Opportunities for developing the Natural Products Sector in Zimbabwe: Results from a Desktop Review

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1.0 INTRODUCTION

Agricultural production in the Southern African region's marginal areas where the majority of the rural populations reside is highly unreliable, often due to poor soils, erratic rainfall and frequent droughts. Alternative livelihood sources are therefore needed to address the declining livelihoods and increasing food insecurity. The Natural Products sector development being spearheaded by PhytoTrade Africa seeks to facilitate the generation of supplementary incomes for rural communities through the sustainable exploitation of wild harvested natural products. Natural Products are defined as 'those products derived from naturally occurring biological resources, harvested from the wild by rural producers' (PhytoTrade Africa, 2006). These products are being supplied to the nutraceutical, phyto-medicinal, botanical flavour and fragrance, herbal remedy, dietary supplement, cosmeceutical and personal care industries. It is important to develop some understanding of the potential scale of the Natural Products sector in Zimbabwe if investment is to be channeled towards this sector. This desktop review therefore aims to assess the potential scale for the NP sector in Zimbabwe with specific focus on PhytoTrade Africa focal species used for producing lipid oils. These species include Marula, Baobab, Trichilia, and Parinari

This desk study to assess the potential scale of natural products (NPs) in Zimbabwe, focusing on lipid oils, was commissioned by PhytoTrade Africa in collaboration with IUCN under the Natural Futures programme. PhytoTrade Africa is the Southern African Natural Products Trade Association that was established in 2001 with the aim of facilitating growth in the Natural Products industry in Southern Africa. PhytoTrade Africa's natural product development in eight Southern African countries focuses mainly on species that include Marula (*Sclerocarya birrea*), Mongongo[1] (*Schinziophyton rautanenii*), Baobab (*Adansonia digitata*), Sausage tree (*Kigelia Africana)*, Kalahari melon (*Citrullus lanatus*), Mobola (*Parinari spp*), Natal Mahogany (*Trichillia emetica*), Ximenia and Devils' Claw.

The Natural Futures Programme under which this assessment was done aims to strengthen existing initiatives in the development of the natural products industry in southern Africa and address barriers in the market by making systemic interventions that assist the development of a pro-poor Southern African natural products sector. In addition, the Natural Futures Programme recognises the potential for the growth on the natural products sector and seeks to enhance environmental sustainability and the livelihoods of the poor through the development of a vibrant pro-poor natural products sector in the region. For the natural product industry to be sustainable, it is important to have an idea of how much NPs are available so as to project the potential scale of commercializing the NPs.

Information on the human populations dependent on these resources is also important if we are to understand the potential scale of NP commercialisation.

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[1] Mongongo also called Manketti/Mungongo

Four main types of conditions that favour improvements in livelihoods of rural communities engaged in natural products commercialization identified in the literature include:

1) good natural resource endowment that allows for a wide range of options for harvesting and use of the different NPs;

2) the existence of clear resource tenure and secure access to resources that promote people's direct involvement and the long term development of the NP industry;

3) market demand that could be satisfied by sustainable harvesting of NPs with guarantee of long-term supplies; and

4) suitable policy and legal framework for management, processing and marketing of the NPs (Rønne, 2004).

To assess the potential scale of the NP commercialisation in Zimbabwe within the context of the Natural Futures Programme, this current assessment emphasises mainly on the first two conditions, i.e. the nature of resource availability and the ability of resource users to access these NPs although the market demand and other institutional issues are also discussed. There is need to understand the broader national context within which the development of the natural products sector takes place. Below is a description of the Zimbabwean socio-economic context.

1.1. The national context

The profile of Zimbabwe

Zimbabwe has a total area of 390 580 sq km where 386 670 is land and 3 910 is water. The total population is 12 236 805 (Census Report, 2002). About 37 % of the people are under the age of 14 and 59.1% are between 15-64 years of age and only 3.5% are above 65 years of age. The population growth rate is 0.62% and adult prevalence of HIV is 24.6%. The rate of literacy is 90.7%. About 80% of the population lives below the poverty datum line in a county where GDP is estimated US$407million as of 2006 (The World Bank, 2006) having dropped from US$3.1 billion in 2004 (SADC, 2004).

Zimbabwean agro-ecological regions

For purposes of agricultural production, Zimbabwe is divided into five agro-ecological regions, Natural Regions (NR) I to V. NR I is the most agriculturally productive region and productivity declines as you move to NR V. Natural regions IV and V are susceptible to droughts and erratic rainfall patterns that limit the land's potential for agricultural production (Herbst, 1990). The majority of the rural areas are classified under agro-ecological zones IV and V. The poor quality of the land and poor agronomic practices in the rural areas make sustainable agriculture almost impossible (Matondi, 2001). Thus, there is need to have alternative sources of livelihoods to sustain the rural households. Zimbabwe is characterised by three phytogeographic regions, the Zambesian, the Afromontane and the East African coastal. The Zambesian region covers over 95% of the country. The Eastern Highlands form part of the Afromontane region and have the highest level of endemism, notably in the Chimanimani Mountains. The Zambesian phytogeographic region comprises five woodland types – miombo, mopane, teak, acacia and Terminalia/Combretum. Zimbabwe's land area is classified in the following categories: 0.03% is moist forest (tropical rainforest), 0.4% is Forest Plantation, 65.92% is indigenous woodland (including bushland), 4.85% is grassland, 27.47% is cultivated land, 0.36% is settlement and 0.97% is rock outcrop and water body (http://www.cbd.int/countries/?country=zw).

Natural resources use in rural Zimbabwe

Approximately 70% of the population in Zimbabwe lives in the rural areas. These rural populations are dependent on natural resources for their survival as the majority of the communal lands fall in areas of poor agricultural productivity. Commercialization of NPs therefore contributes towards the overall household economy and in improving rural livelihoods. The commercialization of natural products is on the increase for both the local and export market. Collection of the fruits and seeds used in processing oils is done from the wild on communally owned land. In some cases, collection is also done from trees left standing in the field and occasionally in homesteads (PhytoTrade Africa, 2005b). There are no reports of the domestication of the PhytoTrade Africa focal species in Zimbabwe. Thus, the focal species that is utilized is indigenous tree species, harvested mostly from the forested areas. It is worth noting that women are the main collectors of the NPs (Goebel, 1999). Considering that women often fall within the poorest categories in communities, commercialization of NPs offers the opportunity to improve their household welfare. It is within this context that the NP sector development focuses on wild harvested plant species accessible to rural communities. The following section outlines the objectives of this desktop study.

Institutional and Management aspects

While the Zimbabwean law requires a permit for the collection of forest products for commercial purposes as outlined in the Communal Land Forest Produce Act (1987), for NPs, this legislation has not been found to be restrictive as it is often not enforced. Despite the lack of enforcement of the Communal Lands Forest Produce Act (1987), collection of the NPs in the communal areas is also governed by traditional rules and regulations that local people often adhere to. These have not been found to be restrictive to access to NPs in the current operating environment (Rønne, 2004).

