Domestication, Post Harvest Handling and Marketing of Selected Indigenous Fruit Trees

(Food and Agricultural Organisation, TCP/NAM/0167-A)

Final Report

on research done by the

Rural Survey Specialist (NC-1)

and the

Fruit Harvesting and Marketing Specialist (NC-2)

Submitted to:
Food and Agriculture Organisation
of the United Nations (FAO)

Directorate of Forestry (DoF)
Ministry of Environment and Tourism
Republic of Namibia

Prepared by:

Saskia den Adel
Pierre du Plessis
CRIAA SA-DC
P.O. Box 23778 Windhoek

November 2003

Acronyms and abbreviations

ABS	Access and benefit sharing (of genetic resources)
A-SNAPP	Agribusiness for Sustainable Natural African Plant Products
CBNRM	Community-Based Natural Resource Management
CPWild	Commercial Products from the African Wild
CRIAA SA-DC	Centre for Research Information Action in Africa, Southern African Development and Consulting
EWC	Eudafano Women's Cooperative
FAO	Food and Agriculture Organisation of the United Nations
ICRAF	International Centre for Research in Agro-Forestry (World Agroforestry Centre)
IFAD	International Fund for Agricultural Development
IFTT	Indigenous Fruit Task Team
IPTT	Indigenous Plants Task Team (formerly known as IFTT)
MAWRD	Ministry of Agriculture, Water and Rural Development
MET	Ministry of Environment and Tourism
MTI	Ministry of Trade and Industry
NACSO	Namibian Association of CBNRM Support Organisations
NASSP	National Agricultural Support Services Programme
NCRs	North-central Regions
PIF	Promoting Indigenous Fruits in Namibia project
PRA	Participatory Rural Appraisal
S&AP	Strategy and Action Plan for Promoting Indigenous Fruits in Namibia
SANProTA	Southern African Natural Product Trade Association (currently known as Phytotrade Africa)
UPDP	Useful Plants Development Project

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1) Background to the Study

1.1) Introduction

The project TCP/NAM/0167-A was designed in 1999. The formal agreement between the Ministry of Environent and Tourism of the Republic of Namibia (MET) and the Food and Agriculture Organisation of the United Nations (FAO) was signed in January 2002. Due to the unfortunate death of the National Project Coordinator in the Directorate of Forestry, and delays in recruiting and appointing a suitable International Lead Consultant, actual implementation of the project started with an inception workshop late in 2002. The contract for the present study was awarded in mid-2003.

In the meantime, the same objective considerations that had originally prompted formulation of the present project (i.e. the important role that indigenous fruits play in rural livelihoods under marginal agricultural conditions) has given rise to a number of related initiatives, interventions and research projects around indigenous fruits in Namibia and the SADC region. These activities have mainly been aimed at product and market development for fruits and fruit products harvested from the existing resource base (with less emphasis on domestication) – some of the more pertinent instances are discussed in more detail below.

Despite not targeting propagation and domestication directly , these recent developments have changed and are changing the context – and especially the marketing environment - within which any concerted attempt to domesticate indigenous fruit trees in Namibia will have to take place. Specifically, it has become obvious that a much more detailed and differentiated understanding is required of the socio-economic, commercial and farming systems realities around domestication, if the planting of indigenous fruit trees is to be transformed from an externally driven intervention into a demand-led process owned and steered by rural people themselves, but still based on sound economic considerations. Put simply, policy makers, implementing agencies and other change agents have to develop a better understanding of why, when and where rural people will prioritise the active planting of indigenous fruit trees, and then create an enabling environment to stimulate such domestication.

For these reasons the consultants have attempted to achieve a balance between the very local and specific (detailed participatory rural appraisals of three communities, primarily amed at three pre-selected fruit species) and the more general and generic (a review of on-going inititatives relevant to the objectives of the project). The aim has been to tease out the potential connections and synergies between local realities and perceptions, on the one hand, and national, regional and international developments, on the other, so as to make recommendations for action in the next phase of this work.

Throughout this document specific recommendations are distinguished by bold italic text set in boxes, as in this example.

1.2) Components of the project

Although the intended focus of TCP/NAM/0167-A is clear from its title, *Domestication, Post- harvest Handling and Marketing of Selected Indigenous Fruit Trees*, it is important to realise that the ordering of these components in the title (first domestication, then post-harvest handling, then marketing) implies an apparently logical, but ultimately misleading, hierarchy or sequence of activities. To misunderstand this carries a grave danger of also misunderstanding the potential drivers and motivators that could stimulate more widespread planting of indigenous fruit trees.

A key limitation of previous indigenous fruit tree domestication initiatives in Southern Africa has been to rely too much on the aggragated preferences of groups of farmers for species selection, without giving the same farmers (at individual or household level, where land use and resource allocation decision are typically made) adequate information about potential markets, so that they can make a rational economic choice about planting trees. A related failing has been to concentrate on the scientific and technical challenges of propagation and domestication, without adequate consideration as to how the products of domesticated indigenous fruit trees can be adequately marketed. Similarly, initiatives that teach rural people about small-scale processing of and value-adding to indigenous fruits have typically had very limited sustainable impacts in the longer run, because they have ignored such crucial aspects as on-going technical support, assistance in procuring equipment and packaging, and the formulation of business and marketing plans.

"Unassisted" domestication of indigenous plants will only spread widely among farmers if and when marketing creates the perception that a previously abundant indigenous resource is or might soon become scarce. On the other hand, successful marketing often depends on correct post-harvest handling and quality control, which in turn can be made easier through the selection, propagation and domestication of superior genotypes yielding a uniform crop of high quality fruits. For this reason it is important that the components be considered holistically and in parallel, on a case-by-case basis, with close reference to the local (agri)cultural context and specificities, but also with wider reference to national and international markets. In short, the successful domestication of indigenous fruit trees depends as much and more on livelihood systems, local farm economies and market promotion as it does on propagation techniques, site selection, irrigation and other silvicultural aspects.

Domestication is understood to include several sub-components:

- Identification and selection of superior phenotypes
- Development of techniques for the vegetative propagation of selected species to enable multiplication of promising phenotypes
- Cultivation of phenotypical clones under uniform conditions to confirm their status as superior genotypes
- Bulking up and distribution of superior genotypes, and dissemination of techniques for their further propagation
- Active planting and silvicultural management of the improved indigenous fruit trees on farms and around homesteads

In this study an attempt is made to document traditional knowledge and compile existing information relevant to these sub-components, for possible use in project components dealing more directly with domestication aspects. The need to integrate fruit tree planting with the wider farming systems practiced in a particular area is flagged and discussed. Since domestication is intimately connected with agro-ecological factors, some of the more pertinent features of the abiotic environment, such as the meteorology of the target areas, are also discussed.

Post-harvest handling is understood to include the following sub-components:

- Factors that influence harvest decisions (i.e. how much of which fruits to harvest, when and where)
- Criteria used to decide when fruit is ready for harvesting and harvesting techniques employed
- Transport from the harvest site to the next location in the value chain
- Storage techniques used to preserve desired qualities
- First-line post-harvest processing (e.g. drying, decortication)
- Traditional processing and value-adding methods

- "Modern" or improved processing and value-adding techniques
- Storage of processed products

An attempt has been made to combine traditional knowledge on post-harvest handling of various indigenous fruits with relevant information from the literature, so as to guide the planning of future post-harvest work.

Marketing has been interpreted (a bit wider than it usual scope) to include:

- Household uses
- Gifting, sharing and other forms of social exchange
- Local and informal-market sales of unprocessed fruits, or of the products of traditional processing (e.g. dried fruits, decorticated nuts, oil, non-alcoholic drinks, fermented and distilled alcoholic drinks)
- Formal market sales of fruits, traditional products and existing "moderu" products
- Potential urban, niche and/or export markets for new and innovative indigenous fruit products (pending sufficient investment in product and market R&D)
- Product specification, packaging, labelling and regulatory requirements in various market segments
- Product differentiation strategies in various markets
- Potential market development and promotion strategies
- Transport and other logistical considerations around raw material collation and product distribution
- Potential enterprise and business models for improved marketing

For reasons of time, seasonality and logistics the authors have been unable to conduct a systematic quantification of the current marketing of indigenous fruits in Namibia as part of the present study, but the information gathered through participatory rural appraisals and informal market surveys has nevertheless contributed substantially to a better overview and understanding of existing indigenous fruit (product) marketing. The focus has been on describing and characterising existing marketing activities, detailing on-going market development initiatives, and suggesting ways in which the project can incorporate marketing consideration into further domestication and post-harvest work.

2) On-going initiatives, existing information, information gaps

The lead consultant in this project, Dr J.C. Dagar, and the wild fruit trees improvement specialist, Dr Abdou Maisharou, have in their first reports very competently reviewed much of the relevant regional and international literature (including previous reviews of the literature). This section is therefore mainly intended to add additional (primarily local and national) information, much of it gleaned from "grey" literature or gathered in the course of previous work.

2.1) Current initiatives around indigenous fruits

This section gives a general overview of a selection of on-going activities that are relevant to the domestication, post-harvest handling and marketing of indigenous fruits at various levels.

2.1.1) National initiatives

Namibia's ***Indigenous Plants Task Team*** (IPTT) is a multi-stakeholder working group constituted of representatives from relevant government departments (including the Directorate of Forestry), parastatals, academic institutions, farmers organisations and other NGOs. The IPTT changed its name from IFTT – Indigenous Fruit Task Team – in early 2003 to reflect growing stakeholder interest in all indigenous plants and plant products of potential economic interest, but fruits remain an important

focus, especially of the Promoting Indigenous Fruit (PIF) project sponsored by the Ministry of Agriculture, Water and Rural Development (MAWRD), steered by the task team and coordinated by CRIAA SA-DC.

The national workshop that mandated the creation of the IFTT also tasked it with developing a coordinated national approach, which resulted in the production of the *Stategy and Action Plan for Promoting Indigenous Fruit in Namibia* (S&AP) published by the IFTT (Du Plessis 2001). The promotion strategy contained in this document ean be summarised in a nutshell as "use the existing resource endowment to develop supply chains, processing technologies, products, markets and commercial partnerships, and meanwhile start helping farmers to cultivate better varieties of those fruits for which markets emerge". Because of the many unknowns involved, the S&AP also advocates a flexible response to changing circumstances.

Phase One of the PIF project was designed to start implementing the S&AP by conducting various trials around fruit purchases, processing and marketing. The main aim of the project was to improve the level of information available to plan sustainable businesses based on indigenous fruits, and for this reason the focus fell largely, but not exclusively, on those fruits that are naturally available in relative abundance. The activities undertaken as part of PIF have been detailed in various monthly and interim reports to the IFTT, and the lessons learned summarised in the *PIF Phase One Final Report* (Du Plessis 2002).

The main recommendation of this report is to spin off those project components that can stand alone (e.g. marula pulp processing, manketti oil production trials) but to continue with a "pipeline approach" in which the widest possible range of resources are promoted to see how far they can go. On the basis of this report the IPTT has agreed to fund further specific work on marula fruit, manketti oil and nuts, Kalahari melon seed, baobab pulp and oil, and *Ximenia* oil. The report also identified and flagged the need for a mechanism that can use public sector support to leverage additional private sector investment in a commercialised ntural products business incubation unit in which primary producers can own significant equity, but to date nothing concrete has materialised in this regard.

In 2002 implementation of the ***National Agricultural Support Services Programme*** (NASSP, funded jointly by the Namibian Government and the European Union's 8th EDF), started with an inception phase. Because NASSP includes an indigenous plant promotion component as part of its crop diversification work, it commissioned an *Indigenous Plant Promotion Strategy Review* (Du Plessis, 2003). The recommendations of this report were later reviewed and approved by stakeholders at the NASSP inception workshop, and – along with the recommendations of the *PIF Phase One Final Report* – by the 2nd National Workshop on Indigenons Fruits.

The features of the NASSP indigenous plant component that are relevant to the current project include support for the establishment of a system of eco-regional indigenous plant promotion satellite centres, an internship programme aimed at tutoring recent graduates in indigenous plant commerialisation, and various cultivation initiatives (for devil's elaw, indigenous vegetables and indigenous succulents) which are expected to result in improved infrastructural and institutional capacity that can later also be used to promote the domestication of indigenous fruits.

The ***Useful Plants Development Project*** is funded through MAWRD from the proceeds of the sale of food aid donated by the United States of America. This money is administered by the Namibian Agronomic Board under the direction of the IPTT, and will be used to establish a useful plants database

at the National Botanical Research Institute (NBRI) and to support priority activities as and when they emerge from this database and from the on-going work of the IPTT.

Of interest at community level are various initiatives around ***Community-Based Natural Resource Management*** (CBNRM), especially the recent shift in emphasis away from wildlife and tourism towards a more integrated and more business-like environmental management approach that seeks to maximise the returns to management effort by actively engaging with other land and resource use sectors, such as water, grazing management, forestry and natural products harvesting. This shift in CBNRM is also closely linked to recent forestry legislation, which established the principle that organised communities can gain clearly defined management powers and sustainable use rights over legally recognised "Community Forests" (the forestry equivalents of community wildlife conservancies).

Namibia already has a well-developed and well-supported CBNRM system, with a rapidly growing number of community conservancies being serviced by Government and NGOs. The main NGOs active in the field are grouped together in the ***Namibian Association of CBNRM Support Organisations*** (NACSO) and there are moves afoot to form a national conservancy association. Regardless of how the players eventually line up, the CBNRM movement is potentially a major partner in efforts to domesticate indigenous fruit trees, not least because in many areas such domestication and tree planting can raise incomes and diversify livelihoods without compromising alternative land uses such as eco-tourism, but mainly because it offers an opportunity to work with an organised and environmentally aware network of communities.

Finally, any systematic intervention in the domestication of indigenous fruits will need to stay abreast of national (and international) legal developments around ***access and benefit-sharing*** (ABS) related to genetic resources and the associated ***traditional knowledge*** (in Namibia this is coordinated by the Directorate of Environmental Affairs in the MET). On the one hand there is the issue of farmers' rights to their genetic resources, including superior germplasm of indigenous fruits (which must be recognised and rewarded when such genetic material is collected –with the prior informed consent of the owner(s) – and made available to other users or used to develop improved cultivars). On the other hand there is the issue of national sovereign ownership of genetic resources, which has (mainly intellectual property) implications for export trade, product-development agreements and other commercial partnerships.

It is recommended that any national attempt to collect and domesticate superior genotypes of indigenous fruit trees set a good example by taking full cognisance of the rights of farmers and traditional communities, and explore novel and innovative ways to share with these people the benefits arising from the propagation of their genetic resources, in accordance with current best practices.

2.1.2) Southern African initiatives

The IPTT is a member of ***PhytoTrade Africa*** (the Southern African Natural Products Trade Association, previously known as SANProTA). This regional initiative is funded by International Fund for Agricultural Development (IFAD) and other donors. The other Namibian members are CRIAA SA-DC (the national focal point), the Ohangwena Forest Trust and the Nyae Nyae Conservancy. The association also has members in Botswana, Malawi, Zambia and Zimbabwe, and plans to expand into South Africa, Mozambique, Swaziland and Angola in the medium-term.

In pursuit of its aim, which is to improve rural incomes in the more marginal aras of Southern Africa by stimulating the development of an enduring regional natural product industry based on natural resources accessible to the rural poor, PhytoTrade Africa has a substantial R&D budget to develop markets on behalf of members, including funds for a fulltime research and market development officer based in the UK. Its current list of focal species include marula (*Sclerocarya birrea*), manketti/mongongo (*Schinziophyton rautanenii*), Kalahari melon (*Citrullus lanatus*) and other indigenous Cucurbitacea, sausage tree (*Kigelia africana*), baobab (*Adansonia digitata*), mobola plum/imbula (*Parinari* spp.) and monkey orange (*Strychnos* spp.). Other species of interest to PhytoTrade include *Ximenia* spp., *Trichillia emetica, Sterculia africana, Ziziphus mauritiana, Acacia* spp and many others.

It is interesting to note that the Southern Arican regional office of ICRAF (the World Agroforestry Centre) recently became a member of PhytoTrade Africa. This implicitly acknowledges the need for domestication work to interact closely with product and market R&D, and vice versa. Informal discussions with senior ICRAF staff have confirmed that they are increasingly aware of the need to design agro-forestry systems in such a way that they are compatible with traditional farming and livelihood systems (Kwesiga pers. comm.)

Two other regional initiatives – the relatively well-established USAID-funded ***Agri-business for Sustainable Natural African Plant Products*** (A-SNAPP) and the nascent South African-led ***Commercial Products from the African Wild*** (CPWild) programme (which is still seeking donor funding) can potentially affect the marketing situation around Namibian indigenous fruits, but since neither is currently active in the country they are not discussed further here (but are worth watching anyway).

