HOUSEHOLD LIVELIHOODS, MARKETING AND RESOURCE IMPACTS: A CASE STUDY OF BARK PRODUCTS IN EASTERN ZIMBABWE

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The Economics Of Production Of A Rare Medicinal Species Re-Introduced In South-Eastern Zimbabwe – *Warburgia Salutaris*

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Abstract

The bark of Warburgia salutaris, *locally known as* muranga, *is a medicine of great traditional significance in Zimbabwe. However, trees of this species are at or near extinction in the wild in Zimbabwe. In this paper, the economics of the re-introduction of this rare medicinal species in some relatively moist, high altitude sites in south-eastern Zimbabwe are examined. The analysis builds on the information base provided by a recent pilot project of Warburgia re-introduction, as well as on market price data from a survey of current medicinal bark markets and on assumptions regarding the prospective future production and use of* Warburgia *leaves and bark by farmers and healers. The economic analysis strongly suggests that expanded* Warburgia *production, at least on a small scale, in the remote, hilly region of southeastern Zimbabwe is very economically attractive and conducive to improving rural incomes and livelihoods of small-holders. This conclusion holds true in private feasibility terms, for both small-scale farmers and healer-growers, and in terms of social cost benefit analysis wherein seedling subsidies are removed.*

Introduction

Traditional herbal medicines are widely used in African health care. In Cote d'Ivoire, for example, 80% of the population use traditional medicines (Ake-Assi, 1988), with similarly high rates reported for southern Africa (Ellis, 1986). Medicinal species most in demand for their symbolic significance or effective active ingredients are gathered for sale to urban markets. In East and southern Africa, the association between trees, known as *imithi* (singular = umuthi), and medicines (known by the same name) is very strong. Where harvest of leaves, flowers or fruits occurs, there is rarely concern about sustainable utilization, but where roots or bark are commercially harvested from tree species with a narrow geographical distribution, then resource depletion typically occurs, undermining the local self-sufficiency of rural healers and the resource base of commercial harvesters.

Bark is a commonly traded herbal product in southern Africa. In KwaZulu/Natal province, South Africa, for example, the bark of 119 species enters commercial trade, the vast majority of these (94%) being wild species (Cunningham, 1988). The most favoured medicinal bark used in southern Africa comes from *Warburgia salutaris*, locally known as *muranga* (Shona), *isibaha* (Zulu, siNdebele, *siSwati*) or *chibaha* (Tsonga). It is sold in urban marketplaces in Mozambique, Swaziland, South Africa, Lesotho and Zimbabwe (Cunningham, 1993, Mukamuri and Mavi, 1996). The only southern Africa representative of the family

Canellaceae, it is one of only four *Warburgia* species found in Africa, all of which are highly valued for their effectiveness as herbal medicines. This medicinal value is probably due to biologically active drimane sequestiterpinoids, typically warburginal and mannitol, the latter being more widely used as a diuretic and to treat dyspepsia (Bruneton, 1995).

In Zimbabwe, *Warburgia* has all but disappeared from the wild, its possible presence proving difficult to substantiate. Destruction of *Warburgia* populations not only represents a conservation problem: it is also an issue of concern to local people and traditional healers in particular, for whom this represents loss of access to their most important herbal medicine. Re-introduction of this species through transplanting of rooted cuttings was considered a viable alternative for three reasons. First, the high cultural values associated with this tree species as the most important medicinal plant species in Zimbabwe; second, that re-introduction of this species was considered useful from a conservation perspective; and, thirdly, that the high value of the bark, vigorous re-sprouting ability and reasonably rapid growth rate of this species suggested that it may be an economically viable agroforestry tree species. In late 1997 and early 1998, a pilot project began, under the auspices of the WWF People and Plants Initiative and Zimbabwean NGOs, to re-introduce *Warburgia* seedlings to south-eastern Zimbabwe. The objective of this paper is to review this experimental re-introduction and assess its economic potential to small-scale farmers in south-eastern Zimbabwe.

Conservation background

The high demand for, and commercial trade in, *Warburgia* bark has raised conservation concerns in East Africa for the endemic species *W. stuhlmannii* and in southern Africa for *W. salutaris*. In the early 1930s, for example, the botanist Jacob Gestner, who spent many years living in northern KwaZulu, South Africa, recorded that bags of *isibaha* bark were being transported from Hluhluwe to Durban for sale. In a vain attempt over more than a decade to collect flowers or fruits of this species for scientific identification, all he found were sterile coppice shoots sprouting from already exploited trees (Gerstner, 1938).

