 2kg fruits
- 0.75kg sugar
- 125mls lemon juice
- Rind 1 teaspoon

#### **Preparation**

- Sort the fruits
- Wash the fruits by using tape water
- Extract the pulp from ripe fruits by using mortar and pestle then strain through a sieve.
- Extract lemon juice by squeezing
- Use white sugar or dissolve brown sugar in warm water and strain through a cheese cloth
- Mix all ingredients and boil until thick while stirring the mix frequently
- Pour the hot jam into sterilized hot jars and seal
- Cool and label the jars and store a fudge or dark cool place.

## **Berchamia wine**

### Ingredients

- 4kg fruits
- 2kg sugar
- 1 orange
- 4 lemons
- 1 cup of tea
- Wine yeast
- 6 litres of water

### Preparation

- Sort the fruits
- Wash them with clean water
- Extract the juice/pulp using mortar and pestle
- Extract orange and lemon juice
- Prepare wine yeast (as in baobab wine)
- Dry heat 4 tablespoonfuls of sugar until it changes colour to brown then add it to the fruit juice
- Pour all ingredients into plastic container and cover it.
- Store in a place where it will not be disturbed
- Stir once every day for 8 days
- Filter the mixture and transfer the juice into fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, to allow carbon dioxide to escape while preventing oxygen to enter the vessel.
- Store it for 10 – 14 days and decant
- Fill it in pre-sterilized bottles and cork
- Label and store.

## **Practicals**

The participants were trained practically on making *Adansonia digitata* juice, *Tamarindus indica* wine, *Vitex payos* jam and *Adansonia digitata* vegetable.

### ***Vitex payos* jam making**

#### Ingredients

- 1kg fruit pulp
- 655g sugar
- 80g Pectin
- 11g citric acid
- 3 Ltrs water



Left, *Vitex payos* fruits ready for jam making, while right, participants extract pulp from the fruits. Fruits of this tree are often underutilized.



### Preparation

- Sort the fruits to remove dirt
- Wash the fruits to remove dirt (using tap water)
- Extract lemon juice by squeezing
- Extract the pulp from the fruits by boiling for 5 five minutes then use mortar and pestle to loosen the pulp.
- Add white sugar or (dissolve brown sugar in water and strain to remove impurities)
- Boil all ingredients and boil while stirring frequently until the required consistency is reached.
- Add citric acid when Jam is near to set.
- Taste jams setting by using refractometer to required TSS (69%) brix. Or (drop a little jam on a plate with cold water, if a drop remains whole, the jam is ready and if it spreads it needs longer cooking.
- Pour the hot jam into sterilizes glass bottles, tight the lid let it cool, and store.



Left, trainers participate in jam making while right, they do jam packaging in bottles. The jam made was used by the participants during the workshop.



### ***Adansonia digitata* Juice making**

#### Ingredients

- 1.5 cups of ripe fruit pulp
- 0.25kg sugar
- 0.25cup lemon juice
- 0.75 litre of water



Left, baobab fruits and right, participants start the process of baobab juice making. The participants prepared juice from baobab fruits.



### Preparation

- The fruits were sorted to remove dirt and plant debris, and then cut to remove the hard skin.
- Pulp was extracted from ripe fruits by using hot water (soaked for sometimes then sieved through 800 micron sieve)
- Lemon juice extracted
- Rind was prepared from lemon fruits using grater
- Sugar was dissolved in warm water, rind was added and strained through a cheese cotton muslin cloth
- Extracted juice was added to the sugar syrup, mixed well and added in the lemon juice and boiled for one to five (1-5) minutes
- The juice was pasteurised below boiling point less than a minute
- The juice was poured in sterilised jars and heated for 5 minutes with loose lid and tight after cooling



Participants serve a baobab juice they had prepared. The juice is rich in vitamin C.



### Tamarind Wine making

#### Ingredients

- 1kg ripe fruit pulp
- 1kg of sugar
- 1 orange
- 2 lemons
- 1 teaspoonful of yeast
- 3 litres of water



Left Tamarind fruits while, at right, trainers participate in extracting pulp from the fruits. Tamarind wine is very nutritious.



### Preparation

- Sort the fruits to remove dirt and those with physical signs of or infection, discolouration
- Extract the pulp from fruits by using hot water (soaking in hot water for sometimes then sieve through 800 micron sieve)
- Extract orange and lemon juices
- Prepare wine yeast by mixing one teaspoonful yeast, the spoonful sugar, lemon juice extracted from half lemon fruit and 125mls of warm water. Mix well and leave for rising.
- Dry heat 4 tablespoonfuls of sugar until it changes the colour to brown and add it to the fruit juice.
- Pour all ingredients into plastic container and cover it store in a place where it will not be disturbed.
- Stir once every day for 8 days
- Filter the mixture and transfer the juice into a fermentation vessel with a plastic tube connected to the lid and the other part immersed in water, allowing carbon dioxide to escape while preventing oxygen to enter the vessel
- Store it for 10 – 14 days and decant
- Fill it in pre-sterilised bottles and cork



Trainers participating on making wine from tamarind. Tamarind wine has great potential to increase income in the rural areas.