1.2. Objectives of the country study

The objectives of the study are:

- To generate information useful for assessing the commercial potential of the PhytoTrade Africa focal species for lipid oils in Zimbabwe.
- Produce species distribution maps for the focal species for lipid oils in Zimbabwe
- Provide statistics on members' primary producers, their incomes, volumes and value of NPs and exports for 2006

1.3. Methodology

This assessment was done through a desktop study. Relevant literature was identified and located in electronic and/or hardcopy form from various visits to key websites, and Internet searches. Both primary and secondary literature were accessed and reviewed. Experts in the forestry department (Forestry Commission) were interviewed in order to establish specific districts in Zimbabwe where the four focal tree species are found in quantities that make economic sense. An assessment of the current vegetation cover of the selected districts of Zimbabwe which together with the known species densities and area covered by woodland and cultivation areas the estimated number of trees of a particular species were determined. From the known potential fruit yield and estimated potential volume of harvesting the amount of oil was calculated. Potential incomes from oil were therefore determined from the potential volumes of oils and the current market values of the oils. The following formulae were used to estimate the potential production in Zimbabwe:

1. Number of trees = Tree density (n stems per ha) X Size of vegetated area (ha)
2. Yield = n% X Number of trees X Average fruit yield per tree (kg). [The percentage of trees that bear fruit is assumed e.g. 10% for marula trees]
3. Amount of oil= known percentage of seed mass that is converted to oil during oil pressing
4. Potential income per year = Amount of oil per year X current market price of oil.
5. Population residing in the area from the 2002 census report. In calculating potential direct beneficiaries, it is assumed that at least 1 person from each household residing in the areas where a particular natural product is found will be actively involved in the harvesting and trading of the natural products.

The calculation on the potential scale of production in this study is based on the natural products available and therefore is not only concentrating on the PhytoTrade Africa membership. The current production levels indicated in this report however are primarily figures from sales generated by PhytoTrade Africa members.

2.0 SPECIES ASSESSMENTS

For the four species that are of focus for this desktop review, i.e. Marula, Baobab, Parinari and Trichilia, oil is produced from the seeds. Besides use in oil production, the pulp from seeds or fruits from Marula, Baobab and Parinari are also used for household consumption, especially during drought years when agricultural yields are low. The fruits and nuts/kernels therefore play a significant role in food security. There could be potential conflict in the use of Marula and Parinari kernels during drought years as the kernels are used for both as food and for oil production. This is not the case with Baobab in which case pulp is consumed and the seeds are not – mainly used for oil production. In Zimbabwe, Trichilia seeds are not commonly used for consumption (as is the case elsewhere in the Southern African region), thus there is no conflict over uses of the seeds.

It is worth noting upfront that variations in species productivity from year to year as influenced by climatic changes may have implications for the oil quantities produced annually as raw materials may be inadequate. In other cases, while seed may be available, the low level of seed collection by the primary producers affects the market supply. In the Zimbabwean context, the low level of seed collection by rural suppliers is mainly due to lack of incentives resulting from low pricing of the raw materials which is influenced by the overall poor performance of the national economy. For instance, in a study done in Binga district where oil from Baobab and Trichilia is produced, 70% of the collectors found the income from collecting seeds poor to very poor, although the 63% of the respondents indicated that the income was the second most important income source (Rønne, 2004). Often oil producers, who are the PhytoTrade Africa members, cannot meet the demand for oil from buyers with the amount of seeds collected and sold by the primary producers.

Low volumes of seeds collected are also due to the fact that the collection of seed is not an intensive activity but often done sporadically when other household chores have been completed. In addition, the fruiting season of some of the tree species overlaps with the agricultural season, thus more time is allocated to agricultural activities rather than collecting seeds for oil production. For species such as Marula and Parinari where the fruits are also used for beer brewing and sometimes eaten as fresh fruit, time is still allocated to collection of the fruits. Hence the seeds that are used for oil production are a by-product of beer brewing. The short fruiting season also constrains the consistent supply of raw materials for oil production. The oil processors therefore have to purchase sufficient amounts of seeds during the harvest season and store them in order to enable supply of oil all year round. The following section focuses on each of the four focal species used for the production of lipid oils in Zimbabwe.

2.1. MARULA

2.1.0 Botanical description

Marula occurs throughout most of sub-Saharan Africa outside the humid forest zone. The tree is found in frost free and relatively warm areas as well as in open woodland, grassland and bush veld on sand to sandy loam (van Wyk and van Wyk, 1997). It can tolerate water logging but prefers light to medium textured well drained soils and tolerates saline infertile soils. The Marula tree is drought tolerant.

Marula is primarily a dioecious species with male and female flowers on different trees. The female flower is normally single or in small groups on stalks up to 3cm long, with an almost spherical ovary. Insects are generally responsible for pollinating the flowers. The tree grows easily from seed sown in washed river sand in spring (Palgrave, 2000).

The fruiting season of Marula is from January to April, while flowering occurs from September to January. The fruits abscise before ripening, while they are still green and firm. The trees begin to fruit at the age of 5 years and they show a wider inter-annual variations in amount of fruit produced. The size of the canopy and diameter of the trunk are traditionally good indicators of the productive capacity of a given tree.

The fruit is fleshy, almost spherical, plum-like, up to 3.5cm in diameter, and yellow when mature. Each fruit contains a very hard single stone inside which there are 2 or 3 and sometimes 4 flattened seeds. One kg of seed is constituted by 200 to 500 seeds (PhytoTrade Africa, 2005a).

Data from South Africa and Namibia indicates that the kernels make up approximately 9% of the nut mass and that the nut makes up to approximately 16% of the fruit mass. These percentages were used by PhytoTrade Africa (2005b) to calculate the potential seed production. The estimated production of Marula kernels lies within the range of 160 to 1,640 tonnes. Regarding the oil production capacity, the oil content in Marula kernels have been found to be within the range of 45 to 72%. On average the oil content is about 58% (PhytoTrade Africa, 2005). Depending on the machinery and techniques used for the extraction, the extractable percentage may differ and is likely to be lower. Producers of Marula oil in Zimbabwe extract oil in the range of 25 to 50% (Mujuru, 2005).

2.1.1 Distribution of Marula

A study done in Zvishavane district in southern Zimbabwe (PhytoTrade Africa, 2006) to determine the availability and distribution of Marula trees for the harvesting of nuts for oils, through determining abundance, population structure and regeneration capacity provides some basis for assessing the potential scale of commercializing Marula in Zimbabwe. The show general abundance of Marula. The population density for Marula in some parts of Zimbabwe, including in Zvishavane is as high as 9 trees per ha (PhytoTrade Africa, 2005b). Figure 1 below shows the distribution of Marula tree species in Zimbabwe.