2.1.3) International initiatives

In addition to well-known multilateral institutions such as the FAO, ICRAF etc. it is important to bear in mind multilateral environmental agreements, especially the so-called Rio conventions (i.e. on climate change, biological diversity and desertification/land degradation). Not only do these conventions lay down guidelines and rules for national policies, they also potentially make available substantial human and financial resources, and support mechanisms, for activities that have global environmental benefits and/or protect global environmental goods and services. In this regard one of the authors (Du Plessis, unpublished) has recently argued that: "economically viable agro-forestry systems based on useful indigenous species (which at one extreme of management includes wild harvesting of resources from relatively pristine areas) can:

- contribute to the conservation of globally important dryland botanical biodiversity (and associated traditional knowledge) by raising the actual and perceived value of indigenous plants, and providing incentives to propagate rare and/or valuable species
- contribute to the global options available for adapting to the adverse effects of climate change (by conserving drought-adapted genetic material for possible later use in other parts of the world)
- provide rural Namibians with alternative and additional sources of income based on perennial (groundwater-fed) plants, thus cushioning them to a significant degree against the increasing variability in rainfall that is predicted to result from climate change (and the attendant effects on rain-fed annual crops in marginal farming conditions)
- contribute to livelihood diversification in dryland areas (a key strategy for combating desertification)
- contribute to global carbon sequestration (to a minor extent, but in ways that produce many other sustainable development benefits)

- help to avoid and possibly even reverse deforestation, desertification and other forms of land degradation
- strengthen the implementation of an ecosystem approach to natural resource management and biodiversity conservation"

2.1.4) Relevance of on-going initiatives

These on-going initiatives are mentioned here because they are dynamically shaping the situation – especially markets, but also institutions, support mechanisms and partnerships – around indigenous fruits (and other natural plant products) in Namibia and Southern Africa. They are therefore relevant to the present project for several reasons:

- Markets are being created for fruits that are widespread but do not occur anywhere in great abundance , e.g. *Ximenia* – domestication of these species will help to prevent potential supply problems if and when commercial demand grows
- Supply networks based on the harvesting and collation of wild fruits potentially provide channels through which domestication initiatives can reach out to rural people who are already interested and involved in, and organised around, the commercial potential of indigenous fruits
- Farmers cannot make rational economic choices about indigenous fruit tree domestication unless they have access to up-to-date information about existing, developing and potential markets
- Fruits that are rare in Namibia may be very abundant in neighbouring countries (and vice versa) – such abundant wild populations might limit (or the lack of them might suggest) opportunities for Namibian producers of domesticated indigenous fruits to penetrate and compete in potential international markets
- Other initiatives aimed at domestication of indigenous plants (e.g. vegetables, suculents, medicinal and aromatic plants, fungi) will obviously face many of the same issues as domestication of indigenous fruit trees – an obvious opportunity to share lessons and research results, and to collaborate around a systems approach to diversifying rural livelihoods
- The same institutions (and to a lesser extent the same infrastructure) used to collate and trade in one indigenous natural product can be used to facilitate trade in others; similarly, the facilities used to domesticate other indigenous plants can be used to spread the domestication of indigenous fruit trees to a wider range of stakeholders, in many more parts of Namibia

It is recommended that any continuation of the present project be designed to fit in and cooperate closely with other components of the national programme to promote the commercial use of indigenous botanical resources, including making full use of the support available from PhytoTrade Africa, and the opportunities offered by international instruments of environmental governance.

2.2) Information on abiotic factors

This section has been added to the report at the request of the project leader and is intended as a brief summary of the most relevant information about the three project areas (Caprivi, Kavango and the NCRs). The information summarised here is taken from *Atlas of Namibia* (Mendelsohn *et al* 2002).

2.2.1) Meteorology

All three project areas receive on average more than 6kWh/m^2/day of ***solar radiation***, with the NCRs receiving slightly more (up to 6.4kWh/m^2/day) due to less cloud cover. An average 8-9 hours of

sunshine per day is received and because the areas are in the tropics the sun is directly overhead in mid-November and late January.

The average annual ***temperature*** in Caprivi is 20-22°C, and in Kavango and the NCRs more than 22°C. ***Frost*** occurs on average 1-5 days a year, but is usually limited to low-lying areas. In the NCRs the ***average maximum*** temperature during the hottest month is 34-36°C, and in Kavango and Caprivi slightly lower at 32-34°C. The hottest months are September (Caprivi) and October (Kavango and NCRs). The coldest month is July, and the ***average minimum*** temperature then is 4-6°C (Caprivi and Kavango) and 6-8°C (NCRs).

Average ***humidity*** fluctuates between 10-20% at 14h00 in September and 80-90% at 08h00 in February/March. Even in the most humid months the average at 14h00 drops to around 50%.

Median annual ***rainfall*** figures are 550-600mm in Caprivi, 500-550mm in Kavango, and between 400 and 500mm in the NCRs. All areas can expect an average of 45-50 days each year with more than 1mm of rainfall. The variation in rainfall (standard deviation of annual totals as a percentage of average annual rainfall) is 30-40%. There are more years of below-average rainfall than of average and above-average. The pattern is influenced by the El Nino Southern Oscillation, with lower average rainfall in El Nino years and higher in La Nina years. In Caprivi the rains start earlier (September/October, peak in December/January, and then decline into April. As one moves further west into Kavango and the NCRs the rains start later and peak falls can occur from January to March. The timing of rainfall varies greatly from year to year. The once-in-14-years drought expected in Caprivi is 300-400mm of rain, in Kavango 250-350mm, and in the NCRs 200-300mm.

Average annual ***evaporation*** varies from around 1500mm/year in Caprivi through about 1800mm/year in Kavango to more than 2000mm/year in the southwestern parts of the NCRs. The average water deficit is 1500-1700mm/year in the NCRs, 1300-1500mm/year in Kavango, and less than 1300mm/year in east Caprivi.

While ***wind*** speeds are generally low over northern Namibia, local heating effects can create powerful whirlwinds. Dry, dessicating winds sometimes frustrate efforts to plant early in the season by scorching newly emerged crops.

The predicted effects of ***climate change*** on northern Namibia are an increase in temperatures (i.e. even higher evaporation rates), a reduction in absolute rainfall, and increased inter- and intra-annual rainfall variability. This is a very bad scenario for annual crops in marginal agro-ecological environments, and dramatically increases the urgency of initiatives to diversify farming systems towards perennial crops (such as this project).

2.2.2) Soils and landforms

The fertile fluvisols of the east Caprivi floodplains are regularly inundated by the Zambezi, enabling farmers there to grow a counter-seasonal crop planted in the moist soils left behind by the receding waters. Combined with higher rainfall, these soils allow species of fruit to grow that are found nowhere else in Namibia. Patches of fluvisols also occur along the Okavango river and along fossil watercourses in Kavango region.

The cambisols and calcisols of the Cuvelai floodplain are also relatively fertile and densely settled. In these areas the suitability of a particular site for growing specific fruit trees species often depends more

on landform and geo-hydrology than on soil type. For example, *Hyphaene petersiana* can grow anywhere but often grows right next to the water at oshana level, *Sclerocarya birrea* and *Berchemia discolor* generally prefer higher-lying, better drained soils that are not too sandy, while *Diospyros mespilliformis* and *Ficus sycamorus* appear to favour well-drained soils with relatively shallow water-tables (both species are common near wells and waterholes).

The above-mentioned exceptions notwithstanding, most of the project area is covered by porous and relatively infertile arenosols, which in Kavango are shaped into a series of regular east-west tending dunes and straits. While the straits are treeless, the dunes are usually covered in trees, with the species mix changing as one moves higher. *Schinziophyton rautanenii* predominantly occurs mid-slope, *Strychnos* spp. prefer the lower slopes, and the dunecrests are typically dominated by *Baikiaea plurijuga* and *Pterocarpus angolensis*.

Research has shown that experienced local farmers in the NCRs have extensive traditional knowledge at the micro-level of soils and landforms in their areas (Verlinden and Dayot 1999, 2000; SDP11/DRFN 2003) and of the variable trees species mixes typical of such traditioual land units. Botelle (1999) has documented similar traditional knowledge about the relationship between land units and tree distribution in Kavango, and it is also known from Caprivi (A. Verlinden pers. comm.), where it has apparently not been recorded at the same level of detail.

It is recommended that systematic documentation of traditional knowledge about the land unit and soil preferences of indigenous fruit tree species be continued in all project areas.

2.2.3) Water and irrigation

The non-availability of water has repeatedly been mentioned as constraint on the planting of indigenous fruit trees (this study; SDP11/DRFN 2003). While it has been shown (Mateke 2000) that growth rates increase dramatically when trees are irrigated, and watering is undoubtedly a great aid to the establishment of newly planted trees, indigenous fruit trees can and do grow in the project areas without additional irrigation. Furthermore, even in places where absolute water availability is not (yet) a problem, irrigation is expensive to install and maintain, especially for small farmers, and the slow cash flow from tree planting is a serious limitation. At current prices it is not at all clear that indigenous fruit trees alone could repay an investment in irrigation infrastructure, although there might be incidental opportunities for in-field or hedgerow planting in plots irrigated for other cash crops.

Every effort should therefore be made to find and exploit alternative ways to provide additional water for domesticated indigenous fruit trees.

Household waste water clearly has a role to play at homestead level, but it should be acknowledged that most rural household in northern Namibia obtain their water from public (open or piped) sources and transport it to the house in containers, resulting in very little greywater being generated. At best this source of water can therefore help in the establishment of a few trees near the home (and, in areas where homesteads are periodically moved, to the establishment of groves of fruit trees in various places around the farm).

Rainwater harvesting is an option with more broadscale potential. Even on sandy soils with limited run-off simple earth basins can be used to hold and infiltrate rainwater around trees. On low slopes with a higher clay content the once-off cost of bulldozing or grading contour swales might be justified in certain

cases. Combined with direct seeding and temporary protection against livestock, such strategies might succeed in establishing large numbers of trees (and hedgerows/windbreaks) at relatively low cost.

Some parts of northern Namibia have copious amounts of relatively shallow, saline groundwater. In the Negev desert in Israel marula trees grew well when irrigated with 20% sea water, and this option should be assessed more closely in Namibia. While the cost and investment considerations around irrigation apply as much to saline water as fresh, at least such use will not in the longer run compete with human and animal uses.

In sandy soils the availability of water can be improved significantly – and the need for irrigation reduced substantially – through simply improving the soil in planting holes by adding clay minerals and/or organic manures and/or artifical water-holding gels.

Mulching should be taught as standard practice.

2.3) Domestication

It is now widely recognised that plant domestication is a continuum ranging from wild harvesting of unmanaged populations all the way through to deliberate planting and nurturing of selected genetic strains in enhanced environments (Wiersum 1996 quoted in Maisharou 2003). Numerous recent studies (Botelle 2001; Botelle et all 2002; Leakey et al 2002; SDP11/DRFN 2003; this study) have documented the fairly advanced stage of traditional domestication that has been achieved with favoured indigenous fruit trees, especially marula, in Namibia's NCRs. In Kavango and Caprivi people retain favoured trees when clearing fields, but if similar traditional knowledge to that of the NCRs about tree propagation and management occurs in these regions it has – to the best of our knowledge – not been documented. This section attempts to summarise the most relevant existing information about various aspects of indigenous fruit tree domestication in Namibia.

2.3.1) Identification and selection of superior phenotypes

There can be little doubt that the marula population of the NCRs is more highly selected for fruiting qualities than similar populations e.g. in South Africa. Leakey *et al* (2002) found that a random sample of Namibian marula fruits were on average some 20+% larger than a similar sample from South Africa, with the difference attributable to a higher percentage of juice and pulp in the Namibian fruit. The same study found that a sample of fruit collected by South African rural women for processing corresponded to the best 84% of the random sample – clear evidence of deliberate on-going selection for quality.

In the NCRs marula fruit processing occurs under the trees and personal observations suggest that people not only know very well which are the best trees in terms of fruit quality, but that the women are also highly selective when choosing fruit for processing from any particular tree. Because each processor is allowed to take home the seeds from the fruits she processes (for later nut decortication) it is relatively easy to postulate the mechanisms by which selection has been achieved – inferior trees have been cut out, superior trees have been retained, and only the best fruits from the best trees have been processed (and their pips carried into the protection offered by traditional homesteads). Over centuries such practices are bound to improve the average genetic stock of the population, especially in the NCRs, where germination inside homesteads appears to be the dominant recruitment mechanisms at work (and the genetically randomizing effect of "wild recruitment" is therefore restricted).

The available evidence further suggests that people who settle in parts of the NCRs where indigenous fruit trees are scarce are very interested in actively planting such trees, and when they do so they inevitably choose their propagation material (seed or vegetative) from superior phenotypes. That there is substantial scope for increasing productivity through selection was also confirmed by Leaky et al (2002). One superior marula tree encountered in northern Namibia had fruits three times bigger than average, with superior kernel qualities, and an upright growth habit compatible with plantation requirements.

Because indigenous fruit trees are relatively more abundant in Kavango and Caprivi it seems unlikely that the same degree of pre-selection would have been operational in these area, but farmers can still be relied on to know which the superior trees in their area are. Veld Products Research and Development in Botswana had significant success with a fruit selection competition aimed at schoolchildren (on the basis that they were the primary local expert on superior fruits).

It is recommended that a systematic and competitive selection of indigenous fruit tree germplasm be organised for priority species in Namibia, with appropriate rewards and ownership arrangements for winning farmers/communities.

2.3.2) Development of techniques for the vegetative propagation of selected species to enable multiplication of promising phenotypes

While there is no reason why seedlings should not be used for broadscale strategies or when no alternatives are available (and there are good reasons to maintain a healthy and genetically varied population of open-pollinated trees) there is also no doubt that major improvements in fruit quality, crop uniformity and other desirable agro-economic traits can be achieved most rapidly through vegetative propagation.

The traditional use of truncheons for vegetative propagation has been recorded for marula and manketti, in the NCRs and Kavango respectively (Botelle 1999, 2001). In general it appears that very large cuttings (up to 25 cm in diametre for marula) are more successful than smaller growth, possibly because of greater tissue reserves of moisture. There are conflicting verbal accounts as to whether *Berchemia* and *Strychnos* can be propagated by truncheon cuttings.

A major advantage of vegetative propagation is that it significantly shortens the time between planting and fruiting. Because sexually mature wood is used for grafting material, grafted marula trees fruit after two or three seasons, compared with 10 or more years for seedling trees. Grafting is however a somewhat sophisticated procedure with a higher risk of failure. It also requires growing seedlings for rootstock.

It is recommended that further systematic trials be performed with various vegetative propagation techniques for indigenous fruit trees, aiming primarily at levels of technology and skills appropriate for community and farm-level use.

2.3.3) Cultivation of phenotypical clones under uniform conditions to confirm their status as superior genotypes

This is longer-term research that can add substantial value to the national genetic endowment and provide material for breeding even better varieties, but it is slow work that should not hold back much

wider short-term implementation – it is more urgent to get people planting good trees than it is the find the perfect tree.

However, a related consideration – that of extending the season through selection of early and late varieties – potentially has major advantages, and should therefore be prioritised. To do so requires at least that phenotypes from such early or late trees be grown at a number of sites in different regions to eliminate variation introduced by local soil and climate.

For this reason it is recommended that large truncheons of selected early and late marula trees are exchanged on a regional basis between the NCRs, Kavango and Caprivi, and that their performance be monitored and compared with that of the mother trees.

2.3.4) Bulking up and distribution of superior genotypes, and dissemination of techniques for their further propagation

When very superior genotypes are identified it is desirable to have techniques for rapidly bulking up the supply of planting material. Truncheon planting and grafting are of limited use. Micro-propagation is a distinct option, but it is expensive and currently constrained by the limited availability of suitable facilities and skills in Namibia.

Leaky and colleagues, working with ICRAF in West Africa, developed a simple and cheap community-level propagator for leave cuttings. This system can produce thousands of clones relatively quickly and at very low cost.

The potential use of this propagator in Namibia should be further investigated.

2.3.5) Active planting and silvicultural management of the improved indigenous fruit trees on farms and around homesteads

There is evidence to suggest (Du Plessis et al 2002; SDP11/DRFN 2003) that the association between people and trees in the NCRs is a mutualistic one founded on niche soils: people preferentially settle in areas with fruit trees because they are indicators of relatively superior agricultural soils AND people introduce fruit tree to areas where they settle because the soils there are suitable. Homesteads or fields provide favoured and protected recruitment sites. Seedling trees in fields are often actively protected with thorn branches or by other methods, and commonly named after the person who found them (Botelle 2001).