### Baobab Vegetables preparation

#### Ingredients

- Baobab leaves
- Salt
- Onion
- Cooking oil

#### Preparation

- Sort the leaves in order to have good quality vegetable

- Wash the vegetables
- Cut them into small pieces using a sharp knife on a chopping board
- Slice the onion into small pieces
- Add oil into cooking pan
- Add onion and stir
- Add vegetable, stir and cover with lid
- Let it cook for 3 minutes then put the cooking pan off from the fire and serve



preparation of baobab soup vegetables. Young leaves are rich in Vitamin C and A, contains uronic acids, and is high in demand in West Africa as a soup vegetable. The vegetables are thus an important food and nutrition supplement in the drylands.





## **2. Training on IFTS products value addition (Lecture and Practical).**

By: Mr. Toma Ngovu, Kitui Agriculture office.

### **Importance of fruit processing and preservation**

1. Processed fruit has longer shelf life than fresh fruit hence it can keep longer
2. Processed/preserved fruits will be available to the consumer even in the off –season hence serves as a food security measure to the farmers
3. Proper fruit preservation minimizes nutrients losses e.g. vitamins that are essential for good health.
4. Processed fruit products are attractive to most consumers hence fetch better prices for the farmer therefore improving the farmers income
5. Processing reduces the bulk of fruits hence the ease of transporting and storage of the products

### **Value addition on fruit products**

Value addition simply means improving the quality of a product to meet the tastes and preferences of potential consumers

- it is done to improve sales of the said products
- It improves shelf life of the products

Measures of carrying out value addition on processed fruit products (jams, Jellies and Juices)

1. Processing and packaging the products this prolongs their shelf life and eases transportation to markets, internally and externally.
2. Addition of recommended food colours and flavours this makes the products attractive hence fetching better prices.
3. Increases competition of the home made fruit products against the industrial ones.

### **Some food colours and flavours available in the markets are:**

Colours- Tomato red, Pink, Blue, Orange. Purple, Mango red etc  
Flavours –Mango, Strawberry, Pineapple, Orange etc

NOTE: Value addition will increase the production costs hence is only recommended where there is a ready market for the products.

### **The Dos and Don'ts in food preparation and handling**

1. Always wash hands in clean water before handling food
2. Use clean equipment and utensils to prepare and serve food
3. Wash food for example vegetables, fruits and meat in clean water before cutting or chopping
4. Use fresh food
5. Wash hands after visiting the toilet and before meals
6. Do not sneeze or cough over cooked food
7. Wear protective clothes and cover the hair with a head scalp or a cap

8. Do not store cooked food for a long time to avoid food poisoning

### **Cleanliness and safety in the kitchen**

1. Keep the kitchen dry and free from food spills and crumbs. This is to avoid accidents and attracting household pests.
2. Keep all the equipment, utensils and storage facilities clean.
3. Store all equipments on a raised surface.
4. Wash kitchen clothes and tea towels every day after use. It is advisable to dry utensils and equipment on dish rack where water is scarce.
5. Clean your kitchen regularly. Preferable every time you finish preparing a meal. It is advisable to clean as you work.
6. Never leave sharp utensils such as knives and forks in washing water. This is to avoid accidents.

### **PRESERVATION OF FOOD AS SUGAR CONCENTRATES (Jams, Jellies, Marmalades and preserves)**

Food concentrated to 65 percent or more soluble solids, and containing a good quantity of acid may be preserved with mild heat treatments provided it is protected from the air. With more than 70 percent solids, high acid content is not required. The making of jams, jellies, preserves, and marmalades is based on the principle of high-solid high acid products. Such fruit concentrates are important methods of preserving fruits, and also provide a way of utilizing fruit which is not good enough to be used for bottling (canning), or for freezing, e.g., those fruits which are too large, or too small, and those which are regularly shaped.

Basically, these fruit products are much alike in that all of them are preserved by means of sugar and usually all are jellied to some extent. Their individual characteristics, however, depend on the kind of fruit used and the way it is prepared, the proportions of different ingredients in the mixture and the method of cooking.

**Jams:** A jam is made from crushed or ground fruit. It holds its shape, but not as firmly as the jelly.

**Jelly:** A jelly is made from fruit juice, the product is clear and firm and holds its shape when turned out of a container.

**Marmalade:** Marmalades are tender jellies with small pieces of fruit distributed evenly throughout the product. They are usually made from citrus fruits such as oranges, lemons, grapefruits, and limes or a mixture of two or ore. Chunky marmalade contains bigger pieces of fruit peel and they are not always clear.

**Preserves:** Preserves are whole fruits or large pieces of fruits in thick syrup, which is slightly jellied.

### **Essential Ingredients**

To make jellied products, proper amounts of fruits, pectin, acid and sugar are needed.

## **Fruit**

Fruit gives each product its characteristic flavour and furnishes at least part of the pectin and acid required for successful gels. Fruits that are rich in flavour are best for jellied products because the large proportions of sugar necessary for proper consistency and good dilute the fruit flavour keeping quality.