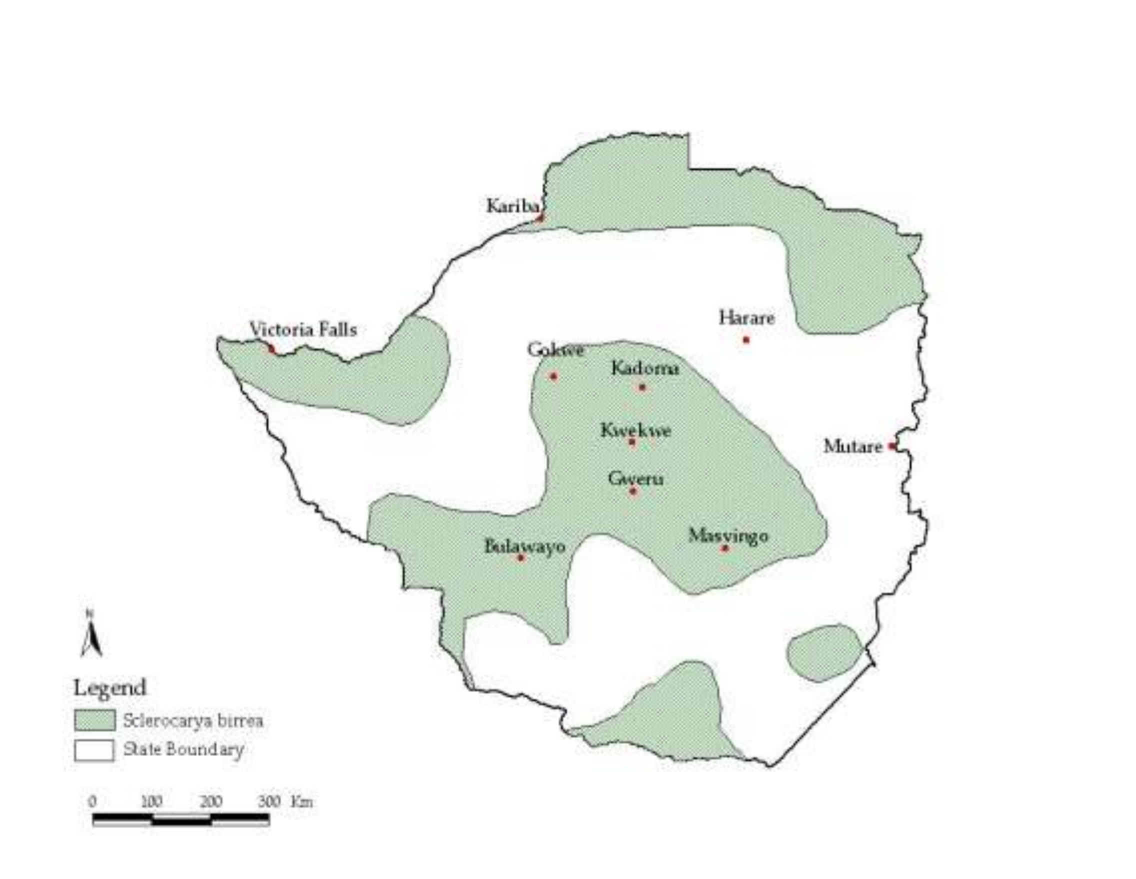

Figure 1: Distribution of Sclerocarya birrea in Zimbabwe

Figure 1 shows widespread distribution of Marula in Zimbabwe covering thirteen districts. Currently only two members of PhytoTrade Africa are producing Marula oil, namely Zvishavane Water Project in Zvishavane district and Tjinyunyi Babili Trust in Bulilima district. No members are actively involved in the rest of the thirteen districts.

2.1.2 Regeneration

Little is known about the silvicultural characteristics of Marula, literature shows that it regenerates naturally from seed, coppice, truncheons and gregarious root suckering. If the fruit operculum has been opened, germination is fast and uniform, reaching 70% after one week and 85% after two weeks from sowing (Mojeremane, *et al*, 2004 quoted in PhytoTrade Africa, 2006). Seed dispersal occurs largely through fruit consumption by mammalian herbivores, which disperse the nuts during eating and defecation. Dispersal distances vary greatly and may be as far as several kilometers.

2.1.3 Production capacity of Marula

In order to come up with an estimate of the potential production capacity, the total area where Marula grows need to be known together with the average density (trees per ha). Zimbabwe is one of the countries in the southern African region that has high percentages of land coverage by Marula, along with Swaziland, Botswana and Mozambique. The population density for Marula in some parts of Zimbabwe is estimated to be as high as 9 trees per ha (PhytoTrade Africa, 2005). Table 1 – overleaf summarises the production potential of Marula in Zimbabwe. The data is divided by district, based on the districts in which Marula is found. While the population density of Marula can be as high as 9 stems per ha, the range can be between 0-9 trees per ha. Thus, in calculating potential yield of Marula, an average of 5 stems per ha was used. It is also assumed that 10% of the Marula trees found in a particular district are fruit bearing trees, bearing in mind that marula is a dioecious species.

Table 1: The production potential of Marula in Zimbabwe

District	Size of land with Marula (woodland and cultivated land)	Estimated Number of Marula trees	Annual yield (kg)	Amount of kernel(kg)	Amount of oil (kg)	Income from oil (US$)	Potential direct beneficiaries (Number of persons)	Potential beneficiaries in the area (Number of persons) [5]
Zvishavane	260,877	1,304,385	158,156,681	13,918	6,326	126,525	9,714	67,999
Chivi	343,466	1,717,330	208,226,263	18,324	8,329	166,581	22,234	155,640
Mberengwa	491,378	2,456,890	297,897,913	26,215	11,916	238,318	26,200	183,399
Bulilima	1,129,549	5,647,745	684,789,081	60,261	27,392	547,831	13,474	94,320
Chikomba	575,414	2,877,070	348,844,738	30,698	13,954	279,076	17,178	120,248
Gwanda	870,165	4,350,825	527,537,531	46,423	21,101	422,030	16,665	116,658
Chiredzi	1,247,147	6,235,735	756,082,869	66,535	30,243	604,866	29,739	208,171
Masvingo	683,286	3,416,430	414,242,138	36,453	16,569	331,394	27,781	194,467
Rushinga	235,427	1,177,135	142,727,619	12,560	5,709	114,182	9,598	67,187
Mt Darwin	447,138	2,235,690	271,077,413	23,855	10,843	216,862	28,570	199,988
Mutoko	404,163	2,020,815	245,023,819	21,562	9,801	196,019	18,895	132,268
Murewa	329,188	1,645,940	199,570,225	17,562	7,983	159,656	23,167	162,168
Kadoma	927,809	4,639,045	562,484,206	49,499	22,499	449,987	21,429	150,000
	7,945,007ha	**39,725,035 trees**	**4,816,660,494kg**	**423,866kg**	**192,666kg**	**3,853,328**	**264,645people**	**1,852,513 people**

Notes

1 Number of trees = Tree density (5 stems per ha) X Size of vegetated area (ha). The density for Marula ranges between 1-9 in Zimbabwe. Thus an average was used to calculate the potential scale of Marula production in Zimbabwe.
2 Yield = Number of Marula trees X Average fruit yield per tree (kg) per annum. It is assumed 10% of trees produce fruits
3 Amount of oil= known percentage of seed mass that is converted to oil
4 Potential income per year = Amount of oil per year X current market price of oil
5 Population residing in the area from the 2002 census report. In calculating potential direct beneficiaries, it is assumed that at least 1 person from each household residing in the areas where Marula will be actively involved in the harvesting and trading of Marula.
6 The tree density of marula (5 stems per ha) is an average as in some areas marula density is 9 trees per ha.

There is a very high potential for an increased production of marula from Zimbabwe because of the abundance of Marula in many parts of the country such as Zvishavane, Chivi, Mberengwa, Bulilima, Chiredzi, Gwanda and Rushinga. The potential amount of marula oil from Zimbabwe is estimated to be approximately **193,000 kilograms and estimated potential income is US$ 3,9million bringing benefit to approximately 264,645people.** These areas have a high proportion of people living in communal areas. At present about 5 corporate members of PhytoTrade are actively engaged in the processing of Marula.