Erkilla (2001) and Verlinden (pers. comm.) have used aerial photographs to documented the establishment of groves of indigenous fruit trees on old homesites in the NCRs – a system that relies on the traditional practice of moving homesteads at regular intervals and is assisted by the judicious use of small quantities of waste water, accumulated fertility due to human activity (ash, urine) and termite attacks on the traditional wooden pole fences (which brings clay soils and phosphates to the surface). This recruitment mechanism might be threatened by the modern tendency to build permanent brick structures. In-field tree recruitment and protection might in turn be threatened by the spread of mechanised cultivation, which favours completely cleared fields. These threats should be highlighted as additional reasons to adopt ative tree planting.

Current information, and the data collected during this study, suggest that people are traditionally predisposed to managing indigenous fruit trees within traditional farming systems. Additionally, people will make an active effort to plant such trees if they perceive a need for them (e.g. if they live or settle in areas where such trees are absent or scarce). When markets are created for indigenous fruits they stimulate perceptions that supplies might not be adequate for long, and increase interest in propagation (Botelle 2001; Den Adel 2002). Market creation is therefore of key importance to sustainable domestication at larger scale.

However, people are also interested in variety, and in this and other studies (SDP11/DRFN 2003) they have expressed interest in growing fruit species that are scarce in their areas. Making available selected strains of a variety of species could therefore help to stimulate increased indigenous fruit tree planting. When one considers how well an "indigenous exotic" such as *Kigelia africana* has done in the NCRs, and sees the extent to which it has been actively planted because it can grow into a useful shade tree in 8 years, it seems like a good idea to introduce to each of the pilot regions those fruiting species that occur naturally in the others.

It is recommended that, in order to capitalise on the publicity value of rarity and novelty, domestication efforts target a wide variety of useful indigenous fruit trees as early as possible, and that active efforts are made to introduce domesticated specimens of rarer or "exotic indigenous" species to demonstration sites and pilot communities.

2.4) Post-Harvest Handling

This section analyses existing information on post-harvest handling with a view to identifying issues of relevance for domestication and/or marketing. Since there are currently no large plantations of indigenous fruit trees it is not possible to present more detailed information on how to deal with much larger harvests.

2.4.1) Factors that influence harvest decisions

People harvest indigenous fruits when they have both access and time. Poorer households tend to rely more on wild fruits than more affluent neighbours (Flowers and Van Rooyen 1999), although larger honseholds with more family labour available often extract higher levels of benefit from their ability to harvest large quantities quickly at the best time.

In terms of access, people typically have preferential use of the fruits that grow on their homesteads or farms, and open access to the fruit of trees on communal land (sometimes subject to the approval of nearby neighbours or traditional authorities). In the NCRs, where there are hardly any communal fruit trees, and where distribution of certain fruiting species is restricted by soil conditions, many people rely to a certain extent on being allowed access by more fortunate neighbours (Den Adel 2002).

Some large indigenous fruit resources (e.g. the manketti groves of Kavango) remain under-utilised because they occur far from human settlements, in areas with little or no surface water, and therefore require both 4x4 transport and a degree of logistical organisation (provision of food, water etc.) before they can be effectively harvested. The extent to which such remote resources can and will be accessed depends crucially on whether the income would justify the expense and effort (under current market conditions it usually does not).

The availability of time depends to a large extent on how harvesting fits into the traditional agricultural calendar, how it competes with seasonal farm labour requirements, and how long the harvesting window of opportunity is. The amount and distribution of rainfall received in a particular season also sometimes plays a role. For example, in a good marula year with lots of rainfall (i.e. lots of planting and weeding to be done) substantial quantities of fruit remain unutilised and eventually rot due to shortages of labour for processing. In bad seasons with low rainfall when there is little else to do the production of the same number of trees will be processed completely. Other fruits (e.g. *Strychnos*, baobab and manketti) fruit outside the main agricultural season and/or can be safely left for a few months before being harvested.

Two of the three species pre-selected for this study (marula and bird plum) are highly perishable and must be processed within days of abscising from the trees – in certain areas they are probably already perceived as being (sometimes) available in surplus, thus partly removing the incentive to plant more.

Rapid urbanisation and rural population declines caused by AIDS is making agricultural labour scarcer in many areas, which might affect fruit harvesting in the longer run.

It is recommended that domestication efforts prioritise species that are relatively rare in a particular area, can be marketed in significant quantities, are easily stored, or can be harvested in the agricultural off-season.

2.4.2) Criteria used to decide when fruit is ready for harvesting and harvesting techniques employed

Marula and bird plum abscise when they are almost ripe and then ripen completely on the ground. This makes harvesting easier, but processing more difficult (because the fruits are often sandy or dirty).

Bird plum drops small quantities of fruit that must be picked up almost daily, otherwise many of them will spoil (especially if they get rained on). People often shake the branches before they start harvesting to dislodge fruits that are about to drop anyway. Marula takes a while longer to ripen after abscising and fruits need only be harvested every three days or so.

Jackal berry abscises when it is very ripe – because the trees are quite large it is not common to pick fruits from the tree. Wild figs are picked when they can be reached, but are more often picked up from the ground. Manketti is almost always picked up from the ground, where it can remain for a year or more without deteriorating in quality. Mbola plum is another fruit usually picked up from the ground.

Monkey oranges are usually picked from the tree when they start changing colour, but they can also be harvested while green and will then ripen over a period of about two weeks. People do this when they want to take fruits to distant markets. The trees are small but spiny, and people have been seen using rakes to pull down the fruits.

Soft fruits like wild medlar and sour plum are usually picked from the trees when they start turning colour. Leaving them any longer incurs the danger that they will be eaten by birds. Fruits that do not abscise, like Kalahari podberry, are sometimes harvested by cutting down branches or even the whole tree – an obviously unsustainable practice.

Makalani palm fruits remain on the trees for a long time. To get at them more quickly people sometimes throw stones or sticks at the fruits to knock them down. This is also the case with baobab, although people will sometimes drive pegs into the bark so that they can climb into the trees to get at the fruits.

2.4.3) Transport from the harvest site to the next location in the value chain

In the NCRs marula fruit is traditionally processed under the tree and only the pips are transported to the homestead, where they are dried and later decorticated to remove the oil-rich kernels. In Kavango people have been observed to carry bags of marula home for processing (but marula processing is quite rare in the region). In Zimbabwe and South Africa fruits are usually carried home in bags and/or on wheelbarrows. (Interestingly enough, in those countries it is the usual practice to mix fruits from various trees before making marula cider, while in the NCRs omaongo is almost always made from the fruits of a single tree).

During pilot marula processing trials in the NCRs woven polypropylene bags worked well enough while quantities remained low, but a degree of crushing occurred despite the tough, leathery skins when bags were stacked up and transported over bad roads. For much larger quantities it is therefore probably advisable to use standard fruit picking crates that can be stacked without crushing the fruit at the bottom (as is done at the factory in South Africa that produces pulp for Amarula liqueur).

Soft fruits intended for drying (bird plum, jackal berry, wild medlar) are traditionally collected in flat baskets to avoid crushing (damaged and over-ripe fruits are fermented for distillation into alcoholic spirits). During processing trials these fruits could not be transported successfully in soft form – any centralised processing will therefore have to be use farm-dried fruit.

Hard fruits like manketti, monkey orange and baobab are commonly collected in used grain bags. Manketti is extremely robust, but monkey oranges can bruise, resulting in unsightly blemishes, and baobab fruits might crack (exposing the pulp to bacteria and other contaminants) if they are handled too roughly.

2.4.4) Storage techniques used to preserve desired qualities

Dried fruits are traditionally stored indoors in bags or baskets. Storage pests (weevils, moths) have been observed in dried fruits stored for long periods (jackal berry appears most susceptible, properly dried bird plum least). Baobab fruits are sometimes tied into bunches and hung from the rafters.

Fresh fruits are only stored for short periods in small quantities, usually in open baskets inside the home. Palgrave (1983) reports that monkey oranges are sometimes buried in the sand to ripen and liquefy.

In Zimbabwe beer makers store green marula fruits in a special hut with porous sides, from where they select a carefully balanced mix of greener and riper fruit for their own recipes, but this has not been observed or reported in Namibia.

Seeds and nuts intended for eating and oil processing are best stored in undecorticated form as living seeds – traditionally small quantities are decorticated when they are needed.

After decortication the combination of oxygen, atmospheric moisture and internal enzymatic action will tend to cause accelerated oxidation and hydrolysis of the fats in the seeds, resulting in rancid flavours and high levels of free fatty acid values (which are detrimental to health and/or increase refining losses).

Decorticated seeds and nuts should be stored in a cool dry place and processed into oil as soon as possible. Oil should preferably be packed under nitrogen and refrigerated.

2.4.5) First-line post-harvest processing

The most common traditional processing method is simply to dry fruits on a grass mat in the sun. Roofs and shadecloth structures are sometimes used instead of mats. During rainy periods drying can be quite slow and half-dried fruits are inclined to go mouldy if they must be kept indoors for any length of time due to rain. A solar dryer that also keeps off the rain would be very useful, but it is not clear that such an infrequently used and relatively expensive device would be an economic proposition for many households at current production levels and prices.

In Namibia marula, manketti and *Ximenia* nuts are traditionally decorticared by holding them against the sharp edge of an axe (which is held under the legs while sitting on the ground) and striking them with a short heavy stick.

A simple but effective (and affordable) improvement on this technology is to use a T-shaped springsteel blade mounted on a flat piece of wood instead of an axe. Because the leg of the T is longer than an axe blade, and the flat wood is less inclined to roll around than an axe handle, decorticators can work safer and faster. This device can increase the production of an experienced decorticator 20% or more.

Marula decortication has so far proved difficult to mechanise in a cost-effective way (or at all, in fact). The most promising option appears to be a guillotine-like cutter operated by two people (or hydraulically with a foot pedal). Widespread rural poverty and un(der)employment favours labour intensive methods, for the moment.

A variety of mechanical manketti crackers have been designed and tested. Some were not as productive as the traditional way. A recent model from Zambia claims to be much more productive, but costs US$1000 – an investment that would be hard to justify unless much larger markets are created.

2.4.6) Traditional processing and value-adding methods

These topics are covered in great detail in setion 6 below. In developing the indigenous fruits sector it is important to bear in mind that traditionally processed products sold in local informal markets play an important role iu local livelihoods, and that such existing value-adding and trading systems should not be disrupted gratuitously.

2.4.7) "Modern" or improved processing and value-adding techniques

The indigenous fruit processing technology development work that has been done in Namibia so far has mainly been at the low-tech or "appropriate technology" end of the scale, aimed at producing simple, affordable and robust production systems that can be used by technically unsophisticated entrepreneurs in the SME sector.

Currently available technology includes a robust and reliable 30 ton hydraulic cage-and-plate bridge press, a smaller 10 t press of similar design for pressing marula juice and oil (both manufactured by the Katutura Artisans Project, KAP) and a similar small press of alternative design manufactured by the

Rural Development Centre in Ongwediva. The small marula juice presses can extract about 200 litres of juice a day and are a viable SME business opportunity at current prices, provided adequate fruit supplies and markets can be organised.

A more sophisticated marula pulping technology is under development in cooperation with CIRAD of France (this technology package will also include a pasteuriser). There is also a need for a simple and cost-effective way to extract pulp from other fruits like *Strychnos* and *Berchemia* for further processing.

Making jams, chutneys and juices (cordials) for local and national markets is a potential SME which has attracted a considerable degree of interest. In Namibia the viability of such enterprises (which have a mixed record in other parts of the world) is constrained by the small domestic market. Nevertheless, a standardised and cost-effective technology package, backed up with business and technical training and supported by a facilitated supply of bottles, labels and other consumables at key rural centres, seems worth trying under the circumstances.

Despite the many advantages of simple small-scale technologies it has lately become clear that a true market-driven approach to indigenous fruit processing necessitates the use of whatever technology is required to deliver the products the market wants. If investment in a more sophisticated level of processing enables an enterprise to produce more cost-effectively and secure a better strategic position in the market, such enterprise could afford to pay primary producers more for their fruits, because it could add more value. Such investments are best pursued in partnership with the private sector.

2.4.8) Storage of processed products

Fruits are seasonal, and consequently so is most fruit processing (oil processing is easier to continue year round). This implies that a fruit processor targeting formal markets must be in a position to store sufficient stocks of finished product to supply clients during the off season (and oil processors sufficient stocks of raw materials for a year, if they can). It also means that product developers must aim for a shelflife of at least 12 months. Cool, dry and dark storage can help to keep products in good condition longer.

2.5) Marketing and market opportunities

The *PIF Phase One Final Report* (Du Plessis 2002) concluded that one of the main lessons learned from project implementation thus far was that pro-active market liaison and promotion is the key to successful natural products commercialisation, and that it was consequently essential to provide adequate resources for this work. Creating sustained market demand for indigenous fruits is also believed to be a key driver in promoting active adoption of domestication by farmers and is therefore – paradoxically – maybe more important to domestication efforts than actual tree selection, propagation and planting activities. If a sustained demand and reliable market exist for indigenous fruits, and the prices offered in this market are high enough, and the quantities demanded by the market are large enough, farmers will eventually find, or demand access to, ways to produce more indigenous fruits. It is only when such markets have been created that queues will form outside indigenous fruit tree nurseries, and/or on-farm nurseries will become a common feature of rural Namibia.

2.5.1) Traditional uses and informal markets

At present there are three main categories of demand for indigenous fruits and their products:

- Household use

- Gifting, sharing and other forms of social exchange
- Local and informal-market sales of unprocessed fruits, or of the products of traditional processing (e.g. dried fruits, decorticated nuts, oil, non-alcoholic drinks, fermented and distilled alcoholic drinks)

Traditional uses have been covered in great detail during the rural surveys and are reported below.

Informal markets are highly significant to rural livelihood strategies, but are notoriously hard to quantify with any degree of accuracy. It is also doubtful whether a more comprehensive study of informal markets will actually add any knowledge that will help to promote increased trading of indigenous fruits.

Most informal traders interviewed for this and previous studies have complained about low levels of demand for traditional products (which are due to the fact that most households have their own mechanisms for accessing the products offered in these markets, and typically prefer their own "home-made" versions of these products). Furthermore, such studies, as well as practical experiences, have revealed that people who do not usually sell in informal markets will produce for and sell to more formal markets if and when they can make larger sales at lower transation costs.

A transitional or "grey" market exists for indigenous fruits or their products in national and regional urban informal markets. A good examples is the widespread street trade in *Strychnos* fruits, which is also common in urban markets in neighbouring countries, for example Gaborone and South Africa's Soweto – it has been calculated that a trader buying *Strychnos* at Zambian producer prices and re-selling in Gaborone can make up to 500% profit, wholesale (G. Mickels-Kokwe and D. Thamage pers. comm.), while the Soweto market is so large and lucrative that it is apparently controlled by organised crime (F. Taylor pers. comm.).

Another example is the growing but still unquantified trade in marula cider from the NCRs to the central, coastal and southern urban areas of Namibia, in which prices are 100-200% higher than the informal market price in the NCRs.

One of the main advantages of such informal markets are their low entry requirements, low marketing costs, and low or no regulatory regimes. Because they are easily accessible to poor and marginalised producers, such markets are important to the livelihood strategies of many rural families, and should not be disrupted (unless it is done gradually by creating better markets through stimulating increased demand).

It is recommended that informal markets are not deliberately targeted by outside interventions, except by helping producers increase their productivity.

2.5.2) Formal markets for fruits and existing products

In SADC generally and in Namibia particularly there are currently limited formal markets for indigenous fruits and their products, but the situation is dynamic and changing.

The biggest single formal market (in terms of volumes) for indigenous fruits is the factory in Phalaborwa (South Africa) that produces marula pulp for use in Amarula liqueur. It buys between 2000 and 3000 tons of marula fruit a year by using a combination of direct factory gate purchases from producers and market intermediaries, and sending its own trucks to central buying points on a regular schedule.

Because its capital and processing costs are relatively high (the modern factory cost around N$30 million to build and the pulp is trucked to the Western Cape in refrigerated tankers) it pays fairly low prices to fruit producers (around N$0.25/kg, which proved unacceptably low to producers in the NCRs during pilot processing in 2003).