## **Pectin**

Pectin is the gum-like substance in the fruit, which causes jellied products to set and thicken. Some types of fruits have enough natural pectin to make high quality products. Others require added pectin, particularly when they are used for making jellies, which should be firm enough to hold their shape. All fruits have more pectin when they are under-ripe. In over-ripe fruits, the pectin has been changed to pectin acid by enzymes; hence the products made from them may not set properly. The pectin in the fruit is released when the fruit is cooked over gentle heat, until it is reduced to a pulp. Sugar interferes with the release of pectin and therefore, should not be added at the initial cooking stages.

## **Acid**

Acid is needed to add flavor and for the formation of gel. The acid content varies in different fruits and is higher in under ripe fruits. With fruits, which are low in acid, lemon juice or citric acid is added in making of jellied products. In recipes calling for the use of lemon juice, this can be substituted by citric acid at the rate of 1/8 teaspoon crystalline citric acid for each tablespoon lemon juice called for.

## **Sugar**

Sugar helps in gel formation, serves as the preserving agent, and contributes to the flavour of the product. It also has a firming effect on the fruit: a property that is essential in the making of preserves.

## **Equipment and containers**

A large saucepan or sufuria is essential to cook the fruit without boiling over. Other kitchen equipment that may be useful include a measuring cup, spoons, stainless steel knives, a wooden spoon, grater, chopping board, a masher, and a kitchen scale. For making jellies, a jelly bag is essential for extracting juice from the fruit. The bag may be made of several thickness of cheesecloth, or a firm unbleached muslin cloth.

Containers include glass jars with well fitting lids that have no chips or cracks.

## **Points to remember when making jams and jellies**

- Use sound, firm and ripe, or slightly under ripe fruit.
- Use a saucepan which is large enough to allow frothing up when sugar is added
- Simmer the fruit until it is soft and all the juice and pectin has been extracted.  
Use only enough water to start juice extraction
- Add sugar slowly, stirring all the time and do not allow fast boiling before the sugar is completely dissolved.
- Boil rapidly after the sugar has dissolved until setting point is reached, testing for setting point after it has boiled for at least ten minutes

- Remove the scum when the jam or jelly is ready, but not before, to avoid wasting the jam.

### **Jam making**

A jam is smooth and thick, and has the natural flavour of the fruits from which it is made. It has a softer consistency than jelly. The methods of preparing different fruit jams vary slightly with each fruit. However, the basic principles are the same, as will be seen in the preparation methods given below for different fruit jams. It is possible for failures to occur during jam making. Causes of some of the faults in jams are brought about by the factors explained below

1. Over boiling with sugar- this darkens the colour of the jam and spoils the flavour. It may also cause the jam to be sticky.
2. Undercooking- this causes the jam to be syrupy or runny and results in a fermented product.
3. Insufficient acid, pectin and sugar- this causes the jam to be runny (not set) and may also result in a fermented product.
4. Too much sugar- this may cause a sticky or crystallized jam. Overcooking after the setting point has been reached may cause the same.

**Note:** it may be possible to correct some faults in time to save the product, an undercooked jam could be returned to the fire, or a low acid/pectin fruit can be saved by adding acid or pectin, however, a crystallized jam is permanently damaged and cannot be rectified, it should not be bottled.

### **Testing the setting point of jam**

The setting point of jam occurs when the sugar concentration is about 65 percent of which five percent will come from the fruit and 60 percent from the added sugar. Testing whether this concentration is reached can be done using two simple methods shown below:

#### **a) Flake test**

Dip the stirring spoon in the boiling jam mixture, then raise it at least 30cm above the pot, and out or reach of the steam. Hold the spoon horizontally for a few seconds, and then turn the spoon so that the jam runs off the side. If the jam falls in clear drops from the spoon it should be done. However, if it runs on a continuous flow, it should be cooked a little longer and tested again.

#### **b) Cold plate test**

Pour a small amount of the jam onto a cold plate or saucer and stand it in a draught to cool. When quite cold, push the jam with the forefinger. The jam is ready if it forms wrinkles and a skin forms on it. During this test, the jam should be removed from the heat to avoid overcooking. If a refrigerator is available in the house, the test sample can be put into the freezer compartment to hasten cooling.

### **Finishing the jam**

When the jam has reached the setting point, it should be removed from the heat and the scum removed quickly with a spoon, which has been dipped in boiling water, and wiped just before use. The jam is then poured into clean hot jars, leaving a headspace of about two cm. The mouth of the jar should be wiped with a clean cloth and wrung out after dipping in hot water.

If the jam is to be used within a few weeks, it should be covered with a well fitting lid and kept in a cool place or in a refrigerator if available. Jams that will be kept for longer periods, should be processed in a boiling water bath, sealed with melted wax, cooled, labeled and then stored in a cool dry place.

### **Preparing the jars**

The jars for use in storing the jam should be made ready before fruit for the jam is prepared for cooking. Wash the jars in warm soapy water and then rinse in hot water. Sterilize jars in boiling water for at least ten minutes. Jars must be completely submerged in the boiling water during sterilization. After this, keep them hot either in a slow oven or leave them in the sterilization water on top of a low heat until the jam is ready. This will protect them against re-infection.