2.2 BAOBAB

2.2.0 Botanical description

The baobab grows at altitudes from sea level up to 900m above sea level with a mean annual rainfall between 90-1500mm. Baobab tolerates drought and fire and has the ability to regenerate rapidly. The distribution of baobab appears to be determined by minimum requirements for a certain annual precipitation and in Zimbabwe, it is found in the savanna low lying areas (PhytoTrade Africa 2005a).

The fruiting season for baobab is between April and August while flowering occurs during the rainy season from October to November. The fruits develop 5-6 months after flowering. It is estimated that the baobab trees first flower at between 16-23 years of age.

The baobab fruit is yellowish/greenish, woody and felted outside. Fruits are very variable, usually globose to ovoid but sometimes oblong, often irregular in shape, 7.5-54cm long X 7.5-20cm wide. The shell is 8-10mm thick. The fruit contains numerous hard blackish kidney-shaped seeds covered by a white powdery pulp.

2.2.1 Distribution of Baobab

The number of studies dealing with densities and distribution of Baobab are very limited (PhytoTrade Africa 2005a). One detailed study on the distribution of baobab in Zimbabwe was done in the Save Odzi Valley in Zimbabwe by Romero *et al*, (2000). The Save Odzi Valley area is characterized as being one of the areas in Zimbabwe where baobab is common and found in high densities. This study indicates that the density of baobab in the Save Valley is 8.5 trees per ha. Figure 2 below shows the distribution of baobab in Zimbabwe

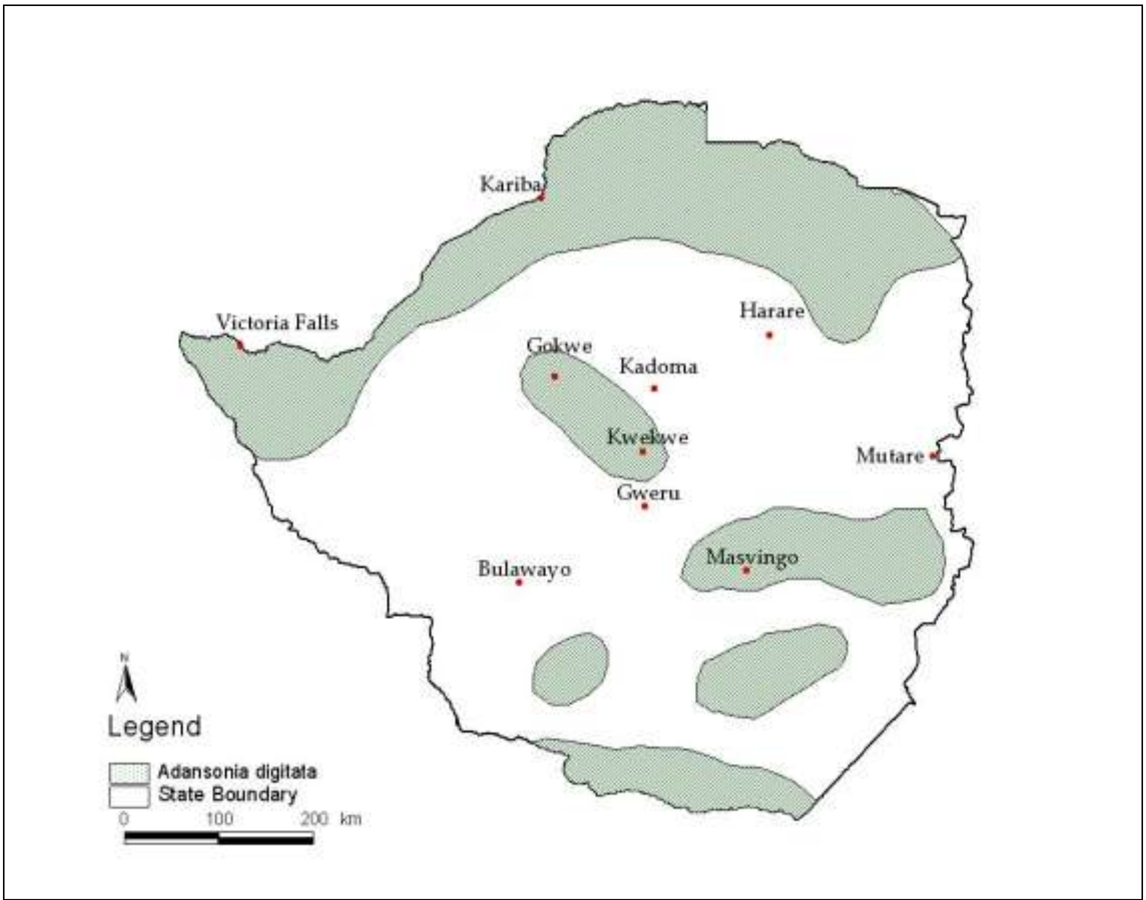

Figure 2: Distribution of baobab (Adansonia digitata) in Zimbabwe

Traditionally baobab seed, which may be eaten raw or roasted, yield edible oil, which is a useful substitute for vegetable oil, and are sometimes ground up to produce a coffee-like hot beverage. Medicinally, baobab seed has many applications as all parts of the tree are reported to have medicinal properties (Wilkinson and Hall, 2007). It is either applied externally or drunk in water to cure gastric, kidney and joint diseases. In the Kalahari, the San/Bushmen use the seeds as an antidote to Strophanthin, a common plant-derived arrow poison. While there are these traditional uses of seeds that are used to produce oil for the cosmetics industry, it is worth noting that there is no conflict over the various uses at present. Harvesting of the seeds has also been found to be of no environmental threat to the various tree species as compared to other forms of use such as for timber, bark for medicinal purposes, carving and in some cases as fuel wood (PhytoTrade Africa, 2005b).

2.2.2 Relative abundance

There is little information on the relative abundance of the baobab. It should however be noted that most of the baobab is accessible to the rural communities in which it occurs except in protected areas such as national parks. Arum (1989 quoted in Rønne 2005) estimated that, allowing for variations in site conditions and genotypes, an average mature fruiting baobab produces 200kg of fruit per season. A similar estimate was made by

Bosch *et al*, 2004. However, it has been noted that trees may go several years without fruiting, probably due to ecological factors.

2.2.3 Production capacity

In order to estimate the potential production capacity, a number of things need to be known such as the total area where baobab grows and the average density (trees per ha). It is estimated that in Zimbabwe, 20% of the total land area of 390,580km² is covered with baobab (Ronne, 2005). The majority of baobab trees are found in the low lying areas such as the Zambezi Valley and the Save Valley. Baobab is widely distributed in Zimbabwe in districts such as Guruve, Rushinga, Mt Darwin, Mutoko, Chimanimani, Buhera, Chipinge, Chiredzi, Gwanda, Gokwe, Kwekwe and Hwange.

Rønne (2004) estimated the baobab fruit production. The potential production capacity of baobab fruits was calculated at 10 different densities from 1-10 trees per hectare. While it is estimated that a baobab produces 200kg of fruit per season, the calculation done by Rønne (2004) takes note of annual fluctuations in production/yield and incorporate this by lowering the annual yield per tree to 80kg per annum. Rønne (2004) also suggests the need to consider the possible reduction in baobab production due to alternative use, inaccessibility (e.g. baobab fruits found in protected areas such as national parks and reserved forests) and animal consumption.