A number of large companies in South Africa and internationally have recently expressed an interest in sourcing a reliable supply of stabilised marula pulp. In March/April 2003 the IPTT provided funding for a pilot processing project at Ondangwa, which aimed to buy around 300 tons of marula fruit at a target price of N$0.25/kg. This price was not acceptable to producers. Despite later offering N$1/kg for good marula fruit delivered to the processing site, and repeatedly advertising this offer on regional vernacular radio, only about 10 tons of fruit could actually be bought. While it seems likely that the supply problems were caused by doing the trial purchases late in a bad marula season (which was also a bad agricultural season, so that larger than usual quantities of household labour were available for traditional processing) it might turn out that formal markets eventually require larger quantities of marula fruit than can be supplied from the current population, which would create an incentive to plant more (improved) marula trees. This is not yet the case. The pilot processing is planned to continue in early 2004.

In Namibia there is a limited formal market for marula kernels used to produce cold-pressed crude oil for international cosmetic markets, but it is currently owned and controlled by the Eudafano Women's Cooperative (EWC, which is a registered Community Trade supplier to The Body Shop). At the moment the cooperative cannot even sell all the kernels its members produce and has to use producer quotas to avoid over-supply by its members. Significant efforts are being made to develop bigger export markets for marula oil, which might then create bigger formal markets for marula kernels, but the projected demand in the medium term could readily be supplied from the existing population (i.e. would not create a specific additional incentive to domesticate and grow more marula trees). There is also an emerging formal market for Kalahari melon seed oil, but that is beyond the scope of this report.

As part of exploring and developing potential markets for marula and other indigenous oils, CRIAA SA-DC (acting as a service provider to EWC) has bottled these oils in attractive (award-winning) packaging aimed at local and tourist markets. However, the price is quite high and the volumes are low, making this market one of dubious profitability. Moves are afoot to expand distribution and marketing in a more systematic way, but it remains uncertain how much oil can actually be sold along these channels.

A formal market for *Strychnos* fruit has been created by the Namibian company that makes Maguni liqueur, but this limited market (about 5 tons/year at present) can easily be supplied by the current informal trade. PhytoTrade Africa recently facilitated the supply of *Strychnos* fruit samples to a South African company with a large international market. If product development trials by this company are successful, a much larger market for *Strychnos* pulp will be created in due course. Whether Namibian producers can be competitive suppliers to this market would ultimately depend on the efficiency and cost-effectiveness of local production (producers prices are much lower in Zambia and Zimbabwe, and transport costs are likely to be higher).

2.5.3) Potential urban, niche and/or export markets

Trade development through technical and market R&D is the core focus of the work being done by PhytoTrade Africa. It is therefore likely that substantial formal markets will eventually be created for most of the association's focal species, and possibly some others (see above).

However, indigenous Southern African fruits (and oils) are new to export markets, and face substantial (and increasing) regulatory barriers to market entry, which take time and effort to overcome. At this stage it is impossible to predict if and when these market development interventions will create a demand that cannot be supplied from existing populations of indigenous fruit trees (and for which species).

2.5.4) Product specification, packaging, labelling and regulatory requirements

Accessing formal markets, especially export markets, requires compliance with a range of rules and regulations, which is hard enough now and about to get harder.

For example, introducing an African fruit to European markets requires (under the EU's new "Novel Food" regulations) producing proof that the fruit (or fruit product) was consumed in substantial quantities in a European country before a specific date in 1997, or an expensive and cumbersome serious of consumer-safety tests. The USA is also about to get much stricter with "food supplements", while its recently introduced Bio-Terrorism Act (and draconian phyto-sanitary requirements) makes it extremely difficult for smaller producers to actually get exports into the world's biggest market.

Even something as basic as producing a crude oil for cosmetic use in world markets requires extensive efforts to develop attainable, acceptable and repeatable product specifications, as well as toxicology tests, allergy tests and formal registration of an ingredient name. All of this takes time and money, but unless it is done the market will remain small and local.

Most developed countries (and an increasing number of developing countries) have stringent packaging and labelling regulations, requiring producers to list ingredients (and nutritional values, in the case of foods). To do so requires not only analyses, but formal packaging design services, which are relatively expensive and therefore only worthwhile if fairly large sales can be more or less guaranteed.

2.5.5) Product differentiation strategies in various markets

Indigenous fruit products offer many features that can potentially be used to differentiate them from competitors and create market niches. These include:

- Functionality
- Novelty
- Cost-effective substitution of more expensive ingredients
- African identity and image
- Community or smallholder production under Fair Trade arrangements
- Potential for organic certification

Unless funding is available to develop and exploit these opportunities, however, they are likely to remain untapped, and therefore unable to expand the adoption of domestication through increasing market demand.

2.5.6) Potential market development and promotion strategies

It takes a lot of money, resources, skills and time to introduce a new product successfully to formal markets, especially lucrative export niche markets. There are two possible strategies that can be used to target such markets:

- Raise substantial amounts of donor money to develop generic opportunities for producers, share the outcomes between potential producers, and hope that the market will take care of the opportunities created
- Enter into partnership agreements with well-resourced commercial partners who already have access to and infrastructure in appropriate markets

The approach adopted by PhytoTrade Africa combines these two strategies. However, it contains no mechanism to support primary production and post-harvest processing, assuming that such activities can and will be performed by its members. At present it seems increasingly likely that this assumption is in fact wrong, and that significant additional support will need to be focused on the supply side of the trade.

2.5.7) Transport and logistics of raw material collation and product distribution

The absolute lack or high cost of transport in rural areas is a major limitation on the growth of the commercial trade in indigenous fruits and fruit products. The logistical challenge is increased by the fact that such commodities are currently produced in small quantities by large numbers of producers spread out over vast areas without adequate communication infrastructure. This presents a formidable barier to trade development.

Practically the only way to overcome this problem is to invest in the establishment and expansion of supply networks (which can be a mixture of cooperative community initiatives and private sector entrepreneurs). The higher the number of products moving through these networks, the lower their overhead and opportunity costs, and the more sustainable they are likely to become – this is a compelling argument for targeting a large number of potential products in a parallel way (as is being done under the nationally agreed "pipeline approach" to product development). Without such supply networks the raw material procurement situation becomes so uncertain that it is almost impossible to implement the next step in the value chain (regardless of whether this is direct trading of larger volumes, or further processing and value-adding).

Similarly, distributing products to wholesale and retail markets (or to downstream value adders) requires appropriate infrastructure and resources. Investing in such distribution capacity requires at least some economies of scale and this is one common reason why SMEs in the indigenous natural product sector have often struggled and failed in the past. As pointed out above, cooperation and sound commercial partnerships are the only realistic solutions to this problem.

2.5.8) Potential enterprise and business models for improved marketing

Ownership models for Nambian natural product enterprises was the topic of a recent consultancy for the Ministry of Trade and Industry (MTI) – see Schreckenberg 2003.

In Namibia this debate is current, on-going and politically sensitive.

The consultants therefore recommend increased and on-going engagement of actors from the primary supply side in this national debate, but refrain for the moment from promoting specific views on how it should be resolved, except to point out that a degree of equity ownership for primary producers remains highly desirable and advisable.

2.6) Current information about resource availability

Resource availability has two aspects:

- Bio-physical availability, i.e. the number of trees and their average annual production under varying seasonal conditions
- Socio-economic availability, i.e. the extent to which people prioritise the harvesting and post-harvest processing of a particular resource in a particular place at a specific price, thereby making available commercial quantities for processing and trade

For commercialisation purposes it is not necessary to know the bio-physical availability of most resources exactly (at this stage) and attempts to do so can be (dis)regarded as morbid scientific curiosity (a.k.a. "pure science"). It is enough to say that a resource is available in surplus, available in large quantities but with no apparent surplus, relatively scarce, or very scarce. Even such a simple quantification of production fails to account for normal inter-seasonal variations due to climatic fators.

Very little detailed research has been done in Namibia or the region into the yields or existing populations of indigenous fruit trees. A few pertinent figures and observations include:

- In the 2002 season a sample of marula trees surveyed in the NCRs produced on average just over 500 kg of usuable fruit over an average individual fruiting period of about three weeks (Botelle et al 2002) – but much higher yields have been reported from elite trees (in the study cited one record of three tons was discarded as an outlier value during final data analysis); significant seasonal variations are known to occur but remain unquantified due to the long-term nature of such research; the number of marula trees in northern Namibia remains a matter of speculation (and existing resource inventories are not reliable because they have mostly excluded farmers' fields, where most indigenous fruit trees grow)
- An average *Strychnos cocculoides* tree can produce at least two big bags of fruit a year (about 70kg) but again the seasonal variability and population remain unknown
- No information is available on the expected annual yield of a *Berchemia* tree, or the Namibian population of this species, although large seasonal variations in yield have been reported
- Bio-physically, manketti is available in very large quantities at least in Kavango, but the limited market prevents an accurate assessment of socio-economic availability at this stage
- Baobab is an uncommon tree in Namibia, occurring in significant numbers only in the western parts of the NCRs and neighbouring parts of Kunene; commercially the Namibian population is too small to compete with Zimbabwe or Malawi, although other competitive advantages suggest a niche market might be possible

It is recommended that a more systematic recording of indigenous fruit yields over several seasons be planned into the on-going work of the Directorate of Forestry.

3) Methodology used in rural surveys

3.1) Participatory Rural Appraisal

During fieldwork, Participatory Rural Appraisal (PRA) methods were used to generate general information about the selected communities, to do more in-depth research regarding the identified information gaps, and to discuss issues specific to the project. The participatory approach is important in the planning, implementation, and evaluation stages of any project as the community input and

participation increases the chances of success and sustainability. Other advantages of the PRA method are that it is flexible, multidisciplinary, it makes use of different research tools and triangulation of results, and if PRA is done in a proper way it can generate a lot of useful qualitative and quantitative information within a relatively short time span.

3.2) PRA Research Tools

Community meetings were held before the research was done to inform the community members about the project, our presence and our intentions, and to ask for their permission to proceed. At the end of our research, community meetings were held to inform the communities about the preliminary findings, discuss some opportunities and constraints for their community within this program, inform them about the way forward, and to answer any questions or requests for clarification. In Kasheshe, the community we worked with in Caprivi, it took almost 4 days of explaining our aim in meetings with the community and the traditional authorities (Indunas, sub-Khuta, Khuta), before getting permission to proceed with our activities. In the other communities getting a permission to conduct a short research for this programm only took one community meeting.

Questionnaires were conducted among individual households to gather more quantitive data about the community in general and the project components in particular. The questionnaires were kept as short as possible, in order to spare the respondents' time, to keep their attention, and to enhance the quality of their answers. The questions were divided into 3 sections:
A. GENERAL INFORMATION, i.e. household size, migration, intensity of agricultural activities, sources of water, and sources of income.
B. MARKETING OF INDIGENOUS FRUITS, i.e. questions regarding selling, buying, bartering, and giving away indigenous fruits or fruit products.
C. USAGE, ACCESS, AND MANAGEMENT OF INDIGENOUS FRUIT TREES, i.e. ranking of indigenous fruit trees for household use, commercial use, and domestication, harvesting rights, resource availablility, and practices of planting and retaining trees.

The communities we worked in were relatively small, which limited the ***sampling size.*** In Mile 20 the National Planning Commission recently counted a total of 156 households, and we interviewed 29 households which is 19% of the community. In Kasheshe we managed to conduct 16 questionnaires in a community with 22 extended family village sections and an estimated 150 households. In the North-Central regions no questionnaires were conducted as an extended PRA had already been done in the communities selected.

For chosing the households to be interviewed a ***random sampling method*** was used, although we made sure that we interviewed both households far from and close to the road, and that at least 50 % of the respondents were women. In Mile 20 64% of the repondents was female, and in Kasheshe 63%.

Focus group discussions were the core of our Participatory Rural Appraissals. A total of 6 group discussions were held in each community with a small group of community members interested in the topic. We asked questions and/or provoked discussions regarding the following issues:

PRA1: TRADITIONAL USAGE, i.e usage of indigenous fruits and fruit products, contribution to household food security, traditional methods of harvesting, processing & storage, socio-economic benefits, and cultural aspects. ***Resource ranking*** was used to identify the most important indigenous fruit trees for household use.

PRA2: INDIGENOUS FARMING KNOWLEDGE ON (INDIGENOUS) FRUIT TREES, i.e. planting, selection, management, soil types, moisture, spatial arrangements, fruiting periods, diseases, perceived problems, needs & expectations, resource availability, and male:female population.

PRA3: RIGHTS, i.e. rights on and ownership of trees & land, harvesting rules, decision-making, profit sharing.

PRA4: MARKETING, i.e. existing local market systems, informal economics, potential local supply and demand, and a ***SWOL analysis*** was done to identify market opportunities & constraints.

PRA5: LAND USAGE, i.e. prevailing farming systems, relative importance of agriculture, livestock, and forestry. The method of ***map drawing*** was used to identify the location of homesteads, crop fields, pasture areas, forests, boundaries, fences, roads, and water points.

PRA6: DEMOGRAPHIC DATA, i.e. population density, settlement, migration, etnicity.

Semi-structured interviews were used mostly in gathering information from market women selling indigenous fruits and fruit products. Interview topics included; what do they sell, where do they sell, how much, how often and at what price, seasonality, sources, opportunities, restraints, and problems experieneed. Semi-structured interviews were also planned for gathering information from small or medium enterprises producing indigenous fruit products, but no such businesses were found in the areas researched. Few open interviews were conducted among key informants in goverment positions (Ministry of Agriculture, and Department of Forestry), and traditional authorities.
Secondary sources of information like maps, population figures, resource inventories and other earlier research done, were sought for at local level, also as part of the training of the Forestry staff, but little was found in the Northern regions, and we were referred to Windhoek for most information needed.

Limited use was made of ***participatory observation*** as a research method, as for most fruits we eame in the wrong season, and little traditional production and harvesting methods could be observed.

Transects were not done at all, partly because of our time limitations and also because most foresters who had done the exercise before felt that the communities know their area very well and that more accurate and comprehensive information could be gathered by drawing a map together with the community.

3.3) Site Selection

All three research areas, the Caprivi, Kavango, and North-Central regions, are very diverse in terms of culture, land use, soil and vegetation types, and within the limited timeframe given it was not possible to gather statistically valid data for the whole of these regions. Furthermore the Forestry staff working on the project still had to be trained in conducting research through PRA, and project implementation was planned to start in only one village per region. Therefore it was opted for an approach whereby only one village in each of the three regions was selected for the research. In this way we could gather more in-depth information regarding a small number of communities rather than a lot of superficial or unvalid information over a larger area. The other advantage of working with a few pre-selected communities is that it avoids dissapointment among those communities which have been participating in the research phase, but will not be included in the project implementation phase. Furthermore, PRA's in other communities can be conducted at a later stage by trained Forestry staff.

The Forestry staff in each of the 3 regions were asked to pre-select communities which were likely to participate in the programm, taking the following points into consideration:
- The communities should be located in forested areas, although not too dense because if there are more than enough trees and tree products around for everyone, the people may not be interested in a domestication project.
- The area should be a relatively densely populated rural area, where people are largely dependent on agriculture and the use of forest products for their livelihoods.
- There should be a tradition of people organising themselves, or even better existing organised and motivated groups.
- The communities shonld be situated relatively close to the participating forestry offices, so that project implementation is more viable.
- In general; the availability of the resource (the fruit trees likely to be selected), suitable planting areas with water sources, and enough people in the community that are willing to plant trees and provide care.

The participating staff of Hamoye Research Station (Kavango region) had selected ***Mile 20*** as their pilot community for this project for the following reasons:
- The community had been visited by the fruit tree improvement specialist of this program some months ago, and seemed interested in dealing with indigenous fruits.
- The abundance of *Strychnos cocculoides* in the area, a species that was pre-selected in this FAO/DoF program.
- Many community members are trying to sell indigenous fruits, mainly *Strychnos cocculoides* and *Guibourtia coleosperma*, and they had asked for assistance especially in the marketing of these fruits.
- The DED-supported Community Forestry Program will start in Mile 20 shortly, and the two programmes may want to link up at a later stage.
- Mile 20 is situated relatively close to Hamoye research station (+- 80 km).

At the Katima Mulilo Forestry Office the village of ***Kasheshe*** was chosen as a participating community, mainly because of the abundance of *Berchemia dicolor*, one of the three pre-selected species within the programm. Kasheshe was also perceived as a suitable community because of its proximity to the Forestry office (+-30 km), and the presence of an agricultural extension officer, who lives and works in the community.

At Ongwediwa Forestry Office, 3 communities were selected for participation in the programm; ***Eefa, Elombe, and Onkani***. These three communities are located in areas with different vegetation types, and have acted as pilot communities for several projects and programs since 1996. Ongwediwa has a good relationship with all three communities, and wanted to investigate the possibilities of working with them in this programm as well. As general PRAs were done in these villages already, more project-specific topics were discussed.