### **Processing jam**

Processing of jams and other sugar concentrates is recommended in the warm or humid climates in order to improve the keeping quality of these products. For processing, expensive enamel can, deep saucepans or sufurias may be used as long as they can accommodate the jars and allow water to cover the jars fully during processing.

### **Processing method**

Put filled closed jars into water bathe canner or sufuria filled with hot water. Add more water, if needed to bring water to about four to six cm over tops of jars. Bring water to a rolling boil and boil gently for five to ten minutes. Drain water from the canner and remove jars. Place them onto a dry cloth or a dry wooden rack, but never on a cold surface. Cool away from drafts before storing. A proper seal could be achieved for jars which do not have airtight lids by poring hot melted candle wax to fill the headspace in the jar. Replace the lid, cool, label and store in cool dry place.

### **Selected jam recipes**

Follow the general guidelines for making jams whose recipes are given below:

#### **Mango jam**

6 cups mango cubes

3 cups sugar

½ cup water

Grated rind and juice of 1 lemon

#### **Method**

Wash fruit and peel, cut flesh from the seed in cubes. Measure fruit into a pan. Add water, lemon juice and rind and cook for about 15 minutes or until tender. Stir in the sugar until dissolved then bring the contents to boil and cook until the setting point is reached. Put into sterilized hot jars cover and process.

#### **Guava jam**

Any quantity of guavas

Sugar

Water

#### Method

Wash and cut up available fruit. Put into a large pan and add just enough water to cover the fruit. Cook slowly until the fruit forms a soft pulp. Press all the contents through a sieve to remove the seeds. Measure the juice obtained. To every one litre of juice, add one kg of sugar. Dissolve the sugar in the juice over low heat. Bring the contents to boil and boil rapidly until the setting point is reached. Put into hot jars and process.

#### **Pineapple jam**

2 medium pineapples

2 large lemons

Sugar (ration of 750 grams to every kg of pulp)

#### Method

Peel pineapple and remove the “eyes”. Cut lengthwise and remove the core. Mince the soft pulp or cut into very small pieces, being careful to catch all the juice. Measure the pulp, for every five cups of pulp, add one-cup water. Put the water and pulp into a pan and cook for about 15 minutes. Weigh the cooked pulp and for every one kg of pulp, add 750 g of sugar. Dissolve the sugar in the pulp, add strained lemon juice and bring to a boil. Cook rapidly until the setting point is reached. Pot and process.

#### **Gooseberry jam**

2.25kg gooseberries

3 kg sugar

1.25 litres of water

#### Method

Wash the fruit and put into a pan with the water. Cook gently until the fruit is tender. Add the sugar and stir until it dissolves. Increase the heat and boil hard until the setting point is reached. Pour into hot jars and process.

#### **Plum jam**

2kg plums

2kg sugar

½ litre (500ml) water

#### Method

Wash the fruit, cut it into halves and remove the stones. Put into a pan together with water. Simmer until the fruit is tender. Stir the sugar to dissolve, then increase the heat and bring the contents to a rolling boil. Boil until the setting point is reached. Pour into hot jars and process.

#### **Strawberry jam**

1 kg strawberries

1 cup lemon juice

1 kg sugar

#### Method

Select fruit and wipe clean with a damp cloth (do not wash fruit). Put into a pan together with lemon juice and cook slowly for about 10 minutes. Stir in the sugar until it dissolves. Increase the heat and boil rapidly for 4-5 minutes, then test for setting point. Boil a little longer, if necessary. Pour into hot jars, cover and process.

### **Pawpaw (papaya) jam**

3 cups mashed pawpaw  
3 cups sugar  
½ lemon juice

#### **Method**

Wash ripe pawpaw, cut into halves, and scoop seeds. Scoop flesh into a bowl and mash with a fork. Measure into a preserving pan and then add lemon juice and water. Heat to boiling point then cook rapidly until the setting point is reached. Proceed as for other jams.

### **Banana jam**

3 cups ripe bananas  
4 cups sugar  
½ lemon juice  
¼ cup water

#### **Method**

Peel bananas and cut into very small pieces. Measure into a preserving pan and add the remaining ingredients. Heat the mixture slowly while stirring to dissolve the sugar, and then boil quickly until the setting point is reached. Finish off as with other jams.

### **Tomato jam**

3 cups chopped tomatoes  
3 cups sugar  
3 lemons

#### **Method**

Wash and cut tomatoes into small pieces or chop them. Wash and grate lemons and squeeze out all the juice. Measure the tomatoes into a pan, and then add all the other ingredients. Heat the mixture slowly while stirring to dissolve the sugar. Increase the heat and boil the mixture until the setting point is reached. Finish off as with other jams.

## **Jelly making**

### **General guidelines**

The principles outlined for jam making apply equally to jelly making. To get a well-set jelly, pectin acid and sugar must be present in the correct proportions. A good firm jelly should be bright in colour, clear, well set, but not too stiff, and should have a good fruit flavour.