Regarding oil production, there is controversy on how high the oil content in baobab seeds is. Grandgirard (1989) and Eckey (1954) both quoted in Ronne (2004) stated that it lies between 8.4 to 13.2 percent while other literature states an oil content of 15% and even up to 68% (Bosch *et al*, 2004). Average oil percentages in baobab seeds for Zimbabwe was found to be at 34.8% and 32.4% in two sites, Rushinga and Muzarabani districts respectively (PhytoTrade Africa, 2002).

Table 2 – The production potential of Baobab in Zimbabwe

District	Size of vegetated area (ha)	Number of trees	Annual yield(kg)	Amount of seed(kg)	Amount of oil (kg)	Income from oil (US$)	Potential direct beneficiaries (Number persons)	Potential beneficiaries in the area (No. of persons)
Guruve	753,927	3,015,708	150,785,400	53,680	2,684	42,944	26,471	185,299
Rushinga	235,427	941,708	47,085,400	16,762	838	13,410	9,598	67,187
Mt Darwin	447,138	1,788,552	89,427,600	31,836	1,592	25,469	28,570	199,988
Mutoko	404,163	1,616,652	80,832,600	28,776	1,439	23,021	18,895	132,268
Chimanimani	255,342	1,021,368	51,068,400	18,180	909	14,544	16,471	115,297
Buhera	535,632	2,142,528	107,126,400	38,137	1,907	30,510	31,437	220,060
Chipinge	505,012	2,020,048	101,002,400	35,957	1,798	28,766	40,542	283,792
Chiredzi	1247,147	4,988,588	249,429,400	88,797	4,440	71,037	29,739	208,171
Gwanda	870,165	3,480,660	174,033,000	61,956	3,098	49,565	16,665	116,658
Gokwe	1,826,335	7,305,340	365,267,000	130,035	6,502	104,028	72,440	507,079
Kwekwe	870,691	3,482,764	174,138,200	61,993	3,100	49,595	22,781	159,467
	7,950,979 ha	**31,803,916 trees**	**1,590,195,800kg**	**566,111 kg**	**28,305 kg**	**US$452,888**	**313,609people**	**2,195,266 people**

Notes

1 Number of trees = Tree density (5 stems per ha) X Size of vegetated area (ha). (5 trees per ha used is an average, in some area 8.4 trees per ha is recorded)

2 Yield = Number of trees X Average fruit yield per tree (kg) per annum

3 Average yield per tree in a season is 200 kg and it is assumed that 20% of trees bear fruit

4 Amount of oil= known percentage of seed mass that is converted to oil

5 Potential income per year = Amount of oil per year X current market price of oil

6 Population residing in the area from the 2002 census report. In calculating potential direct beneficiaries, it is assumed that at least one person from each household will be actively involved in NP harvesting and processing for commercial purposes.

It is estimated from the above calculations that approximately **28 000 kg of oil can be produced from Zimbabwe resulting incomes of about US$ 454 000 due to sales of baobab oil and benefiting approximately 313 609** people involved directly in the trade of baobab oil.

2.3 TRICHILIA EMETICA

2.3.0 Botanical description

This is an evergreen or semi-evergreen tree which grows up to between 8-20m tall. Its bark is grey to brown and leaves are compound with 4 to 5 pairs of leaflets plus a terminal leaflet. Leaflets are elliptic, 12-15cm long with entire margins. Its flowers are creamy-green, in about 5cm long, with compact heads. The sexes are separate but male and female flowers are similar in appearance (*Seed Leaflet, No. 68, May 2003*, Danida Forest Seed Centre, Denmark).

The Trichilia fruit is a woody, dehiscent capsule, rounded 2.5-3cm in diameter, creamy-green or light brown and velvet on the surface. The fruits are borne in dense, pendent clusters. Each fruit has an up to 1cm long neck connecting it to the stalk. At maturity, it splits into 2 or 3 valves exposing the 2-6seeds. The seeds are 15-20mm long, shiny black and almost completely covered by the bright red aril. There are typically 500-1000 seeds per kg. In general, the flowering season is August to October (Manjengwa and King, 1999) and fruits mature between December and March (Palgrave, 2000). On the contrary, for the *Trichilia dregeana* trees found in Harare flowering takes place from September to December and the fruits fall between May and August (Kurebgaseka, 2007). Seed production varies from year to year. When capsules begin to open, it indicates the seeds are mature. It is recommended that ripe fruit be collected from the tree just before opening. Seed collected from the ground may be of low quality. Little is known about the biology of trichilia but it has been reported that hornbills eat the seeds and thus disperse them.

Trichilia emetica are dioecious, having male and female flowers on separate trees. Random samples of trees have indicated that there are more males than female, the sex ratio being about 3:1 (De Wilde, 1968 quoted in Manjengwa and King, 1999). The male flowers do not produce fruit.

The tree’s leaves bark and seeds have a wide variety of traditional medicinal uses such as treatment of stomach and intestinal ailments and the oil is used for rheumatism treatment. In particular the oil is easily extracted by immersing the seeds in hot water, soaking them for several hours and then crushing the seeds. This pressing process releases a solid, yellow fatty butter commonly known as Mafura butter (Matakala *et al*, 2005). The oil is a central part of the Southern African’s domestic life, a testimony to its highly effective cosmetic and healing properties. The conditioning and colouring properties of Mafura butter have made it a popular hair care product, as well as being used on the skin to nourish and revitalise (PhytoTrade Africa, 2007).

2.3.1 Distribution of Trichilia

The *Trichilia emetica* tree is found in low altitude, frost-free areas where rich alluvial soils are present, mainly along rivers. The distribution of Trichilia in Zimbabwe is shown in Figure 3 below.