3.4) Working with Forestry staff

Although working with Forestry staff was pleasure in all areas, and they were very motivated to work and eager to learn, a problem was encountered mainly in the Kavango and Caprivi regions. In these regions, the Directorate of Forestry has quite a negative image. Illegal cuttings are daily practice, and Forestry is associated with fining people and reposessing woodcarvings that are a source of income for many, especially in the Kavango region.

As trees are still relatively abundant in both Caprivi and Kavango regions, and most people live by the day, communities fail to see the positive role that the Directorate of Forestry plays. As a result, a lot of

distrust and suspicion was encountered at first instance. Communities needed a lot of convincing to believe that Forestry would try to help people improving their livelihoods, bring some positive developments without trying to get something out of it themselves.

In the more densely populated North-Central regions, where trees have rapidly dissappeared in the last 20 years, and most people now realise the importance of trees, the Directorate of Forestry had a much more positive image, and ideas and projects coming through Forestry were welcomed without any suspicion. In all areas though, working with people from the Directorate of Forestry constitutes a bias to research, as questions regarding the cutting of trees, for example, will obviously not be answered truthfully.

It is recommended that Forestry offices especially in the Kavango and Caprivi regions concentrate less on law enforcement but rather adopt a positive approach to communities by implementing and facilitating projects aimed at improving the livelihoods of people in the communities. The positive image thereby gained will also help improve the success of public awareness caimpaigns, and people will protect trees when they recognise their importance.

3.5) Research guidelines

One of the aims of this project was to train Forestry staff in conducting Participatory Rural Appraisals. The training consisted of general research guidelines, going intensively through the pre-developed research methods, and getting practical field experience. The guidelines given during the training are summarised in this section. Many volumes have been written about research methods, and a lot of practical experience is needed to learn how to ask. This section is therefore not an attempt to be complete, but an overview that can serve as background information for Forestry staff intending to do similar research in other areas.

In conducting Participatory Rural Appraisals, there are four important aspects to be taken into consideration:

Information needs identification. Before starting any research, you need to identify exactly what you want to know. In this way you avoid a situation whereby you take more time than necessary from both the community and yourself, and end up with a lot of information that you are not going to use, or inversely, realise while analysing the data that you have failed to cover sections that are important for the project, and going back is not an option. Identifying your information needs is imperative in developing research methods, and serves as a frame to be kept in the back of your mind while conducting the research.

Flexibility. Knowing what you want to know doesn't mean one has to be rigid in the collection of data, or that research methods that were developed before the start of the research have to be adhered to at all times. Issues that you haven't thought of before the research can come up and be important to go into as well, and some research tools developed might not give you the information you were looking for. Being flexible at all times is very important in gaining the right information. All researchers, no matter how experienced they are, should engage in a continous process of adapting and reviewing methods and questions while conducting research in order to get the best results.

Qualitative and quantitative data. Both qualitative and quantitative information have to be collected and combined to get a proper picture of the topics researched. A common mistake often made in research is using structured questionnaires only, thereby losing touch with reality that doesn't always fit within the pre-constructed framework. To clarify this issue, consider the example of marula research conducted in 2002:

> *Being part of an international research program, pre-structured surveys from South Africa were administered in North-Central Namibia. One of the aims of the research was to assess the economic benefits of marula which was done by quantifying marula wine production and commercialisation. Questions asked were 'how often do you collect marula fruits', 'how many bags do you collect each time', 'how many liters of wine do you produce', 'how long does it take to produce that amount' and 'how many liters are consumed / sold'. Unlike the situation in South Africa, women in the North-Central region of Namibia don't collect the fruits and produce the wine in their homesteads, but call together friends and neighbours to produce the wine under the tree. Fruits are piled up and used at the same time, and the largest part of the wine production goes to the owner of the tree. This makes quantifying difficult, but not totally impossible. The questions asked however can not be answered properly, or will be answered but give a distorted view of the reality. Furthermore, the production process itself brings women together as a group, and a large part of the wine is consumed by the producers and others during marula parties. The giving, sharing and assisting is not only important in a social and cultural sense, but also helps people build up their 'social bank account', which does not bring in direct cash, but is of economic importance in peoples' livelihoods. All this information gets lost though if one uses quantitative research methods only.*

So even while conducting structured questionnaires, researchers should listen to the story given by the respondent, and write down all extra information, regardless whether the survey form leaves a space for that. Getting only qualitative data, without a quantitative base, also doesn't give a complete picture. The two types of information need to be combined as much as possible.

Participation. Last but not least, participation of both the community, and the people conducting the research is essential, as it increases the chances of succes and sustainability in any project. The participatory approach in PRA leads to results that are based on the existing knowledge within the community and their actual needs and priorities, because community members are seen as actors in the process of gathering information, rather than subjects.
Dr Abdou (2003) defined participation as *'the active involvement of insiders and outsiders in all decision-making related to identification of of the objectives, the activities, as well as the implementation, monitoring, and evaluation of the project activities. The primary purpose of participation is to encourage community self determination and thus foster sustainable development.'*

Site selection. Where the PRA is going to be conducted depends on the aims and topics of the project or research. Selecting sites is mostly a matter of using common sense. If one wants to learn about the use of marula products for example, it will be useless to do a PRA in an area where marula doesn't grow. Logistical aspects are often important in the selection of sites, but one should avoid convenience being the determining factor, because that will lead to all projects being implemented in the villages next to towns. Section 3.3 shows which criteria were considered in selecting the sites for this research.

Knowing what you want to know, who is going to be involved, and remembering to be flexible at all times, one has to start thinking which qualitative and quantitative ***research tools*** can be used, in order to get the information that you need. Different research tools are appropriate for different types of

information, and it can be useful to get the same information in different ways, to check whether your tools are valid and the results are a reflection of the reality. Possible research tools within PRA are:

Secondary sources of information should be reviewed even before the other research tools are developed. Information regarding the area, the community, or the specific research topics may already be available in other research reports, government documents, or literature, and knowing what information is available will avoid you duplicating efforts already made, but rather fill the gaps in the existing information. More specific sources of information, on new topics coming up for example, can be sought for throughout the research period.

Community meetings are a first step in getting the community involved in the research and/or project. The meetings serve to introduce project staff, inform the community about intentions, share ideas and information, get agreement on issues, and plan further action. The main advantages of the tool are that many people can be reached in a short period of time, the meetings are open to anyone in the community, and regular meetings encourage the community spirit and a co-operative approach to problems, projects, and decision making.

Focus group discussions are interactive meetings on more specific topics with a smaller group of community members. Many people feel more comfortable to talk when surrounded by less people and it's possible to divide the groups in male/female, young/old, or different etnic groups, in order to get not only the views of the dominant groups, but find out what less vocal groups think about the issue as well. Different existing views and ideas may have a major impact on project implementation at a later stage. Furthermore, specific issues can be discussed with a small number of people that is knowledgeble and/or interested in the topic which can generate a lot of qualitative information. During the discussions, other research tools can be used like ranking, drawing, mapping, and SWOL analysis.

Ranking, rating, and sorting can be used to identify priorities and preferences, and the criteria on which people base decisions. The tool can gather both qualitative and quantitative information, and can encourage people to think about the choices that they make. Ranking can be done through concepts, pictures, drawings, or objects.

Drawing can be a useful tool in communities where people have difficulties expressing themselves through language. More often drawings are used as a base for discussion, or for clarifying subjects that are easier explained through or with the help of drawings than in words.

Mapping. Existing maps, or maps drawn by the community can be an appropriate tool to clarify land use systems, identify problems, monitor changes, or assist in planning.

SWOL analysis provides a framework for the analysis of **S**trenghts, **W**eaknesses, **O**pportunities, and **L**imitations of subjects, projects, or situations. The tool can provoke a lot of discussion in the group, and help assessing possibilities by encouraging people to think in a focussed manner.

Questionaires or ***surveys*** can be used to give results a quantitative base. The same questions are asked to a sufficient number (minimum sampling size) of people or households in order to gain statistical valid data on the research topics. Questionnaires are often used to gather general socio-economic information on the community as well. Possible answers are indicated and often coded on the questionnaires in order to conduct the interviews as fast as possible, and ease the analysis of the data. Some of the information does get lost in this process, and one should always leave a space for unexpected answers or qualitative information that is given by the respondents but cannot be fitted in the rigid survey form. A common

mistake often made by people designing questionnaires, is that they make them too long. One has to identify for which topic it is important to have quantitative data, and get information regarding other topics using other tools. In our experience, people lose interest if the interviews are too long, and the answers given will be less valid.

Semi-structured or open interviews are often conducted among ***key informants***, i.e. people who can provide you with a lot of inside information regarding one or more of the research topics. Unlike questionnaires, these interviews are not fixed, but rather evolve flexibly around topics identified. Semi-structured or open interviews allow for more conversational, two-way communication and they enable you to get a better insight in general or more specific subjects.

Participatory observation is a useful tool in gaining first-hand insight in processes or activities. In our case, it could have been used for investigating processing and harvesting methods for example. By observing, participating, and asking questions about processes involved, one creates a more informal atmosphere, and gets a much better idea about what is going on than through surveys or group interviews for example. Other benefits of the tool are that it can avoid main language barriers and be very time-effective.

Transects can be useful to investigate land use systems, vegetation types, resource availability, tree management practices, or spacial arrangements. A transect is an (imaginary) line drawn through the area to be investigated, which can be walked or driven together with community members and other knowlegable people (i.e. Forestry staff), while making detailed observations regarding the subject matter.

It is recommended that Forestry facilitates further practical training on adapted research and community development skills to selected staff in all areas.

4) Results: PRA - General Information

4.1) Mile 20

Mile 20 is situated about 20 miles on the main road from Rundu to Grootfontein. With 156 households, Mile 20 is a relatively small community with a large etnic diversity. The majority of the people living in Mile 20 are Nyemba (+-40%), followed by Ashihokwe (+-30%), and Kwangali (+-25%). There are also a few Oshimbundu, Owambo, and San families. The Kwangali were the first inhabitants in the area, they came from Siya (Kavango region), and settled in Mile 20 from the late 60s. Many Angolan families (Nyemba & Ashihokwe) crossed the border as a result of political developments in Angola in 1975, and some settled in what is now known as Mile 20. With the building of the road in 1979, the population increased once again, and today there is a stable but not excessive increase in population size, although 46% of the households in our survey said they arrived in Mile 20 after 1990. Another result of the road that was built was that people moved their homesteads next to the road. Currently that settlement pattern still exists, people mainly live alongside the road, and have their fields, pastures and forest areas a bit more inland.

Overall average household size in our sample was 8.8, with Nyemba people generally having larger households (10.7). 43% of the household members were adults, 57% children. Among the adults there were more women (61%), than men (39%). 68% of the households were headed by a man, 29% of the sample consisted of female headed households, and 1 household was de-facto female headed.

Except for the San families, agriculture, livestock, and forestry are important in the livelihoods of all etnic groups, although it was said that the Kwangali relied more on agriculture and owned larger herds of livestock, while a lot of people that originally came from Angola, in particular the Nyemba, are largely making a living through the production and trade of woodcarvings. The main source of water for the community are public pumps that are used by 86% of the households in our sample. Few households have their own tap or use the tap of their neighbours. Acquiring a piece of land in the area is relatively easy. There is no land pressure and anybody can settle in Mile 20 as long as the headman and the community agrees. Land ownership is more or less equal as people are given as much land as they can cultivate, and no payment has to be made.
In our survey, all people interviewed owned at least one field on which they practiced agriculture. 20% of the households had a small field (1 hectare or less) surrounding their house, while 93% of the interviewed had a field away from the house. 50% of the respondents had to walk less than 2km to get to their field, for 30% the distance from the homestead to the field was 3-5 km, and 20% said they had to walk up to 8 km. 50% of the respondents estimated the size of their field in the range of 3 to 5 hectares, 38% claimed that the size of their field was smaller than that, and 12% of the respondents said that their fields were bigger than 5 hectares. Fields are generally not fenced, only one of the respondents said they had fenced their field. It is the duty of those people with livestock to make sure that their animals do not eat peoples' crops. The staple crop grown is mahangu, which covers about 90% of peoples' fields. To a lesser extent people also grow maize and sorghum, but these crops need far more water than mahangu and are therefore less preferred. Other crops grown are groundnuts, roundnuts, beans, watermelon, and cotton. Shifting cultivation is not practiced, people generally grow the same crops on the same fields every year. Ploughing is done mostly with oxes, although some still do it by hand. Working groups are common, especially among Kwangali people. In the past households just had to provide beer when they organised working groups, nowadays people are paid either cash or they are given part of the harvest. Homegardens are not vey common, but some people are growing beans, maize, watermelon, and/or sweet potatoes in or around their homestead. As much as 82% of the respondents said their household is able to produce all of their staple food in most years, and 14% said they can only in some years. Reasons for insufficient crop production were varied and included the lack of rain, poor timing of rain, lack of labour, no cattle for plowing, and lack of fertile land.

Most households in Mile 20 own cattle. Herd sizes are small, with an average of 5 heads of cattle per household, ranging from 0 to 40. Kwangali people on average have bigger herds than the other etnic groups. Goats are not kept by many households, as they were said to be prone to diseases. Chickens are common and few households own a pig. Cattle and goats browse for their food anywhere in the area during the dry season, but are kept on the left side of the road, away from the fields, during the rainy season. Pasture areas are sometimes burnt, which may result in bush fires.

4.2) Kasheshe

Kasheshe is located about 30km from Katima Mulilo on the main road to Kongola. It was said that the whole community migrated from a place called Nabulangwe about 60 years ago because that area was unsuitable for farming. The population is relatively stable with some young people going to urban areas, and little or no households moving to Kasheshe. In our survey, 63% of the respondents said they were born in Kasheshe, and only one household claimed to have arrived in the last 15 years. The population of Kasheshe was recently counted and 1067 people live there. A vast majority of the population is Kwengo, and few Totela and Khoisan people reside in the area.

Kashcshe consists of 22 extended family groups or 'villages', each headed by a village induna. Young men may build their own house when they reach a certain age, but remain part of the household until they form a family themselves. Households can be defined as a group of relatives that eat food from the same field. Villages consist of 1-10 households, which are all related to each other. In our survey, the average size of households was 6.8, ranging from 2 to 13. The average number of adults in the household was 4.0, children·2.8. 56% of the households in our sample were headed by men, 25% by women, and 19% consisted of de facto female headed households.

Agriculture, livestock, and forestry are important in the livelihoods of all people, although the Khoisan depend more on forestry products. Access to water is a problem in the area. People used to get their water through a pipeline build by the old government, but that source of water has been dry since last year. There are 6 boreholes in the area, but most residents have to walk far to get there. In the rainy season, pools are used. As the population is relatively stable, there is currently no pressure on land.

Only one household in our sample had a piece of land around their house, while all of the people interviewed had a field away from the house. More than half of the households estimated the size of their field to be between 3 and 5 hectares, 25% had smaller fields, and few households (19%) cultivated up to 10 hectares of land. Most of the fields (73%) were located 3-5 km from the homestead, and only one of the households had to walk further than that. Most households have build small houses next to their field where a aprt of the household stays during the busy agricultural season. The main crop grown is mahangu, but people also cultivate maize, sorghum, cassava, pumpkin, groundnuts, and beans. Land is ploughed by owned or hired oxen, and no shifing cultivation or irrigation is practiced. Less than haf of the interviewed (43%) said they produced sufficient staple crops for the household in most years, 25% produced enough only in some years, and 31% said they generally don't produce enough crops to feed the household for the whole year. The main constraints for agricultural production were said to be the lack of rain (47% of all responses), elephants (16%), lack of animal draft power (16%), poor timing of rain (10%), and infertile land (10%).

Cattle and goats are common in the area, with average herd size of 60 cattle per village / extended family. Goats and cattle browse for their food everywhere, but as fields are generally not fenced, they are taken to a pasture area on the other side of the road during the agricultural season.

4.3) Eefa, Elombe, and Onkani

Although extensive PRAs had been done before in all 3 communities, most of the existing information was locked inside a broken computer and not available at the time of writing this report. Some general information was found on Eefa.

Eefa is a village about 6 km Northeast of Ongwediwa, located in the Cuvelai delta system which is made up of *oshanas* (seasonally flood areas), *omatunda* (raised cropping areas), and intermediary soils known as *ehenene*. The rainfall in the area varies from 300mm to 600mm per year, and the area experiences flooding when the rainfall in Southern Angola is high. The agricultural season is from October to June, and the main crop is pearl millet (mahangu). Other crops grown are sorghum, roundnut, pumpkin, and water melon. There are limited grazing resources, and grazing is generally concentrated in open oshanas and the partially wooded areas in and around the farm. Most households have some cattle, goats, donkeys, pigs and chicken. The homestead *(Egumbo)* is typically surrounded by crop fields *(Epya)* and farm woodland area *(Ekove)*. (Kaambu et all, 1998)

5) Results: Domestication of indigenous fruit trees

5.1) Indigenous farming knowledge

As can be expected, people in areas where a large variety of trees still grow in abundance, had less interest in and less knowledge about tree planting and management. Most knowledge and experience regarding the planting of indigenous fruit trees was found in Onkani, an area where people settled in recent years and only mopane trees grow naturally, while the majority of people in Mile 20 thought that it wasn't even possible to plant indigenous trees.