### **Preparation and cooking the fruit**

The fruit should be carefully washed and any unsound parts removed. Large fruits such as apples, guavas and plums should be cut into smaller pieces before being cooked, while small fruits, such as berries should be cooked whole. To get good results, all fruits should be cooked in some water, the quantity being determined by the amount of natural juice contained in a particular fruit. As a general rule, hard fruits should be covered with water in the preserving pan, while juicy fruits require only a small amount of water to start the cooking process.

Cooking should be done slowly by simmering until the fruit is tender. This takes from 45 minutes to about an hour, but it all depends on the hardness of the fruit. It is necessary to break down the fruit so that the acid and the pectin are dissolved in the water. When the fruit has been cooked sufficiently, it should be strained using a jelly bag. Bags made of unbleached muslin (Americana) or several folds of closely woven cheesecloth can be used. Alternatively, jelly bags can be made by sewing tapes across each corner of square unbleached cloth. The tapes can then be hooked over the legs of an upturned chair with the bag hanging in the middle. The jelly should be scalded in boiling water before the pulp is poured into it.

## **Practical: Mango jam making**

### **Ingredients**

6 cups mango cubes

3 cups sugar

½ cup water

Grated rind and juice of 1 lemon

### **Preparation**

Fruits are washed and peeled, flesh was cut from the seed in cubes.

Fruits are measured into a pan.

Water, lemon juice and rind are added and cooked for about 15 minutes until they turn tender. Sugar is stirred until it dissolved then the contents boiled and cooked until the setting point is reached.

It is put into sterilized hot jars, covered and processed.



Trainers participating in mango jam preparation. Mango jam contains carbohydrates and vitamin c and is popular among many consumers.





### **3. Marketing of Agricultural Products (Lecture).**

By: Mr. Frederic Mutothia, Kitui District Agriculture Office.

#### **Introduction**

In simple language marketing is the process of buying and selling of commodities. It can also be defined as performance of business activities that direct the flow of goods and services from the producer or seller to the consumer or user. The players of the marketing chain are as follows:-

- Producer/seller
- Middle dealers
- Consumer/user

#### **Objectives of this session**

By the end of the session the participants should be able to:-

- Develop the curriculum for disseminating market information to farmers at grass root level.
- Effectively facilitate in sensitizing and disseminating market information.
- Facilitate the farmers to draw an action plan on marketing of the their produce

#### **The major agricultural products in the region are:-**

- Traditional cash crops e.g Coffee, dairy, macadamia, tea
- Non traditional cash crops e.g Maize, bananas, fruits, potatoes, tomatoes, legumes

#### **The most common challenges in marketing agricultural produce are;**

- Many producers/sellers and few buyers.
- Too large a market for an individual.
- Inappropriate storage facilities coupled with perishability.
- Uncoordinated farming (farming enterprises).
- Market leaders lack the right information.
- Mistrust amongst the farmers and their organizations.
- Price liberalization.
- Farmers have a poor perception of market and market information requirement. They are generally price takers who are exploited by middlemen and market intermediaries.
- Traders and processors are constrained by low quality products, inadequate supply and high cleaning costs.
- Market intermediaries also face the high assembly costs, high level of market risks and cash flow problems.
- Inelastic supply/demand.
- Uninformed leaders on marketing.
- Market liberalization has resulted into lack of reliable markets, market information and competitiveness by farmers and market intermediaries.

**Opportunities that exist to address these challenges are as follows;-**

- Planned production (coordinated production/producing for the market).
- Collective bulking and marketing.
- Utilization of existing storage facilities.
- Participation in local markets.
- Use of available market information (quantities farmers have, what buyers need-quality, prices, and packaging).

**The following are the possible ways (technologies) of adding value to agricultural produce.**

Value adding does not have to be very sophisticated. The following simple techniques are used by farmers;-

- Sorting, winnowing
- Grading
- Packaging e.g. Kitui honey
- Processing e.g. mango juice
- Bulking e.g. collection as a group
- Drying and preserving e.g. dried vegetables

**Farmers facilitate or participate in local markets in the following ways;-**

- Establishing markets within society premises or strategic points within the society area of operation e.g. fruits selling by the roadside e.g. wamunyu, masii in Kenya etc
- Discourage selling of produce at farm gate individually
- Fixing of market day and place

**Cooperatives utilize the concept of market information centers/market information in the following ways;-**

- Collecting information from the farmers on the product available
- Information on what buyers need
- Quantities and quality needed, prices, packaging
- Making use of available storage facilities
- Bulking of members produce
- Displaying of market information on notice boards
- Displaying of offers by farmers and bids by buyer/traders (offers and bids board)



An agricultural marketing officer teaches participants on marketing agricultural products. Marketing is a challenge to the utilization and commercialization of IFTS.



**The following are the sources of market information;**

- Newspapers, journals and magazines
- Electronic media (radio, TV)
- Internet
- Sms(short message service)
- Relevant marketing boards and intermediaries
- Visiting markets (market survey) etc

**Way forward**

- Formation of commodity based marketing groups and cooperatives
- Network with marketing bodies (local, national, regional) eg Kenya agricultural commodity exchange.