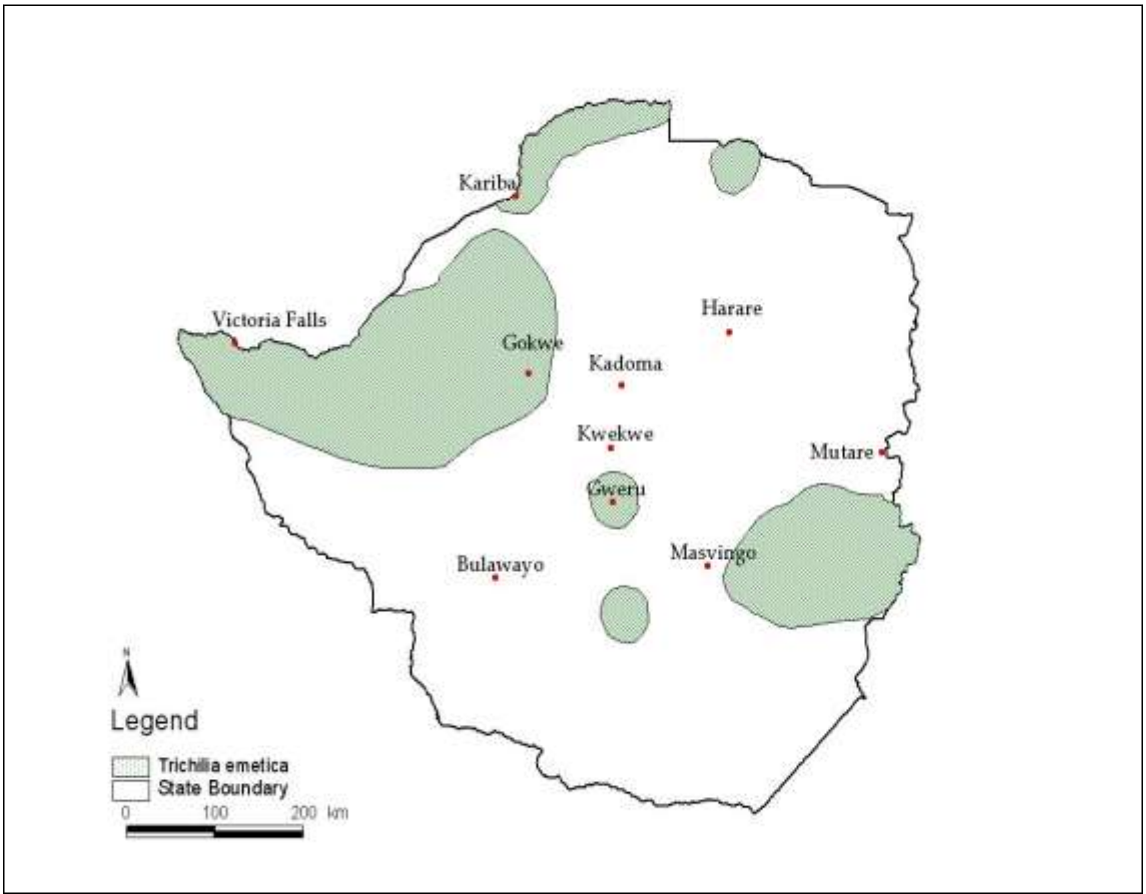

Figure 3: Distribution of Trichilia in Zimbabwe

2.3.2 Production capacity of Trichilia

Although the density of Trichilia has not been determined in Zimbabwe the species is widely distributed in the country in districts such as Mberengwa, Zvishavane, Binga, Guruve, Mt Darwin, Hwange, Marange and Mutare. The tree species is mainly found along rivers and in this study it is estimated that the density of the species is 4 trees per ha. It is also believed that some of the trees in the Hwange district may actually occur in the big Hwange national park and hence can not be counted on contributing to the potential volume of production of Trichilia from Zimbabwe.

Table 3 – The production potential of Trichilia in Zimbabwe

District	Size of vegetated area (ha)	Number of trees	Annual yield (kg)	Amount of kernel (kg)	Amount of oil (kg)	Income from oil (US$)	Potential direct beneficiaries (Number of persons)	Potential beneficiaries (Population residing in the area) [5]
Guruve	553,927	1,661,781	62,316,788	2,493	6,980	153,549	26,471	185299
Binga	491,378	1,474,134	55,280,025	2,211	1,106	24,323	14,314	100200
Mt Darwin	447,138	1,341,414	50,303,025	2,012	1,006	22,133	28,570	199988
Mberengwa	491,378	1,474,134	55,280,025	2,211	1,106	24,323	26,200	183399
Zvishavane	260,877	782,631	29,348,663	1,174	587	12,913	9,714	67999
Mutare	559,235	1,677,705	62,913,938	2,517	1,258	27,682	31,769	222383
Gokwe	1,826,335	5,479,005	205,462,688	8,219	4,109	90,404	72,440	507079
Chiredzi	1,247,147	3,741,441	140,304,038	5,612	2,806	61,734	29,739	208171
	6,577,415 ha	**17,632,245 trees**	**661,209,188 kg**	**264,48 kg**	**18,957 kg**	**US$417,061**	**239,217people**	**1,674,518 people**

Notes

1 Number of trees = Tree density (4 stems per ha) X Size of vegetated area (ha)
2 Yield = Number of trees X Average fruit yield per tree (150 kg). It is assumed 10% of trees produce fruits
3 Amount of oil= known percentage of seed mass that is converted to oil
4 Potential income per year = Amount of oil per year X current market price of oil
5 Population residing in the area from the 2002 census report.

It is estimated from the above calculations that approximately 19,000 **kg of Trichilia oil can be produced from Zimbabwe resulting incomes of about US$ 417 000 benefiting approximately 239,000** people involved directly in the trade of Trichilia oil.

2.4. PARINARI CURATELLIFOLIA

2.4.0 Botanical description

Parinari curatellifolia is very variable in size and shape, ranging from small shrubs of 3m tall to large trees of up to 20m high. The tree is ever green, with pale green, spreading foliage forming a dense, rounded, umbrella shaped crown, which casts heavy shade. The branching is low, and the bole twisted, 25-40cm in diameter. The bark is deeply fissured, with square or rectangular blackish scales and deep red slash. Young shoots are densely covered with yellowish wooly hairs. The leaves are simple, spirally arranged but sometimes looking alternate, elliptic to oblong, 5-7by 3-8cm. They often have small galls and up to 20 pairs of fusing lateral veins. The petiole is pubescent, 6-10mm long, with 2 circular glands. Inflorescences are usually paired, terminal, many-flowered panicles of more or less lax cymes, up to 20cm long. The sweetly scented white flowers are tinged with pink, 4-6mm in diameter, with 5 petals and 5 sepals in compact heads (*Seed Leaflet, No. 110, February 2006;* Sanogo *et al*, 2006).

The fruit is an ovoid or sub-globose drupe, yellow-red in colour, turning brown as it ripens. It has rough, scaly skin, with golden coloured warts on the surface. The fruit measures up to 50mm long by 30mm wide, with a hard stone embedded in a reddish thick fibrous pulp. The endocarp (stone) is hard and woody, 2cm in diameter and contains 1 or 2 embryos (kernels). Each endocarp (stone) with pulp removed is usually considered as a seed. There are 250-350 seeds per kg (source).

The tree has long flowering and fruit ripening periods that often occur concurrently during the rainy and dry seasons. It takes 9-10 months from flower fertilization to fruit ripening. Parinari flowers from July to October in Southern Africa and fruits from October to January (Palgrave, 2000). Not all trees bear fruit every year. This Parinari tree species naturally regenerates from seed and also from coppice.

The fruits can be harvested when they turn yellow-orange. They often fall to the ground before they are fully mature, but it is not recommended to collect fruit from the ground as they can be heavily infected. About 5kg of fruits produce 1kg of seeds. The Parinari seed is orthodox and should be stored at low moisture content. Well dried stones can be stored for up to four years, after which viability gradually decreases.

2.4.1 Distribution of Parinari in Zimbabwe

Parinari is found in open woodlands, wooded grasslands, savannah and often rocky sites, in areas with a mean annual rainfall of 400-2300mm, a mean temperature of 10-30°C and altitudes of 1100-1900m. It grows in association with Miombo woodlands and is fire resistant, making it a prominent feature of fire-maintained wooded grassland. It is typically found in areas with a high water table and poor drainage, and is found near rivers. This species often left standing when land is cleared for cultivation. Average density of Parinari in some selected sites of Zimbabwe is 9 stems/ha although in some sites density can be high as 16 stems/ha (Source). The distribution of Parinari is shown in Figure 4 below.