5.1.1) Planting

Of the 22 people (3 men, 19 women) that attended our meeting in ***Onkani***, 13 had tried to plant marula. For planting marula, seeds, seedlings, and truncheons had been used, which were often selected on the quality of the fruits (taste and juiciness of the fruits and number of kernels in the seeds) of the mother tree. All three planting methods had seen successes, but planting through truncheons was said to have more advantages, as it makes trees fruit faster (some after 3 years), one can be sure that it is a female tree, and that the traits of the tree and its fruits are identical to the mother tree. Truncheons were obtained from friends and relatives in other villages. Some people had also tried to plant *Berchemia* through truncheons, but said it was not possible. 6 people in the meeting said they had tried to plant *Berchemia* through seeds or seedlings, with mixed results. *Berchemia* seeds were also selected on the quality of fruits of the mother tree. A major advantage of planting *Berchemia* was said to be the fact that one can be sure that the tree will bear fruits, the disadvantage, however, is that it takes a long time before they start fruiting. Few other indigenous fruit trees had been planted as well, and a specific question was asked regarding the germination of the hard *Diospyros* seed. People in Onkani said they planted most trees within the homestead, and a few seedlings would then be transplanted into the fields. Most trees found outside the homestead were said to be there because of the shifting of homesteads.

In *Eefa*, most participants were familiar with the technique of planting marula through truncheons as well, and they also said that planting *Berchemia* through truncheons doesn't work. 3 out of 15 people in the group knew how to grow a *Ficus* by cutting and planting a root of another ficus tree. In a PRA done in 1998, it was said that the community had knowledge of planting through truncheons, cuttings, seedlings, and seeds, as well as tree tending activities (pruning, coppicing, selective harvesting, watering, thinning, and protecting trees from being cut by outsiders). (Kaambu et all, 1998)

In *Mile 20*, knowledge about planting indigenous fruit trees was less common, and examples of experiences in planting trees more incidential. One participant said he had succesfully planted a Manketti tree with a truncheon, while another person had tried planting *Strychnos* both with a seedling and a truncheon, but his efforts had failed. On questioning why nobody else had tried planting indigenous fruit trees, it was said that they lacked the knowledge and skills. The same answer was the most common in the questionaires, where only 1 of the 28 respondents had ever tried to plant an indigenous fruit tree (*Berchemia* in this case). Other reasons given for not planting included the abundance of indigenous species in the area, the lack of water, and laziness. 75% of the respondents claimed to look after young indigenous fruit trees, especially with regard to *Strychnos* (*cocculoides* and *pungens*), *Guibourtia coleosperma*, en Manketti, but most of them referred to not cutting them (68%), while 28% said they weeded the area surrounding the young tree. Most of these young trees retained were located on peoples' fields (77%), with the rest in the homesteads.

The survey results of *Kasheshe* show that half of the respondents had tried to plant either *Berchemia* or Manketti or both. Manketti was planted by truncheons, and *Berchemia* with seedlings or seeds, and all but one respondent had planted the trees in the homestead. Half of the respondents had also looked after young trees, especially *Berchemia*. They had done so by fencing it, making sure they were not cut during plowing, or giving it water. Those respondents that had not planted or looked after trees gave as reasons their lack of knowledge, the lack of water, and the fact that indigenous trees grow naturally and don't need any human attention. Pruning of *Berchemia* trees was said to be common practice. Grafting and coppicing techniques were unknown.

5.1.2) Soil type

In *Onkani*, the participants said that in general trees grow best in the homesteads as the moisture level in the soil is higher there. The soil in crop fields is better for tree planting than the communal areas for the same reason. Specifically, marula was said to grow best in *omatunda* soil (in crop fields), and diosporus needs a harder soil containing a lot of clay.
In *Mile 20*, people said that most indigenous fruit trees, especially Manketti and *Strychnos*, grow best in sandy soil (*moheke*), while in *Kasheshe* loamy soil was said to be the best for fruit trees, as it contains a lot of nutrients, which makes the trees grow faster.

5.1.3) Diseases

Few diseases that hamper the growth of indigenous fruit trees were mentioned by the participants in *Onkani*. In their words, without the scientific explanation there are;
- Parasites; other trees or plants brought there through bird droppings growing in the tree. The problem is solved by cutting out the parasite.
- Caterpillars growing underground eating the roots. People didn't have a solution to this problem.
- A kind of mushroom, that grows next to the tree and makes it die.
- In *Berchemia*, there can be a small hole at the base of the tree with reddish water, it will dry out that side of the tree. The solution is to cut open the tree and cut out a 'black thing'.
- Another problem with *Berchemia* was that some trees only grow up to 30 centimeters high. The participants didn't know why this was the case or how they could solve the problem.

In ***Eefa***, the participants also talked of parasites that just have to be cut of, and about an insect that lives inside the tree and makes it dry. The tree eventually dies, and no method of prevention of treatment were known.
In ***Mile 20***, people mentioned a parasite that grows on *Guibourtia coleosperma*, and a disease that dries out the leaves of *Strychnos cocculoides*. No treatment or prevention methods were known.
In ***Kasheshe*** it was said that some trees are eaten by ants or worms, which could be treated by putting ashes on the affected parts, but not always with succes.

It is recommended that knowledge and techniques regarding tree planting and management in the communities is improved by providing training to interested community members about planting, soil types, disease management, grafting, and other relevant topics.

5.2) Needs & expectations

In ***Onkani***, there was a lot of interest in a project domesticating indigenous fruit trees. The two most important species they wanted to plant were Marula (because of its many uses) and *Berchemia* (because one can be sure that the tree will be fruiting). Other species that they were interested in were *Strychnos*

ssp, *Diospyros mespiliformis*, *Ximenia* ssp, *Adansonia digitata*, *Hyphaene petersiana*, and *Vangueria infausta*. Specific needs mentioned by the community included:
- Gaining knowledge on soil types, disease management, etc, i.e. learning how to grow trees best
- Improving technical skills, i.e. grafting technicques to turn non-fruiting marula trees into fruiting trees for example
- Logistical support, the provision of transport to collect seeds, seedlings, and truncheons
- A solution for their water problem, to somehow retain water from the rainy season.
- Forestry to come on a regular basis to monitor their progress and provide support where needed.

In ***Eefa***, there were mixed feelings about an indigenous fruit tree domestication project, as some felt there were enough trees for everyone, and they would rather grow exotic species. Furthermore, some mentioned that mahangn doesn't grow well if there are too many trees in the field. There was however interest in trying to grow indigenous species that are less common in the area, in particular *Strychnos* and Manketti, and people were keen to try out grafting techniques.
In ***Kasheshe*** and ***Mile 20***, participants said they would plant indigenous fruit trees if they were given the knowledge. They wanted men, women, and children to learn skills in planting, grafting, and taking care of fruit trees, and gain knowledge on soil types and the prevention and treatment of diseases. In Kasheshe, people were particularly interested in planting *Strychnos*, *Berchemia*, and Manketti, In Mile 20, people were interested in planting Maguni, Manketti, and Nonsivi. Some people mentioned they would like to grow an improved species of Nonsimba, that can fruit every year. In general though, people in both Mile 20 and Kasheshe just wanted access to more trees and more fruits, and taste of fruits, juiciness of fruits, number of kernels, fruiting season and other traits of fruits / trees were not really taken into consideration.

It is recommended that tree planting trials include a combination of indigenous and exotic species, especially in communities that regard the availability of indigenous species as overabundant.

6) Results: Traditional use of fruits & post-harvest handling

6.1.1) Traditional usage & importance - Mile 20

The PRA on traditional usage in Mile 20 was conducted immediately after the first introductory community meeting and therefore a lot of people were present and providing information. The total number of the gronp was 29, of which 13 were women, and 16 men.
The most important indigenous fruit trees for household use and food security as identified by the community of Mile 20 were (in order of preference):

1. Nongongo	Manketti	*Schinziophyton rautanenii*
2. Nonsivi	False Mopane	*Guibourtia coleosperma*
3. Maguni	Corky-bark Monkey Orange	*Strychnos cocculoides*
4. Nonsimba	Kalahari Podberry	*Dialium engleranum*
5. Nonzwe	Peeling-bark Oclina	*Ochna pulchra*
6. Matu	Spiny-leaved Monkey Orange	*Strychnos pungens*

1. Nongongo was rated as the most important indigenous fruit (tree) mainly because one can survive on that tree only. Its products can be stored for years and kept for times of hunger.

Manketti fruits can be cooked to make a porridge, and made into a non-alcoholic (juice), low alcoholic (beer), and strong alcoholic (kashipembe) drink. Its kernels / nuts can be made into soup, or oil, or eaten just like that. The bark of the manketti tree is used for treating stomach aches, and some rare traditional diseases. If people are really sick they can sit in a bath of stamped bark and water. Manketti wood is used for making canoes, and carving crafts and utensils

2. Nonsivi was seen as important also because its main product can be stored for a year and eaten in times of hunger.

A soup is made out of the thin covers of the kernels, and eaten with porridge. People also used to eat the roasted kernels, but today that is rarely done, as people don't like the taste of it. The leaves of the false mopane are stamped and mixed with water to treat coughing. Cooked bark of the tree helps healing open wounds. The wood of Nonsivi is highly valued and used frequently for building, fencing, making furniture, carving tools and crafts, and as firewood.

3. Maguni is important because the tree carries a lot of fruits which are highly appreciated because of its taste. The problem however is that the fruits cannot be stored well. One can keep them only 1 to 2 weeks after collecting.

The fruits are eaten fresh and made into a non-alcoholic (juice), a low-alcoholic (beer), and a high-alcoholic (kashipembe) drink. The tree has a lot of medicinal uses as well.The unripe maguni can be pounded and mixed with water, this mixture is used to treat snake bites and swellings. The juice of the unripe fruit can be applied topically to treat ear pain and one can drink it to cure stomach ache. The leaves of the tree can be wrapped around the neck for treating neckpain, and the roots of a young tree can be put in water and given as a drink to treat stomach ache in children. The wood of the tree is not highly valued and therefore not really used for anything.

4. Nonsimba was rated high as well because of storage. It was said that fruits could stay on the tree and be used for at least 2 to 3 years. However, the problem is that the Kalahari Podberry only fruits every 2 to 3 years. It was also said that although important, Nonsimba was not planted or retained near the homestead as the tree attracts bees.

The fruits of the Kalahari Podberry are eaten dried and can be made into a non-alcoholic drink and into Kashipembe. The dry seeds of the fruit can be mixed with milk to make it more tasty and nutritious, and the left-over water from washing the seeds is often mixed with manketti nuts and eaten as a soup that is eaten with porridge. Leaves of nonsimba are stamped and mixed with cold water and used to treat chest pain, cooked bark of the tree treats stomach ache. The wood of the tree is not that strong and therefore not really used for anything. It may be used as firewood, but is said to be not very good for that purpose either

5. Nonzwe is seen as an important tree, mainly because of the cooking oil one can extract from the fruit and keep for about a year.

The fruits of the *Ochna pulchra* can be cooked to extract a valued cooking oil. The nuts / kernels are eaten roasted or made into a soup. The bark of the tree can be pounded into a flour to treat wounds and diarrea. The wood of the tree is mainly used to make small kitchen utensils. It is not good for fencing, building or a source of fuel.

6. Matu is similar to Maguni, but less appreciated for its taste. The fruit can be eaten fresh, but is more often made into a porridge. Medicinal uses and use of wood are similar to Maguni.

The group said that all the above mentioned trees were very important to them in terms of food security, and that all people used the fruits and its products. They furthermore claimed that there were no significant differences in benefit between the households, the relatively poor and relatively rich households have equal access to trees, and the benefits people get purely depends on their energy to go and collect the fruits and process them. Knowledge of traditional medicine was seen as common, although it was said that women have more extensive knowledge regarding the subject.

6.1.2) Harvesting - Mile 20

Nongongo starts fruiting after about 20 years. People start harvesting nongongo fruits in April, but can continue to do so for most of the year. Men, women, and children harvest the fruits by picking them from the ground or the tree. ***Maguni*** and ***Matu*** take only about 4 years to reach maturity. The fruits can be harvested from July-August up to January-February. Both men, women and children collect the fruits by picking them from the ground or the tree. The fruits can be harvested from the tree in an unripe state, and then kept in a bag or be burried in the ground to ripen there, which may take up to two weeks. *Nonsivi* starts fruiting after 10 years, and can be harvested from May to October. Mainly women are involved in the harvesting process. ***Nonsimba*** can start fruiting after 7 years. Trees only fruits every 2 to 3 years, and if they do, harvesting is possible from July, but fruits can stay also on the tree for 2 to 3 years. It was said that Nonsimba is often harvested by cutting down the tree or the branches that carry fruit. Finally, ***Nonzwe*** starts fruiting after about 5 years. Harvesting of fruits is done by women from October to February.

Indigenous fruit trees that are located on communal land can be harvested by anybody in the community. Outsiders have to ask for permission from the headman if they want to harvest fruits. Harvesting rights of trees that are located on peoples' field are restricted to the household 'owning' the land, but it is quite common that neighbours are invited to harvest, especially if the household owns many trees. In our survey, 81% of the respondents said they harvest from trees in their own fields, 55% collect fruits from the communal areas, and 22% harvests fruits from neighbours' trees with their permission.

6.1.3) Processing and Storage- Mile 20

Fresh/dried/cooked fruits. Matu and Maguni have the shortest lifespan, when they are ripe you can only keep them well for 1 to 2 weeks. The fruits of the other trees are not eaten fresh. Nongongo fruits can be cooked and consumed after taking of the skin. Nonsimba fruits are eaten dried. They are collected dried from the tree and can be stored for about 3 to 4 months.
Cooking oil. Cooking oil can be made from the nuts of Nongongo, and the fruits of the Nonzwe. To extract the oil the fruits(nonzwe) / pounded kernels(nongongo) are mixed with water, heated, filtered, and cooked until oil is formed. Both types of oil are used for the same purposes, and can be stored for about 1 year. Nongongo oil is the preferred type of oil used.
Porridge from fruits. Manketti and Matu fruits are used to make a porridge. Manketti fruits are cooked, and its fruit pulp pounded into flour that is used to make porridge. It can be mixed with juice from Matu.
Soup from kernels. The nuts / kernels of the Nongongo and the Nonzwe are made into a nutritious soup that can be eaten with porridge. Pounded nuts are cooked with salt until it forms a soup. A popular soup is also made from the thin covers of Nonsivi kernels. Nonsivi fruits are cooked with some salt for 1-2 hours, the water is then filtered out and the kernels seperated from the soup. Nonsivi soup can also be mixed with traditional spinach or dry meat. One can keep Nonsivi fruits for up to a year, and the taste of its soup is well appreciated.
Kashipembe. Most Kashipembe (a strong alchoholic drink) is made from manketti fruits, but it can be made from Maguni and Nonsimba as well. In the case of Manketti, the fruits are cooked first, then pounded and the flesh separated from the kernel, the fruit pulp is then cooked, and a strong alcoholic drink is distilled. Maguni fruits are pounded and kept mixed with cold water for 1-2 days, and Nonsimba fruits are also kept in water for 1-2 days before cooking and distillation takes place. One may or may not add sugar in the process. Kashipembe is a popular drink among Kwangali people, while Nyembas say they don't produce and consume it, as it is against their religion. The drink can be stored in black jerry cans for at least a year.

Low-alcoholic drink. Traditional beer can be made from Nongongo and Maguni. Fruit pulp is mixed with cold water and left to ferment for 2-3 days. It can also be mixed with mahangu. Beer is not often made as most people prefer Kashipembe. Storage time of the beer is 2 days.
Non-alcoholic drink. A non-alcoholic beverage can be made from the fruits of Nongongo, Nonsimba, Maguni and Matu. Fruit pulp is mixed with water and has to be consumed immediately, before fermenting. Non-alcoholic drinks made from Nongongo and Matu can induce stomach ache and are therefore seldomly made.
(Roasted) kernels. Kernels of Nongongo can be eaten raw, or pounded and mixed with traditional spinach, meat, or fish. Kernels of the Nonzwe are eaten roasted. Nonsivi kernels can be eaten roasted as well, but most people don't like their taste, and it is therefore only done if no other options are available. Most people referred to it as 'food from the old days'. Uncooked Nongongo kernels can be kept for more than a year. Nonzwe kernels can only be stored for about a week.