## **SESSION 5: STAKE HOLDERS CONTRIBUTIONS TO PROBLEMS**

Chairpersons: Dr. Benard Muok (KEFRI) and Dr. Zenroku Oginosako (ICRAF)

### **Group work: Key issues and suggestions from the workshop**

SWOT analysis (Strength, Weakness, Opportunity and Threat) approach was used to describe the issues arising from the workshop. The following topics were given consideration as challenges ahead:

- Domestication of IFTS
- Germplasm of IFTS
- Commercialisation of IFTS
- Networking and Partnership
- Capacity Building

From the challenges, groups discussed and presented their findings as follows;

#### **Group 1: Domestication of indigenous fruit trees**

##### **Strengths:**

- Accumulated knowledge and experiences in domestication of IFTS
- Available indigenous knowledge on IFTS among farmers in the region
- Rapidly growing interest on IFTS
- Current domestication work in other regions (SADC )
- Trade in some species already going on
- Existence of researcher-development-farmer linkages among the countries of the region
- Existence of improved varieties in the region
- Adequate regional collaboration
- Adequate research facilities
- Positive attitude among some communities on management and utilization of IFTS
- Adequate will on policy framework to support domestication of IFTS

##### **Weaknesses**

- Poor infrastructure
- Lack of common criteria for prioritization of IFTS
- Inadequate conservation strategies

##### **Opportunities**

- Abundance of IFTS in ECA region
- Abundant land resources
- Increased interest of development partners on IFTS
- Emerging regional cooperation (EAC, IGAD, COMESA, NEPAD, etc)

- Existence of national food policies for increased food production
- Existence of poverty reduction policies
- Abundant labour e.g family, both skilled and unskilled
- Recent advances in communication and infrastructure
- High genetic diversity within IFTS which provides potential for improvement
- Changing feeding habits leading to more use of IFTS products
- Rapidly growing population that will require more IFTS as food supplements

#### **Threats**

- Expansion of agricultural land to marginal areas
- Over-exploitation of IFTS for other uses (timber, fuelwood, medicine, etc)
- Competition with conventional fruits

### **Group 2: Germplasm of IFTS**

#### **Strengths**

- The region is rich in IFTS
- Existing institutions in the region have started work on IFTS
- The value of IFTS is currently being appreciated
- Propagation reduces maturity period
- There is information on propagation on some of the IFTS
- There is considerable documentation on IFTS

#### **Weaknesses**

- Very few IFTS are currently utilized
- Selective cutting has lead to poor quality germplasm

#### **Opportunities**

- There is an emerging positive change of attitude
- Potential exist to improve germplasm through propagation technology
- Willingness to form functional network in the region
- Species of IFTS could be introduced in the nurseries
- Potential to decrease the use of IFTS for other purposes e.g charcoal

#### **Threats**

- Increasing population in ASALs leads to clearance of vegetation including IFTS
- Future mother trees shall be of poor quality

### **Group 3: Commercialization of IFTS**

#### **Strengths**

- There is both IFTS supplies richness and demand in most countries

- Continuous supply of fruit varieties to the industry because they are available throughout the year
- At least every country has research institutions for handling IFTS
- There is ready market in local areas
- Simple processing methods are already in place
- Availability of credit facilities from investors
- Availability of industries e.g. the cottage industries
- People are positively changing their habits towards IFTS
- The price of IFTS products is rising
- Nutrition values of some fruits are known
- Increased participation of both gender on work of IFTS
- Existence of some processing and entrepreneur skills on IFTS
- Poor infrastructure facilities
- Some infrastructure facilities
- The quality of IFTS products is increasingly becoming less variable
- There is a number of processing and storage facilities
- There is increasing demand to domesticate IFTS

#### **Weaknesses**

- There is competition of IFTS by exotic
- No regulatory boards concerning IFTS

#### **Opportunities**

- There is willingness by farmers to domesticate IFTS
- There is high level information exchange on IFTS
- Consumers attach greater utility to natural fruits
- Processing and preservation techniques are known and already being used
- There is availability of formed marketing groups which can be used for IFTS
- The contribution of IFTS to HIV control is considerably documented
- There is possibility to generate income thus improving the livelihood
- There is sustainability of production since there is significant quantity of IFTS

#### **Threats**

- Competition of IFTS versus exotic
- Narrowing of genetic base
- There is possibility of big industries interfering with cottage industries

### **Group 4: Networking and Partnership**

#### **Strengths**

- Indigenous knowledge techniques information and experiences on IFTS
- Interested groups at village level
- Some organizations already have networking
- Increasing information sharing techniques including markets information

- Increasing advertisement on IFTS products
- Increasing awareness on the importance of IFTS

### **Weaknesses**

- Lack of mass communication
- Lack of linkage with the other group and organizations

### **Opportunities**

- Information flow establishment and developing partnership information system
- Encourage development partners to finance on IFTS
- Farmer field schools
- Establishment of associations at all levels
- Expertise exchange within the region
- Study tours
- Farmer groups visits for information exchange

### **Threats**

- Lack of funds
- Lack of trained staff

## **Group 5: Capacity Building**

### **Strengths**

- Available institutions of higher learning where training on IFTS can be done
- There are local people with good knowledge who can train communities on IFTS
- The young people are ready to learn
- We have herbalist who can be trained to train others
- The IFTS are available and the demand for them is increasing
- There is increased interest on IFTS from the international community
- Research is now going on within the region on IFTS
- Indigenous fruit trees are now a priority in the region
- Altitude change towards IFTS
- Increased research targeting IFTS
- Increased efforts towards sustainable utilization