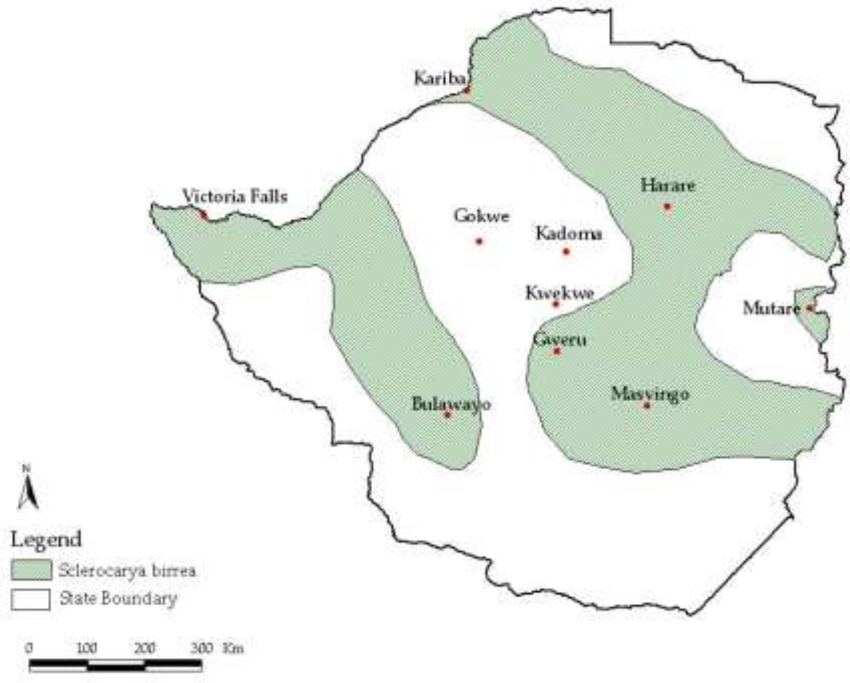

Figure 4: Distribution of Parinari in Zimbabwe N.B. This map needs fixing.

2.4.2 Production capacity

Parinari is widely distributed in Zimbabwe and in some areas such as Shurugwi and Zvishavane densities can be as high as 9 stems/ha (PhytoTrade Africa 2005b). Parinari is widespread in other districts such as Chegutu, Beatrice, Chivhu, Masvingo, Mazowe, Chipinge, and Gokwe. In such areas human population densities are high and rate of unemployment is high. The size of areas accessible has increased due to the fast track land reform programme in Zimbabwe especially in areas such as Chegutu, Beatrice, Marondera and Rusape. Resources are communally owned and easily accessible to the primary producers. Parinari is also available 9-10 months per year which in practice gives ample time for harvesting the fruits.

Table 4 – The production potential of Parinari curatellifolia in Zimbabwe

District	Size of vegetated area (ha)	Number of trees	Annual yield (kg)	Amount of kernel (kg)	Amount of oil (kg)	Income from oil (US$)	Potential direct beneficiaries (Number of persons)	Potential beneficiaries(Population residing in the area)
Chegutu	537,668	2,688,340	201,625,500	7,178	3,589	78,957	20,056	140,395
Masvingo	683,934	3,419,670	256,475,250	9,131	4,565	100,436	27,781	194,467
Mazoe	441,498	2,207,490	165,561,750	5,894	2,947	64,834	27,847	194,927
Chipinge	514,624	2,573,120	192,984,000	6,870	3,435	75,573	40,542	283,792
Makoni	769,372	3,846,860	288,514,500	10,271	5,136	112,982	35,428	247,993
Chikomba	650,796	3,253,980	244,048,500	8,688	4,344	95,569	17,178	120,248
Mutare	559,532	2,797,660	209,824,500	7,470	3,735	82,167	31,769	222,383
Marondera	345,582	1,727,910	129,593,250	4,614	2,307	50,749	14,690	102,830
Shurugwi	367,284	1,836,420	137,731,500	4,903	2,452	53,936	10,218	71,527
Goromonzi	246,190	1,230,950	92,321,250	3,287	1,643	36,153	18,633	130,433
Hwedza	255,274	,1276,370	95,727,750	3,408	1,704	37,487	17,198	120,389
	5,371,754 ha	**26,858,770 trees**	**2,014,407,750 kg**	**71,713 kg**	**35,856 kg**	**US$788,842**	**261,341people**	**1,829,384 people**

1 Number of trees = Tree density (5 stems per ha) X Size of vegetated area (ha)
2 Yield = Number of trees X Average fruit yield per tree (kg) It is assumed 10% of trees produce fruits
3 Amount of oil= known percentage of seed mass that is converted to oil
4 Potential income per year = Amount of oil per year X current market price of oil
5 Population residing in the area from the 2002 census report. Potential direct beneficiaries calculated on the assumption that at least one member in each household will be actively involved in the harvesting and trade of Parinari curatellifolia.

There is a great potential for Parinari oil production in Zimbabwe as results of this study that about **36,000 kg of Parinari oil is produced in Zimbabwe bringing income of about US$789,000 and benefiting directly about 261,341people** who potentially can be involved in the production of Parinari oil as shown in Table 4.

2.5 SUSTAINABILITY

The impacts of NPs extraction are determined by variations in site conditions over space and time. At the same time, the sustainability of the natural products requires that harvest rates do not exceed the capacity of populations to replace the individuals' extracted. Compared to other uses, fruit harvesting appears to have less impact on the persistence of the tree species than other uses that results in damage to the whole tree and hence should be promoted more than the other uses.

Natural products often have more than one possible product that can be utilized (Bennett, 2006). For instance, different parts of the tree are used for different purposes. Depending on the tree species, leaves, bark and roots can be used for medicinal purposes, while fruits are used for both consumption and oil production. Similarly, the active ingredients of commercial interest are sometimes present in several places within the plant (i.e. leaves, bark, root, and fruit), giving the potential for sustainable off-take of several different types of end product such as essential oil, juice, sap, gum, leaf meal, pulp, kernels without negatively impacting on the tree.

In general harvesting of fruits and seeds for oil production does far less damage to the tree than harvesting of other parts such as roots, bark and stems (Rønne, 2004). For example, in a stage-based population matrix model in the Bushbuckridge in South Africa it was shown that 92% of Marula fruits could be harvested without impacting the population profile (Shackleton, 2005). While this is the case, it may be argued that fruit harvesting to produce kernels has a potential impact on dispersal and establishment, but this has to be measured with regard to the quantities harvested.

In the case of the PhytoTrade Africa focal species harvested in Zimbabwe, the seeds are primarily picked from the ground except for baobab fruits, which are harvested either by climbing the tree using wooden pegs to scale the slippery trunk or throwing stones up the crown in order to bring the fruits down. Where such pegs have been used for scaling the tree, the holes created by the pegs eventually heal because the thick bark layer on the trunk and branches minimize the damage caused by the throwing of stones and climbing. The use of baobab seed for oil production is seen as having minimal impact and is a sustainable alternative of the use of the baobab tree resource compared to the widespread use of its fibres for mats, which leaves the trees naked as a result of the stripping for bark use. Peters (1996) suggests that the intensive, annual harvesting of fruit or seeds for oil may gradually eliminate species from their habitats.