6.2.1) Traditional usage & importance - Kasheshe

In Kasheshe, the following indigenous tree species were identied as most important for household use and food security, in order of preference:

1. Muzinzila	Bird Plum	*Berchemia dicolor*
2. Mumaka		*Grewia* ssp.
3. Mulutuluha	Small Sourplum	*Ximenia americana*
4. Mozauli	False Mopane	*Guibourtia coleosperma*
5. Mungongo	Manketti	*Schinziophyton rautanenii*

*1. **Berchemia*** was rated as the most important tree, because of its taste, long storage, nutritional value, and abundance in the area. It was also said that *Berchemia* is important because it is harvested before crops are ready, and can therefore help people survive in periods of hunger. One can eat the fruits dried, fresh, make it into a juice, or use it as a sweetener of traditional mahangu bread. Furthermore, people get a dye from the inner
bark of the tree. No medicinal uses of the tree or fruits were known, and its wood is not used, unless found dead and dry.
*2. **Grewia*** was rated second most important, because of the sweetness of the fruits, and its abundance in the area. Its fruits can be eaten fresh, dried, and mixed with fresh milk to make it into a kind of yoghurt. No medicinal or other uses were known.
*3. **Ximenia*** is relative abundant, and its fruits can be eaten fresh or made into a juice. The main disadvantage of *Ximenia* however, is that both the fruits and the juice have to be consumed immediately. The inner part of the roots of the tree can be pounded into a powder and be used to treat wounds. The wood of the tree is not being used.
*4. **False mopane*** fruits can be made into a relish for meat, a kind of peanutbutter, and its stamped kernels can be cooked and eaten. The leaves of the tree can be pounded, boiled, and used to treat diarrea in children. From the bark one can extract a dye, and the wood is used for making canoes and as firewood.
*5. **Manketti*** is important in that its fruits have many uses and can be stored for years, and many people pointed out how important manketti can be for peoples' survival, but the reason why it comes at the bottom end of this list is its low incidence in the area. Manketti fruits can be cooked and eaten, or made into cooking oil, a relish, or a kind of bread. The water of boiled Manketti roots can treat tooth ache, and is also used for cleaning newborn babies. Manketti wood is a preferred species for making canoes.

Indigenous fruits were said to be important to the community especially during years of drought, when the harvest of peoples' staple food is bad, and they rely on indigenous fruits for their survival. The participants also said that indigeous fruits were equally important to everyone and that the benefits one can derive out of them solely depends on the efforts people put into collecting the fruits.

6.2.2) Harvesting - Kasheshe

Berchemia fruits drop from the tree when they are ready, which is from March to May, and women and children subsequently collect them from the ground. It was said that *Berchemia* fruits are seldomly collected from the communal areas, because high grass makes harvesting difficult. ***Grewia*** grows mostly in the communal areas, and its fruits are collected from the trees from March to August. When the fruits turn from green to yellow, they are ready for harvesting. The job is done by women and children. *Ximenia* like *Grewia*, grows mostly in the communal areas, and are collected from the trees by women. The fruits are ready for harvesting when they turn from green to red, which is from November to January. Both ***false mopane*** fruits and ***manketti*** are collected from the ground by women. Manketti fruits can be harvested from April up to August.

In peoples' fields, the household owning the land has the right to harvest from their trees, although neighbours and friends are often invited to collect fruits together. In communal areas, community members can harvest as much fruits as they wish. Outsiders need permission from the village Induna to harvest fruits on communal land, but this is seldomly requested. In our survey, 75% of the respondents said they collect fruits from the communal areas, 62% harvests on neighbours fields, 38% gets fruits from their own fields, and 12% collects fruits from the field of a relative.

6.2.3) Processing & Storage - Kasheshe

Fresh/dried/cooked fruits. *Berchemia*, *Grewia*, and *Ximenia* fruits can be eaten fresh. *Ximenia* fruits have the shortest lifespan as they turn sour after one day. *Berchemia* and *Grewia* can be kept fresh a bit longer, but are more often washed and sundried for about a week on mats for later consumption. If you keep the fruits clean and dried in containers, free from insects, they can be stored up to 6 months. Manketti fruits can be eaten when you cook them and take of the skin. The fruits can be kept for years, even without proper storage.
Non-alcoholic beverages are popular, and can be made out of *Berchemia*, *Grewia*, and *Ximenia*. *Berchemia* juice is made by soaking dried *Berchemia* fruits in water and taking out the kernels, and *Ximenia* fruits can be squeezed and mixed with water and sugar to produce a juice. One also produces a kind of yoghurt by squeezing fresh *Grewia* fruits into fresh milk. The yoghurt and juices have very limited storage time. None of the participants said to make or use ***alcoholic drinks***, as they claimed it was against their religion.
Cooking oil is extracted of Manketti by cooking the pounded kernels. The left-over is used as a ***soup*** that can be eaten with oshifima or mixed with meat or vegetables. Another relish is made from the skin of the false mopane. The clean fruits are soaked in boiled water for a few minutes, then squeezed, and the kernels seperated from the red skins. Salt is added to the red skin mixture, which can be eaten with meat. The red skins can be eaten by insects, but kept for up to a year if stored properly.
The ***kernels*** of the false mopane can be put on hot ashes to seperate the outerpart from the innerpart. This innerpart can either be cooked and eaten like that, or made into a kind of ***peanutbutter*** by mixing it with peanuts, and frying and pounding it. The participants claimed that kernels of the False mopane can easily be stored for 10 years.
Finally, traditional ***bread*** can be made using either a mixture of roasted manketti kernels and maize, or mahangu and *Berchemia*. The ingredients are pounded and cooked with water.

6.3.1) Traditional usage & importance - North-Central regions

In the Eefa, 6 indigenous fruit tree species were identified as most important in peoples livelihoods. In order of preference they are:

1. Eengongo	Marula	*Sclerocarya birrea*
2. Eembe	Bird Plum	*Berchemia dicolor*
3. Eenyandi	Jackal Berry	*Diospyros mespiliformis*
4. Eenkwiyu	Sycamore	*Ficus sycomorus*
5. Eendunga	Makalani palm	*Hyphaene petersiana*
6. Enkenkete	Buffalo thorn	*Ziziphus mucronata*

*1. **Eengongo*** was rated as the most important fruit tree in the area, because of its many uses, and cultural importance. Its marula wine and cooking oil are very much appreciated, and people also eat the fruits fresh, make a juice and a porridge out of it, eat the kernels fresh, mix them with other food, make a soup out of it, and eat the left-over of the oil processing. The leaves, branches, roots, and bark of the tree can be used for medicinal purposes, and some people use marula oil as a cosmetic.
*2. **Eembe*** was rated important mainly because people like the taste of the fruit, and can store the fruits dry for at least 6 months. *Berchemia* fruits are eaten fresh and dried, they can be used to make a strong alcoholic liquor (ombike), and one can make a *Berchemia*/marula cake. A dye can be extracted from the bark of the tree. Medicinal uses of the tree or its products were not known.
*3. **Eenyandi*** is important to the people because of its different uses, and the relative abundance of the tree in the area. Eenyandi can be eaten fresh and dried, one can make a porridge out of the fruits, and produce a low-alcoholic (omalovu) and strong alcoholic drink (ombike). No other uses of the tree or its products were mentioned.
*4. **Eenkwiyu*** fruits can be eaten fresh, dried, and be made into a very tasty ombike. Some people know how to make Eenkwiyu jam.
*5. **Eendunga*** fruits can be eaten dried or made into ombike. Some people said they used to make palm wine (omalunga), but that they don't do that anymore as the tree dies in the process. Palm leaves are the main material for making baskets and mats, and the branches are often used as fencing material.
*6. **Enkenkete*** fruits are only used for making ombike.

The participants in Eefa felt that indigenous fruit trees are equally important for all community members. They also said that if people are serious and put in a lot of effort, indigenous fruits can provide them with both food security and cash income.

6.3.1) Harvesting - North-Central regions

Marula fruits can be harvested from January to April. The fruits are ripe when they turn from green to yellow and fall from the tree. The fruits are not taken home, but produced into marula wine by a group of women under the tree. The seeds are taken home and kept for kernel extraction later in the year. ***Eembe*** can be harvested from January-February to May. Women and children collect the fruits. Some eembe fall out of the trees and are collected from the ground, while on other trees children have to climb in order to collect them. ***Eenyandi*** is mostly harvested from June to September, but sometimes still found up to the rainy season. Women and children collect them either from the ground or from the tree. Some ***Eenkwiyu*** bear fruit twice per year. Fruiting in January/December is most common, but the fruits can be found at any time of the year. The tree bears fruit for about a week, and these fruits are harvested from the ground by women and children. ***Eendunga*** can be harvested from September/October until the

fruits are finished. In order to get the fruits one has to throw stones or sticks in the tree, which is often done by boys and men. ***Enkenkete*** is harvested by women and children from July to September.

Most indigenous fruit trees in the North-Central region are located on peoples' fields and homesteads, and the households owning that land have the right to harvest the fruits. Friends, neighbours, and relatives can however be invited to harvest fruits. In the case of marula this is a rule rather than an exception. Women invite each other to process marula wine (omaongo) under the tree, and the women have to give a part of the marula wine to the owner of the tree, and take the rest of the wine and the stones with the remaining flesh home. Trees located on communal land are either belonging to the household that lives closest to the tree, or under the rule of the headmen, in which case harvesting is commonly shared among neighbours. Outsiders will need the permission of the headman if they want to harvest.

6.3.3) Processing & Storage - North-Central regions

Fresh/dried fruits. Marula, Eembe, Eenyandi, and Eenkwiyu are eaten fresh, and Eembe, Eenyandi, Eenkwiyu, and Eendunga are eaten dried. Fresh fruits can be kept well for 1 to 3 days, proper drying increases storage time to months or even years. Of Eembe it was said that they should be dried in the sun, as drying inside has a negative effect on the colour and taste of the fruit. Dry eembe can also be put into hot water before consumption so as to give them a fresher taste. The best way to store eembe is to mix them with ash in a clay pot, which protects them from being attacked by insects. If properly stored, eembe can keep for up to 2 years. With enyandi, eendunga, and enkenkete the risk of being eaten by insects is much less, and the dried fruits can be stored in mahangu baskets or bags for up to 2 years. Eenkwiyu is difficult to store, as it easily gets spoiled or eaten by insects.
Ombike is a popular, strong alcoholic drink that is made from most indigenous fruits found. It was said that the best ombike is produced from a combination of 2 fruit species. The fruits are pounded and soaked for a few days, then cooked in a traditional still to produce the liquor. The work is mostly done by women.
A ***wine/cider*** is made from marula fruits. The fruits are squeezed and the juice is left to ferment for 2 to 3 days. Occasionally water or sugar are added to taste. Marula wine (omaongo) should be consumed within a few days, but can be kept for up to 6 months in a fridge, or if one puts the container in a hole, keeping the surrounding soil wet.
A ***low alcoholic beverage*** (omalovu) is made from dried eenyandi fruits which are pounded into pulp, boiled, and put in a sack. Water is added, and the sack is tied and turned until the omalovu comes out.
A ***non-alcoholic*** marula ***juice*** is made after omaongo production by putting the stones with the leftover flesh in water, and removing the stones later.
Fruit porridge can be made from marula and eenyandi fruits. Dry eenyandi fruits are pounded, cooked, and put in a sack. The bag is squeezed and the juice coming out is mixed with mahangu meal and cooked as a porridge. The leftover pulp is fed to chicken and pigs.
Traditional ***cake/bread*** can be made by cooking a mixture of pounded eembe, marula kernels, water and salt.
Marula ***kernels*** are eaten fresh, roasted, mixed with other food like traditional spinach, or made into a soup. ***Cooking oil*** can be produced by adding boiling water and salt, and stirring/rolling it until the oil comes out. The left over kernel sausage (edi) is eaten by the children as a nutricious snack.
Jam can be made out of eenkwiyu and marula fruits by cooking the fruits with sugar, but jam making is no traditional processing method, and few women knew about it.

It is recommended to facilitate the exchange of knowledge on traditional use and processing of indigenous fruits between women from the different regions.

It is recommended that the Forestry staff involved in the rural survey conveys the knowledge gained by the fruit transformation specialist regarding new processing and storage methods of indigenous fruits to the communities.

7) Results: Resource availability

7.1) Community perception

During the focus group discussion in ***Mile 20***, it was said that indigenous fruit trees are most abundant outside of the fields, with a very high incididence of *Strychnos cocculoides*, *Strychnos pungens*, and Manketti, and a high incidence of *Dialium engleranum*, *Guibourtia coleosperma*, and *Ochna pulchra*. The availability of these trees was said to be low to very low in peoples' fields, as those fields were cleared for agricultural purposes. In our survey however, the average number of fruiting trees on peoples' farms was quite high, as can be seen in the following table:

tree species	average no. of fruiting trees per household	percentage of households without fruiting trees	average no. of non-fruiting trees per household	percentage of households without non-fruiting trees	average no. of small trees per household	percentage of households without small trees
Strychnos cocculoides	9.2	16%	2.0	58%	2.9	56%
Strychnos pungens	6.0	12%	2.6	38%	0.4	88%
Schinziophyton rautanenii	3.8	29%	1.5	58%	0.8	75%
Guibourtia coleosperma	3.6	17%	0.5	61%	1.4	88%
Dialium engleranum	3.1	64%	2.1	55%	3.3	64%

Apart from the abundance of especially *Strychnos* species on peoples' farms, one can also see the relatively low retainment of male and young trees.

It is recommended that communities are given knowledge on the importance of male trees for cross-pollonation (?!)

Both in the focus group meeting and the individual questionnaires, there was a general consensus that, with the exception of Manketti, the availibility of indigenous fruit species has decreased in the last 10 years, due to bush fires and people cutting the trees. *Guibourtia coleosperma* is frequently cut as it is a

preferred wood species for woodcarvers, and people also use it for fencing and construction. Fruit trees that do not fruit (anymore) are often seen as useless, and cut down for firewood or other purposes. It was furthermore said that people even cut down indigenous fruit trees if they want to harvest but cannot reach the fruits. Small trees are not really cared for, and often thinned out on purpose. The decision where and when to cut trees is made by men.

In ***Kasheshe***, the participants said there was more than enough *Grewia* ssp. and *Ximenia americana*, both of which grows mainly in the communal areas. *Berchemia*, on the other hand, mostly grows in peoples' fields, and it was said that all *Berchemia* fruits in peoples' fields were being used. In our survey, the average number of fruiting trees per household was 2.4, while 56% didn't have any fruiting *Berchemia* tree in their field. On average the households had 2.7 small *Berchemias* in their field, and only one respondent said to have non-fruiting trees. 38% of the respondents did not have any *Berchemia* tree. Manketti is present, but not very common in the area, and *Strychnos cocculoides* was said to have decreased drastically in the last 10 years because of elephants. Although bush fires are common, and obviously destroying a large part of the natural resources in the area, people on general felt that the number of indigenous fruit trees had increased in the last 10 years, especially regarding *Berchemia*, *Grewia*, and Manketti. In their tradition, it is forbidden to cut down fruit trees for construction, fencing or firewood, and people said they used other tree species for those purposes.

In the North-Central regions, most indigenous fruit trees are tenured by people and grow either at homesteads (Egumbo), crop fields (Epya), or at the woodland areas within farms (Ekove). In ***Onkani***, only Mopane trees grow naturally, with other species like Marula, *Berchemia*, and *Diospyros mespiliformis* increasing with the immigration of people. In ***Eefa***, the most dominant indigenous fruit tree species both on- and off-farm is *Diospyros mespiliformis*. Marula, *Berchemia*, and makalani trees are less abundant, and mostly grow in cropfields and homesteads. Small marula and *Berchemia* trees are often protected if found in the homestead. When homesteads move, the trees are left and found in the cropfields. In general, there is little natural regeneration of trees in communal lands (Kaambu et al 1998).

It is recommended that Forestry reviews the bio-physical and socio-economic availability of indigenous fruits in a large number of communities.

It is recommended that the resource availability of potentially marketable fruits should be increased.

7.2) Existing knowledge

8) Results: Marketing

8.1) Existing marketing structures

The existing marketing of indigenous fruits and fruit products is informal and multi-faceted. Different levels of 'marketing' typically co-exist:

1. The non-monetary system of giving away does not bring a direct cash income, but is nevertheless important for peoples' livelihoods and can be seen as informal economics. By giving away, people build up their 'social bank accounts' and they can expect to be on the receiving end at other times.