### **Weaknesses**

- Undocumented knowledge of herbalist's trees and all people using indigenous fruit
- Poor techniques for storage of IFTS for a long time

### **Opportunities**

- The IFTS are recognized by regional communities
- We can build on what is locally found and the knowledge from willing communities
- There is international increase demand for organic products which IFTS can easily provide

- There is international increased use of IFTS for treating opportunistic diseases
- There is interest by various stakeholders in propagation and of IFTS in the region
- There is an opportunity to scale up the work being carried out at Tabora in Tanzania on IFTS communities in the region are involved in processing and marketing of various products from IFTS individually and there is need to organize them into groups for proper training
- There is opportunity for networking and partnership e.g. the training we are now undergoing.
- Most IFTS are known
- Increasing funding for promotion of IFTS
- School curriculums now have issues concerned with IFTS
- Maturity age of the IFTS can be reduced
- Population increase hence more demand for IFTS as food supplements

### **Threats**

- Population increase has led to land fragmentation hence communities have very small land and this has affected the willingness to plant IFTS



## **Closing remarks: by Dr. Zenroku Oginosako (ICRAF-ECA)**

In the closing remarks the able performance of the principal convener, colleagues and trainers were recognized. The following observations were made:

- Utilization and commercialization of IFTS has great potential to improve livelihoods in drylands through provision of food, nutrition and income.
- Knowledge and experience on the utility, processing and conservation of indigenous fruits was shared.
- Methods for processing, developing and marketing commercial products from indigenous fruit trees were learnt.
- Propagation and management techniques of indigenous fruits were learnt.
- Experiences precipitated formation of community of practitioners who would share information and network for impact in the region
- Much work has been done but there is a large gap of scientific and indigenous knowledge
- Participants have set the agenda for utilization and commercialization of IFTS
- The workshop has exposed leading areas for the cause of action
- Consolidation of the available resources for utilization and commercialization of IFTS is necessary
- Coordination is a challenging point for all stakeholders

The starting point for all that is required for sustainable utilization and commercialization of IFTS should be putting regional arrangements and strategies in place to tackle the work. The rich diversity of the IFTS was recognized as a big strength and local people are challenged to use them to improve their livelihoods using locally available knowledge and skills. Information, knowledge, skills and technology should not only originate from developed countries but also from developing countries. Sharing of experiences gained on the best way to utilize the local resources as a way of enhancing rural livelihoods was emphasized. The community of practitioners formed is a good initiative to share information and network for impact in the region.

The remarks concluded with an indication that the workshop was a wonderful experience where practicals (such as technology on how to make juice, jam and wine), study tours, discussions and interactions were very good and successful, leading to the achievement of the targeted outputs. Key resource persons, organizers and Kitui KEFRI staff that hosted the workshop were acknowledged and thanked. All the participants were congratulated for their full participation and urged to share all the skills and knowledge they had acquired with others beyond their neighborhood for wider impact.

## Conclusion

Utilization and commercialization of the IFTS in the ECA region is based on the concept of ‘use it or lose it’ and it is clear that economic incentives, focusing on household incomes, nutritional and food security, can be powerful motivators. There is continuing traditional importance of IFTS throughout the drylands of the ECA region largely because of their nutritional value and hence contribution to the health status of rural communities. Although there is limited trade of the tree products at present, there is extensive scope for commercial initiatives. The critical point is for the local communities to identify the entry points. The processing and marketing components will form the pillar of any successful local resource-based enterprise.

The workshop stimulated intensive discussions about how trainers can act to improve the identification, processing and marketing of IFTS in drylands of ECA. Much valuable information was generated and shared. It is clear that drylands contains valuable natural capital in the form of IFTS. This resource base, already important, has the potential to contribute to local livelihoods security and income-generation still further. To reach this potential, participants identified an urgent need to strengthen local value-added and marketing channels, improve information about demand and prices, and extend access and training about appropriate processing and production technologies.

Experiences shared on the utility, processing and conservation of indigenous fruits led to the formation of a community of practitioners who would share information and network for impact in the region. The participants have set the agenda for utilization and commercialization of indigenous fruit trees species in the region as indicated in the issues raised and recommendations. This workshop has identified leading areas for right courses of action. What was gained in this workshop has also set up challenges for continued evaluation of the work in this field in the region. Participants expressed a strong desire that additional, external assistance, be sought to develop these ideas and opportunities still further.

The workshop should be viewed as a consolidation base for the available resources for utilization and commercialization of IFTS in the region. Information gained and contacts made during the course of the workshop were felt to form an important first step in this process. The follow up actions would include more research and development efforts to harness the wide genetic diversity of fruit quality among provenances, improving access to quality germplasm, fruit processing, storage and marketing. This requires improved research and capacity building amongst key stakeholders in the region. Capacity building and institutional development will involve training of research and development agents, sensitization and training, and support to local communities for sustainable product development and policy makers. Quick gains can be made by strengthening collaboration at regional level and developing information management systems for indigenous fruits that support research and investments decisions at national and regional levels.