This species has a limited distribution in southern Africa, where it is listed as a vulnerable species in the recent Red Data List (Hilton-Talyor, 1997). The situation in Zimbabwe, however, is particularly acute. The reason for this is that high commercial demand for *Warburgia* bark in Zimbabwe focussed on a very limited supply as wild populations of *Warburgia salutaris* were restricted to forest ecotones on a few moist, high altitude sites in south-eastern Zimbabwe and possibly some small populations in the lowveld and Zambezi valley. In addition, several local people said that many *Warburgia* trees had been cut when a belt of woodland and forest was cleared in the 1930's in Zimbabwe's eastern highlands in an attempt to prevent the spread of tsetse flies from Mozambique. In 1972, botanists searching for this species in the hills east of Tanganda Halt, a locality where it had been reported as occurring by the local people of south-eastern Zimbabwe, only found the stumps of a few trees felled for their bark (Mukamuri and Mavi, 1996). A small number of rooted resprouts were taken from these trees for cultivation in the National Botanical Garden, Harare. A further impact during the war for Independence (1970-1980) was by freedom fighters who, often lacking access to pharmaceutical medicines, heavily utilised *Warburgia* bark while camping out in the valley forests of the Chipinge area.

No trees were found in searches for this species in valley forests in the Chipinge area in 1989 or 1997 by the National Herbarium staff. During the present study some local healers (*n'anga*) and herb traders reported that *Warburgia* bark was obtained from several sites where it had not been recorded by botanists (sites such as Gokwe, Buhera, and Kadoma, which are typically dry areas unlike the Chipinge area). While this claim remains to be verified, there is no doubt that the historic frequency of bark exploitation in Zimbabwe has led to the near extinction of this species in that country. Subsequently, the price of *Warburgia* bark has escalated, and prevailing high commercial demand threatens the six *Warburgia* trees cultivated in Zimbabwe's National Botanical Garden. Currently, most *Warburgia salutaris* bark comes into Zimbabwe from Mozambique and South Africa.

The cultivation survey: methods and results

A small scale survey of cultivators who had planted *Warburgia* seedlings in early 1998 was conducted in May 1999. The cultivation survey was carried out primarily in Chief Mapungwana's area in the Mt. Selinda sub-region of Chipinge district in south-eastern Zimbabwe. In addition, three farmers (the final three cited in Table 1) were interviewed in the Tanganda sub-region, also in Chipinge district, but a drier area less ecologically suited for *Warburgia* than the moister, higher area near Mt. Selinda. Surveyors visited farm homesteads targeting the Chief, four traditional healers-cum-growers, and several small-scale farm holders who had recently planted *Warburgia*. A questionnaire involving issues of establishment of the seedlings, management practices, and current and potential use of the leaves and bark for medicinal purposes was administered. The sample was a representative one, but necessarily small given the time constraints, the limited number of original plantings (less than 100), and the remote locations of most of the homesteads (often accessible only after an hour's walk in the hilly terrain near the Mozambique border). At the end of the visits one chief, 4 healers and 10 ordinary farmsteads had been interviewed. Physical measurements of height of the surviving trees were done and recorded (see Table 1).

Establishment and management

One thousand one hundred (1100) plants imported from South Africa underwent the phytosanitary procedures at the Department of Research and Specialist Services in Harare. Only about 400 plants survived and, of these, slightly over 100 healthy plants were distributed to the Tanganda and Chipinge areas of south-eastern Zimbabwe. Thirty were delivered to interested growers in the Tanganda area, but only 14 were planted. A total of 76 plants were delivered to Chief Mapungwana's area in Chipinge but 10 died before they were planted.

Table 1: Summary statistics for re-introduced *Warburgia* seedlings: Survival rates and current heights of surviving seedlings (two farmers not visited because of their absence from the study area at the time of the work)

Farmer	Seedlings supplied	Surviving seedlings	Height (cm)							Mean height (cm)
Gomba[1]	11	7	44	57	19	41	53	8	19	34
Sabhuku[1]	3	3	50	26	65	47				47
Chief[1]	7	3	38	36	24					33
Chimbonyo (1)[1]	7	2	21	10						16
Councillor[1]	4	3	28	50	40					39
Chimbonyo (2)[1]	3	1	50							50
Muyambo[1]	3	0								0
Chadyiwangembwa[1]	3	2	37	29						33
Edson[1]	4	2	88	88						88
Matsoro[1]	3	2	37	28	28					33
Magoso[1]	7	4	47	36	5	25				28
C/Chapera[1]	3	1	20							20
J Seven[1]	6	Not revisited								
N. Musirwa[1]	2	Not revisited								
Chilengwa[2]	2	2	35	25						30
James[2]	7	1	67							67
Marwendo[2]	5	0								0
Total	72	33					Average			39.8