2. Bartering - direct trade without the involvement of money - is not as common as giving away or selling, but did happen in all the communities investigated, often with few standard products and quantities.
3. Selling occasionally from home, when people come with specific demands.
4. Selling at roadsides, targeting both the local community and outsiders passing by. Fruits are generally displayed unattended at main roads, and the sellers come from their nearby homes when potential customers stop.
5. Selling at local centres like schools or cucashops, to community members on a more regular basis.
6. Selling produce to urban market women, usually in larger quantities, when a surplus exists.
7. Selling own produce at a local urban market or pension markets at a regular, but not daily basis.
8. Selling through household or family members residing in other urban areas.
9. Middle men and women buying from producers and selling to local urban or national markets.
10. Selling to national or international markets through organised groups, as is done by the Eudafano Womens Co-operative that buys and sells marula kernels from its associations in the North-Central regions. Co-operatives were however not active in the areas where this research was conducted.

Quantifing the informal marketing of indigenous fruits is difficult because of its many variations, and the fact that people generally do not keep track of what they are buying and selling. Furthermore, quantities of fruits and fruit products sold fluctuate from year to year, and type of products available vary throughout the different seasons. Doing research in an area for two weeks can therefore not provide accurate quantitative information on al indigenous fruit (product)s marketed, although interesting figures were found.

8.2) Mile 20

In Mile 20, as much as 82% of the respondents in our survey claimed to get a cash income out of selling indigenous fruits or fruit products. Other sources of income for households included woodcarving (39% of the overall sample, 72% among Nyemba people), pensions (36%), selling crops (18%), formal employment (11%), temporary/casual employment (11%), selling livestock, and financial support from non-resident household members (both 4%, but likely to be underestimated). The products mostly sold were *Strychnos cocculoides* (54% of all households), false mopane (46%), and kashipembe (46%). It should be noted that none of the Nyemba families were producing, consuming or selling Kashipembe, while all but one Kwangali household did. Other indigenous fruit products sold included manketti nuts (21%), *Strychnos pungens* (7%), and *Dialium engleranum* (7%). In rating indigenous fruit trees that are important to the community commercially, *Strychnos cocculoides* was mentioned by all respondents, while manketti (kashipembe) was given a first place by half of the respondents. The third position was given to false mopane, followed by *Strychnos pungens*, and *Dialium engleranum*.

In 57% of the cases indigenous fruits or fruit products were sold on the main road, 30% sells from home, 5% on the market in Rundu, 4% in another village, 2% through family in Windhoek, and 2% at the pension market. Products mostly sold on the road were *Strychnos*, false mopane, and manketti nuts, while kashipembe is mainly sold to Mile 20 residents from home. Prices for the fruit (product)s in Mile 20 are N$8 for 750ml of Kashipembe (N$2 for 200ml), N$2.50 for a big cup of Nonsivi, 50 cents for a tea cup of Nonsimba, and prices of *Strychnos* range from 10 cents to N$5 per fruit, depending on its size. On avarage they are sold for N$1. Prices stay low in Mile 20 because of the high competition. At markets in Rundu, Otavi, and Windhoek the products can be sold for twice the price or more. Few people however go there, as the price of transport is high, and they are unsure if they will get enough customers to still make a profit. Working together as a group to share transport costs and time, is not being done.

In our survey, the estimated average income per season from *Strychnos cocculoides* is N$500 or 10 bags, ranging from N$20 (1 bucket) to N$2500 (50 bags). Average income per season from false mopane was estimated as N$115, ranging from N$10 (a few cups) to N$450 (3 x 25 kg bags) The average excludes a rather unlikely estimate of a respondent saying he could sell 50 bags for a total of N$7'000 every season. Average income from kashipembe was rated highest with an average of N$ 830, excluding 2 unlikely estimates of N$ 8'000 and N$10'000. Kashipembe was sold for N$6 to N$10 per litre, and in 30% of the cases, it was bartered with mahangu, exchanging 25 litre of kashipembe for a 50 kg bag of mahangu. In general, women were said to be harvesting, selling, and in charge of the money made, with slightly more involvement from men in the kashipembe business. The main problems perceived in selling indigenous fruits or fruit products were the lack of customers (64% of all responses), the bad behaviour of customers (9%), and the lack of a proper marketing place (9%). 9% of the sellers said there were no problems. The households not selling or only selling occasionally said they didn't sell (more) because of a lack of labour (40%), the lack of a surplus to sell (24%), the low prices for the products (8%), the lack of customers (8%), transport problems (8%), laziness (8%), and the lack of experience (4%).

93% of the respondents said they regularly or occasionally give away indigenous fruits or fruit products, in particular *Strychnos cocculoides*, bnt also manketti nuts, false mopane, and kashipembe. 21% of the respondents give away more than they sell. Only 7% of the households claimed they bny indigenous fruit (product)s on a regular basis, 46% said to do so only occasionally, while 46% said they never buy indigenous fruits because they either have enough themselves, or don't have the money. *Strychnos* was the product mostly bought, with little over half of the buyers saying they buy the fruits not for their own consumption, but to resell them for a higher price at urban markets.

In a focus group discussion, the main advantages and constraints in the marketing of indigenous fruit (product)s were identified as follows:

Product	current demand	resource availability	transport to market	storage of product	season available	no. & type of beneficiaries	Prices / competition
Kashipembe	C	AA	N	AA	AA	A	C
Maguni	AA	AA	C	CC	A	AA	C
Matu	C	A	C	CC	A	C	N
Nonsivi	CC	AA	N	AA	AA	A	CC
Nonsimba	AA	C	C	C	A/C	A/C	N

AA = big advantage *A = advantage* *N = neutral, no effect* *C = constraint* *CC = big constraint*

A number of marketing needs and opportunities were identified. The participants felt that there was a national or even international market for maguni, which grows abundantly in the area, but the main problem to be solved was transport, organisation, and identifying the markets. The demand for nonsimba was said to exceed current supply, as the tree doesn't bear fruit every year. Improving the availability of the fruit would be a main advantage. The participants also expressed the need for the construction of a proper market place in Mile 20. Lastly, they were interested in growing marula and *Berchemia* for marketing purposes.

It is recommended that marketing opportunities and constraints should be analysed for a larger number of communities.

8.3) Kasheshe

Although our survey sample in Kasheshe was relatively small, some figures are quite distinct and can be used to give a general picture. 88% of the households said to get an income out of selling indigenous fruits. A high percentage compared to other sources of income; pensions (19% of the households), formal job (19%), selling crops (19%), selling livestock (12%), and casual work (6%). As few indigenous fruit trees grow in abundance in the area, the range of products sold is quite limited: 75% of all households sells *Berchemia*, 75% sells *Grewia*, and one respondent sells manketti nuts. In rating indigenous fruit trees that are important to the community in terms of cash income, *Berchemia* was rated almost invariably in first place, *Grewia* was rated second, and a few people mentioned manketti as the third most important tree commercially.

Both *Berchemia* and *Grewia* are sold mostly on the roadside (40%), there is a stall at the Kasheshe road where cows are regularly slaughtered and sold, and many people passing by in cars stop there. 28% is sold to market women, 16% sells their fruits on the market in Katima Mulilo themselves, and 16% sells at the local school. As both *Grewia* and *Berchemia* are mostly sold for N$1 per cup, the women had a hard time estimating their total sales for the season. Estimates ranged from a total of N$20 for 3 drums of *Berchemia*, to N$300 for 1 bag. A rough calculation based on the answers given gives an average income per season of N$150 for selling *Berchemia*, and N$300 selling *Grewia*. Women do both the harvesting and selling, quite often assisted by children especially in the collection of fruits. Few households said that the male head was in charge of the money made, but in most cases the cash stayed in the hands of the women doing the work. Respondents felt that the main restriction in selling indigenous fruits was the combination of a large supply and low demand (56% of the responses). Other problems perceived included the costs of transport to markets (17%), and police raids that were held at the market in Katima Mulilo, where for unknown reasons bags of indigenous fruits had been confiscated (17%). Households that didn't sell indigenous fruits, or only sold occasionally, had similar reasons for not selling (more): the lack of markets (27%), the lack of surplus / trees (27%), the lack of transport (13%), police raids (13%), and lack of time (7%).

The practice of giving away is also common in Kasheshe, 94% of the respondents said that they regularly or occasionally give away small quantities of *Berchemia*, *Grewia*, or manketti nuts to neighbours, friends, or relatives. 93% of the people selling however, said they sell more than they give away. Most of the people interviewed said they never buy indigenous fruits because they have enough themselves or can get it for free from their neighbours. 19% said they buy a few cups occasionally for their own consumption, and only one of the respondents said she buys fruits to resell them at the market.

8.4) North-Central regions

In *Eefa*, the participants of the focus group said that indigenous fruit (product)s, are mostly consumed, often given away to friends and relatives, and only sometimes sold. Selling is done locally, through relatives in Windhoek, or when one travels to urban areas for another purpose. The products sold include;

-Ombike. Sold for N$7 per 200ml bottle among neighbours, but participants said the demand for ombike is very low, and the competition high. It was said that on the market in Oshakati the price had gone down in recent years because of Angolans selling their alcohol at low prices, and ombike now can be bought for as little as N$5. In Windhoek the price for the same bottle is N$10
-Eendunga. There is a market for eendunga only locally, as people use it for making ombike. The local price is N$10 per bucket.
-Eenkenkete. Used for making ombike as well, eenkenkete can be sold locally for N$25 per lata, but the demand is smaller than that of eendunga.
-Omaongo. Selling marula wine locally can be difficult, as many headmen in the area are against it, and people feel omaongo is a gift that should be shared without the involvement of money. In recent years however, an increasing number of women have started to sell marula wine. The price is N$3 in the village, N$5 at the market in Oshakati, and N$8 to N$10 in Windhoek. The main restriction for people to sell omaongo in the urban areas was said to be the cost of transport.
-Omahuku. Marula kernels are sold locally for N$3 per 500ml tin. The same prices are asked on the markets in Windhoek and Oshakati, but the cups are smaller there.
-Ondjove. Marula oil can be sold for N$10 per 200ml bottle on the main urban markets. It was said that there is no market for ondjove locally, as people rather buy kernels, and make it themselves.
-Eembe. *Berchemia* fruits are not sold locally, as people either collect them themselves, or receive them as gifts. There is a market for eembe in urban areas. The price of a 500ml cup on the market in Oshakati is N$5, but many different cups and different prices are used.
-Eenyandi. Enyandi is seldomly sold, because the demand for the fruits is low. Its occurance in the area however is high, and participants were eager to find a market for these fruits. Limited amounts of eenyandi are sold on the market in Oshakati for N$2 per cup.

As indigenous fruits are important to the communities both as a source of income and food, it is recommended that additional markets should be found mainly for fruits that are available in surplus, i.e. Strychnos and Manketti in Mile 20, Grewia ssp. and Ximenia americana in Kasheshe, Mopane in Onkani, and Diospyros mespiliformis in Eefa

8.5) Urban markets - interviews with market sellers

Rundu open market

At the main open market in Rundu we found little indigenous fruits, and the few that we found were with people who traded them as a side business.
One couple was selling woodcarvings and other crafts as their main business, but also had a bowl of *Strychnos*. They said they sell 8-10 fruits every day and ask 50 cents for the small fruits and N$1 for the bigger ones. They also sell nousivi if they are having a surplus. The fruits are collected from their own field, 10km from Rundu, and one or two household members walk to the market every day. The stall costs them N$20 per month.
Some other women were selling fruits and vegetables every day. Their main products are tomatoes, apples, cabbage and beans, but they also sell indigenous fruits and vegetables. At the moment of the interview, the only indigenous fruit product they sold was manketti nuts, but at other times they would sell maguni and nonsivi as well. They get their indigenous products from people from the villages who come to sell to them, and seldomly go to the villages themselves. They buy a medium bag of manketti nuts for about N$60, and it takes 2 weeks to sell it to customers. As they are selling the nuts in small cups, and do not really keep track of their sales, it was difficult to estimate how much profit they make, but they felt the business was giving them little. More money is made selling maguni and nonsivi, because they are more popular and therefore selling faster. Maguni is bought at different prices,

depending on their size, and the market women double the price for selling. They can sell a medium bag of maguni in 1 or 2 days and said they didn't have a problem with the supply.

Rundu market

This smaller market is located in a more informal area, and more specialised in food products. The stalls are small, and main products sold are mahangu, meat, fish, tomatoes, cabbage, apples, oranges, and sweets. The urban market women generally don't trade indigenous fruits. These are mostly sold by women that come from the rural areas and sell their own produce. We only found one woman that day selling manketti nuts and mahangu. She said at other times she also sells maguni, nonsivi, and indigenous vegetables. The main problem she experienced was the lack of customers, although she felt the business at this market was better than at the road in Mile10 where she lives and tries to sell her products at other days.

Katima open market

At the open market in Katima there is a large section for women selling traditional food products. Indigenous fruits are a relatively small part of that. We found a few women selling some baobab fruits, and one woman selling *Berchemia*. *Berchemia* is sold by more women in the right season, and *Strychnos* is also sold later in the year. The fruits are supplied by people from the rural areas that come to the market to sell their products to the market women. Baobab fruits are bought for 25-50 cents, and sold for N$1-N$1.50, depending on their size. On average they sell 20 fruits per week per stall. The women pay N$1 for a big mug of *Berchemia* or N$120-150 for a 50kg bag, and sell it for 50 cents per small cup. It can take 1-2 months to sell a 50 kg bag of *Berchemia*. *Strychnos* is readily available during the season. Prices are depending on the size of the fruit, and generally doubled for selling. It was said that although the supply of indigenous fruits is generally sufficient, it is a bit irregular, and one could sell more if the timing of the supply was better.

Oshakati open market

At the omatala in Oshakati, we found six women sitting next to each other selling eembe as their only product. Most of them usually buy the eembe in Angola, as they say the fruits are hard to find in Namibia. They go from house to house in Angola, and buy eembe for N$2 per cup. The selling price is N$2 for a tomato sauce tin or N$4 for a tea cup, and they sell for N$20-N$50 per person per day. They said their main problems are the high costs of transport and the limited customers, but they nevertheless felt that eembe was more profitable than other indigenous fruit (product)s. At the back of the market we found a woman selling eembe for less than half that price. She was also selling marula kernels for N$4 per 500ml tin, marula oil for N$10 (200ml), and *Ximenia* oil for N$15 (200ml), and got the products from her own village. Another woman was selling quite a variety of indigenous fruits and vegetables, i.e. *Strychnos*, eembe, eenyandi, spinach, chilli, and sugarcane, which all come from her village in Okongo. *Strychnos* is her best business as there are few people selling them. It is available from August to October, and she sells 10-20 fruits per day for N$1, N$2, N$3, or N$5, depending on their size. She said eenyandi is the least profitable product, as the demand for it is small.

Elombe pension market

At the pension market, few indigenous fruits and fruit products were sold. We found one woman who travels to sell at different pension markets. Her main business is kapana (prepared meat), but she also sells roasted nuts and eembe, and sometimes eenyandi. She doesn't have eembe or eenyandi in her own field and buys the fruits at the market in Ondangwa or Onankali where she resides. Eembe is bought for N$2 per 500ml tin and she resells the fruits for N$1 per small cup. On average she sells one plastic bag of eembe per day. Eenyandi doesn't sell that well and she only takes it occasionally. Another woman was selling ombike and homemade bread. She only sells her products on the monthly pension market in her village and sometimes from home. She told us she doesn't sell eembe and other fruits, as she rather

produces ombike and make more money that way. She couldn't tell us how much money she makes in total from selling ombike, but that day she took 8 200ml bottles which she sells for N$8, and a few 50ml bottles which she sells for N$2.50. Her main problem was getting the *Ximenia* fruits that she uses to make the ombike, as the trees grow far from her house. Now a small *Ximenia* was growing next to her homestead which she is protecting, and she is hoping to get more *Ximenia* trees. Another local woman was selling ondjove (marula oil) and ombike, both produced by herself. Apart from this pension market, she also sells from home, at other pension markets sometimes, and she takes some products for selling when she visits relatives in urban areas. At the pension market she sells 200ml of ondjove for N$7, and ombike for N$8, but she said she could get N$15 per bottle in Windhoek. She felt ondjove is a better business than ombike and on a pension market she can easily sell 20 bottles, although that day she only brought 3 because that was all she had. This woman also said that she doesn't sell indigenous fruits but prefers to make ombike out of them in order to make more money.

It is recommended that information regarding local market opportunities is conveyed to the communities.

It is recommended that negative impacts of new market interventions on existing local marketing structures should be minimised.

9) Conclusions: Opportunities & Constraints