Currently, there are no studies that show the impact of harvesting and processing of seed on recruitment and regeneration of the four focal species for lipid oils in Zimbabwe. Some studies for Marula have concluded that the size class profiles show a large proportion of smaller diameter trees and this indicates ongoing recruitment of trees into the population (PhytoTrade, 2005). Palgrave (2000) also suggests that people are more likely to conserve Parinari curatellifolia trees as they are valued for both consumption and medicinal uses. Parinari curatellifolia is also associated with traditional beliefs that make people protect the trees (Nhira and Fortmann, 1993). Protection is extended to the Parinari curatellifolia seedlings, creating room for regeneration. In the case of Trichilia emetica, the seeds are said to germinate easily and the trees grows faster in moist areas with rich soil and warm climate (Manjengwa and King, 1999). In terms of the growth rate for Trichilia, an annual increment of 1 and 2m in height is possible in optimum conditions. Literature reviewed here does not show the level of regeneration or recruitment for Trichilia. Considering that currently it is mainly the seeds that are used, little or no damage is caused to the trees. Regarding baobab, there appears to be little natural regeneration of the baobab tree although this is often overlooked because the slender young saplings bear simple instead of the familiar digitate leaves (Wickens, 2007). Since the baobab tree is long-lived, little recruitment is required to maintain existing populations. Never-the-less vigilance and careful monitoring must be maintained, especially in cases where there is increased commercialisation of the baobab products.

2.6. CURRENT STATISTICS ON THE COMMERCIALISATION OF NPs WITHIN PHYTOTRADE AFRICA MEMBERSHIP

The natural products industry in Zimbabwe is still in its infancy just like the rest of southern Africa. There is however some trade of natural products at local, regional and international scale. The statistics of the NP trade in 2006 is shown in Table 5.

Table 5: Number of natural products (NPs) primary producers active with PhytoTrade members, NPs income to primary producers, volume of NPs and revenue generated by PhytoTrade Africa members in southern African countries

Country	**Number of NPs primary producers engaged with members (number of persons)**	**NPs Income to primary producers from members (US$)**	**Volumes(kg) of raw natural products sourced from primary producers**	**Volume (kg) of value added NPs sold by members**	**Revenue generated by members (US$)**
Zimbabwe	4,723	38,453	44,865	5,996	70,952
Botswana	6,000	13,802	9,704	9,120	41,000
Malawi	2,539	13,500	65,000	0	0
Mozambique	2,459	4,300	23,000	0	0
Zambia	2,399	4,000	4,000	560	6,135
Namibia	5,126	113,036	107,695	31,151	278,090
Swaziland	2,475	45,642	14,600	800	56,144
South Africa	3,629	151,267	220,972	13,168	393,068
Total	**29,350**	**$384,000**	**489,836kg**	**60,795 kg**	**$845,389**

(Source: PhytoTrade Africa, 2006 M & E Data).

The current data from the M & E report on the commercialisation of NPs in Zimbabwe shows much lower income realized from NPs than the estimated potential income that could be realized from the four lipid oils species analysed in this report. While the potential yields may be high, income generated will depend on market availability, which has not been considered in this review. In addition, the seemingly low for revenue generated in 2006, may be attributed to slow sales of NPs as the supply-chain needs to be matched with the current demand for lipid oils. The supply of lipid oils is being managed to steadily grow at the same rate with the market availability. At regional level, comparatively, there are relative significant amounts of lipid oils that are sold outside PhytoTrade Africa membership. Approximately 30-40% of Marula oil, 70% of trichilia oil, 50% of Kalahari Melon oil, 40% of Ximenia oil sales are outside PhytoTrade membership (Source: PhytoTrade Africa Technical Services Manager). In the case of baobab oils, the majority of the oils sold have been procured outside of PhytoTrade membership.

3.0. CONCLUSIONS

Zimbabwe has a great potential for increased natural products production and commercialization as shown in the summary in Table 6. The current economic challenges facing the country are a major constraint to the growth of this new industry. The fruit extraction has relatively high economic returns, less negative impact on the trees and therefore should be targeted for the commercialization activities. Some uses of the focal species such as for carving as done with Marula, Parinari and Trichilia and for mat making in the case of baobab may be of threat to the trees and need to be carefully managed to limit the negative impacts on the population of those tree species. So far, there are no studies that show any negative impact of the utilization of seed for oil processing for commercial purposes.

Drawing from the study done by Bennett (2006), it is apparent that the potential scale of the emerging opportunity in natural products exported from southern Africa is substantial. The focal species for lipid oils for Zimbabwean members, namely Marula, Baobab, Trichilia and Parinari are included in the analysis done by Bennett. This analysis gives an overview of the potential for NPs at the regional level. The regional analysis done by Bennett shows that Baobab has the greatest potential for income generation. However, this review for Zimbabwe suggests that Marula has the greatest potential for revenue generation in Zimbabwe.

Bennett (2006) takes the analysis of the potential scale of NPs further by making comparison with other production and export sectors such as agriculture. Bennett’s analysis shows that the potential for wealth and job creation from the NP sector is very substantial.

Overall, Zimbabwe has great potential for NP production, but due to the current poor performance of the economy fewer that anticipated primary producers are actively involved in the NP industry just like in any other sectors of the economy. In recent years, there has also been increased diversification of income sources in the majority of the rural areas as the economic situation in the country worsens and people struggle to sustain livelihoods. For instance there is increase in gold panning activities, which is perceived as having better economic returns compared to the NP and other sectors of the economy (Kurebgaseka, 2007). Thus, the potential of the NPs harvesting and trade, for income generation is not fully utilized in the current context.

Table 6: Summary of ecological, socio-economic, institutional and market aspects of NP trade in Zimbabwe

	Ecological aspects (Resource endowment)	Socio-economic aspects	Institutional aspects	Market
Marula	(i)Widely distributed (ii)high regeneration capacity (iii)high abundance (vi) oil is produced in dry season (v) use of fruits has low impacts (vi) picked from the ground	(i) 70% of 12 million leave in rural area (ii) Current high rate of unemployment (iii) NP second most important to rural communities	(i) 4 members currently producing marula oil	(i) (i) Potential for fair trading from appropriate members (CBOs eg TBT) (ii) (ii)Potential of organic/environmental certification as harvested from the wild (iii) Demand for marula oil increasing abroad (number of derivatives launched has increased) (iv) Currently no domestic demand
Baobab	(i) highly distributed in most dry parts of the country in the Zambezi and Save river basins (ii) Although regeneration is low the tree density are high (iii) Fruits are harvested for oil production	(i) Human population density high in areas of baobab occurrence.	(i) At least 3 members activity involved (ii) potential for high production (iii) current processing challenges due to electricity shortages	(i) potential for fair trading in CBO (ii) potential for environmental certification (iii) International demand high (iv) Low local demand but high potential for regional demand

Parinari Curatellifolia	(i) widely distributed (ii) high regeneration (iii) fruits available all year round and abundant (iv) fruits harvested from the ground	(i) Some occurs in communal areas where population density is high (ii) Rate of unemployment high above 90%	(i) 3 members involved (ii)	(i) High potential for fair trade (ii) High potential for organic/environmental trading (iii) Market for Parinari is low (iv) No domestic market
Trichilia Emetica	(i) widely distributed (ii) high regeneration (iii) fruits harvested from the ground	(i) Occurs in some communal areas (ii)	1 member involved with trichilia	(i) potential for fair trading (iii) high potential for environmental trading (i) international market for trichilia high (iv) No local demand

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