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## Appendix 1 : List of participants of regional workshop on IFTS

Name	Position	Address	Email/Telephone/Fax
Joseph Kalinga	Farmer/ Chairman of a farmers' Group	P.O Box 130 Mwingi, Kenya	Tel: 0735 610881
Daisy M.Ngari	Product Development Officer	Kamurugu Agricultural Development Initiative (KADI) P.O Box 202 Embu, Kenya	kadi@salpha.co.ke Tel: 0722 447545/068 21427/72 Fax: 068 21472
David Muthusi	Herbalist/ Farmer	P.O Box 1 Kalawa, Kenya	
Joseph M. Musini	Farmer	P.O Box 49 Mutomo, Kenya	
Moses C. Chebon	Herbalist/ Chairman of a farmers' Group	Self Help Group Tree Nursery P.O Box 140 Kasok, Baringo	Tel: 0328-21440
Priscilla M. Munyoki	Farmer /Chairlady of a farmers' Group	P.O Box 53 Mwingi, Kenya	
Pius O. Matieka	Forester	Kenya Forestry Research Institute (KEFRI),Kibwezi P.O Box 87 Kibwezi, Kenya	Tel: 0723 824908
Charles Kekai	Nursery Manager	Self Help Group P.O Box 86 Kabarnet, Baringo	Tel: 0720 921986
Ndunge Ikambi	Farmer	Mwitika Division P.O Box 70 Zombe, Kenya	
Isaac Kaleve Muinde	Group Leader, Nursery Resource Person	Tree Nursery Kibwezi P.O Box 88 Kibwezi, Kenya	

Josephine Mwenzai	Farmer		
Bernard Muok	Senior Scientist	Kenya Forestry Research Institute (KEFRI) P.O Box 892 Kitui, Kenya	bmuok@yahoo.com Tel: 0724 804270
James Kimondo	Center Director	Kenya Forestry Research Institute (KEFRI), Kitui P.O Box 892 Kitui, Kenya	Tel: 0722 630931 Fax: 044 22761/22311
Ezekiel Kyalo	Extension officer	Kenya Forestry Research Institute (KEFRI), Kitui P.O Box 892 Kitui, Kenya	Tel: 0722 990454 Fax: 044 22761/22311
Lydia Nalonja	Laboratory Technologist	Kenya Forestry Research Institute (KEFRI),HQ P.O Box 20412 Nairobi, Kenya	lynalonja@yahoo.com Tel: 0721 528749
John Bosco Okullo	Lecturer	Faculty of Forestry, Makerere University P.O Box 7062 Kampala, Uganda	jbokullo@forest.mak.ac.ug okullo66@yahoo.com Tel: 256 41 543647/256 78 326352 Fax: 256 41 533574
Ruzindana Peirre	Dissemination Assistant	ICRAF- Rwanda P.O Box 7239 Kigali, Rwanda	ruzindanapierre@yahoo.fr Tel: 250 587918
Uwimana Brigitte	Research Assistant	Institute of Sciences Agronomists of Rwanda P.O Box 138 Butare, Rwanda	uwango@rediffmail.com Tel: 250 530145 Fax: 250 530160
Remen Swai	Country Representative	ICRAF Tanzania P.O Box 1595 Tabora, Tanzania	rswai@taboraonline.com Tel: 255 026 2604121/255 748339170
Bernadetha Kimata	Nutritionist	Agricultural Research Institute Tumbi, Tabora Tanzania P.O Box 306 Tabora, Tanzania	Tel: 0744816096
Abayneh Melke	Associate Researcher	Ethiopian Agricultural Research Organization P.O Box 2003 Addis Ababa, Ethiopia	abayneh01@yahoo.com Tel: 251 01 370300/370473 Fax: 370377

Tenagne Kidane	Home science Extension Senior Expert	Ministry of Agriculture and Rural Development P.O Box 41105 Addis Ababa, Ethiopia	Tel: 251 01 157006 Fax: 251 01 512659/84
Parnwell Simitu	Research Assistant	ICRAF, Nairobi P.O Box 30677 Nairobi, Kenya	p.simitu@cgiar.org Tel: 7224182 Fax: 7224001
Annah Njui	Programme Officer, ICRAF- ECA	ICRAF, Nairobi P.O Box 30677 Nairobi, Kenya	a.njui@cgiar.org Tel: 7224290 Fax: 7224013
Oginasako Zenroku	Plant Ecologist	ICRAF, Nairobi P.O Box 30677 Nairobi, Kenya	z.oginasako@cgiar.org Tel: 7224222 Fax: 7224001
Bashir Jama	Regional Coordinator Eastern and Central Africa Program	ICRAF, Nairobi P.O Box 30677 Nairobi, Kenya	b.jam@cgiar.org Tel: 7224230 Fax: 7224013
Charity Wangechi	Administrative Assistant	ICRAF, Nairobi P.O Box 30677 Nairobi, Kenya	c.wangechi@cgiar.org Tel: 7224290 Fax: 7224013