[1] Chipinge area
[2] Tanganda area

The growers planted the plants at different times and sites. Some were planted on contours or on edges of fields, others in the garden and in natural forest near homesteads. An average inrow spacing of 3 m was used. The soils in Chief Mapungwana's area are typically well-drained sandy loams. Initial fertilisation on transplanting varied from grower to grower, with most of the farmers applying goat manure or leaf mould (*murakwani*). In one exceptional case, an application of a top dressing fertiliser by one grower (who also acted as a traditional healer) was reportedly given.

In our sample of 15 cultivators, some 33 of the originally planted 72 seedlings had survived-- a survival rate of 46 percent. The survival rate was considerably higher in the Mt. Selinda area (52 percent) than in the Tanganda area (21 percent). The average growth rate of the surviving seedlings was estimated to be approximately 2 cm per month.

Watering of the plants is the most important management activity undertaken by the growers. Almost all the growers interviewed indicated that they watered their plants, especially during the dry season. Some indicated that they watered them as often as two to three times a week. Although most of them spent very little time on the watering activity each time it was done, some spent considerable amounts of time travelling long distances to get the water. Infiltration basins were created around the plants so that water could percolate slowly into the ground.

Termites were one of the major insect pest problems at establishment and during the subsequent growth. Cultivators cited termites as by far the most important cause of loss of seedlings. Growers recognised the problem from the onset and took preventive measures. All growers reported the use of ash in plant stations. The growers used dead plant material as alternative host material for the termites. In one case (Chief Mapungwana), water was not applied to reduce termite attack; however, this is contrary to previous termite control reports where watering was regarded to be a deterrent to termite activity. Some farmers used the juice from *Datura stramonium* fruits to control termites. The other reported cases of loss were due to goats and these led to different protection methods. Some used sorghum stalks and meshwire to protect the plants. One healer/grower planted in a forest within non-browsable thickets of *Lantana camara*. Weeding was done as required after transplanting.

Utilisation

It was observed that there were no *Warburgia salutaris* plants growing in the wild locally so the uses described here are those of the young leaves from the cultivated seedlings. The cultivated seedlings are still too small to harvest the bark so short run benefits are through use of leaves. One traditional healer (n'anga) reported that he used 3 to 4 leaves per plant per week. While *Warburgia salutaris* bark is widely known to be medicinal, some growers reported that they did not know whether the leaves had any medicinal value or not. They claimed that they would consult the researchers who gave them the seedlings and local traditional healers/herbalists on how to harvest and use the tree. When harvesting the leaves all growers claimed that they would harvest the lower leaves to avoid damaging the meristem. Most growers claimed that they will start harvesting the bark when the tree is at least 15 cm in diameter and old enough to withstand stress from debarking. Farmers in the sample did not know and like the practice of harvesting bark by chopping down the whole tree (to promote prolific coppicing - the regrowth of many stems). They feared that hacking down the tree would kill it. Instead, in the absence of further extension advice regarding the merits of coppicing, the growers currently intend to harvest small patches of bark at a time.

Economic evaluation

Warburgia salutaris is generally regarded to be one of the highest valued trees in Africa because of its products - medicinal bark, powder, and leaves. To test the hypothesis that the re-introduction of *Warburgia* as a domesticated species would indeed be a high payoff investment, both to society and to private growers, a partial budgeting approach utilizing benefit-cost and net present value analyses (Dasgupta and Pearce, 1972) was employed.

The most critical assumptions relate to the method and rate of harvest, particularly of bark, as well as to the price regimes that might be anticipated to prevail for *Warburgia* products. Unfortunately, too little is known about these key parameter values. There is a wide range of values in the literature and in recent empirical work in Zimbabwe, regarding both prices and likely harvest quantities. Accordingly, sensitivity analysis incorporating a relatively wide spectrum of parameter values was undertaken. In particular, attention was paid to more pessimistic scenarios regarding the economics of production. In our analysis, the following simplifying assumptions were made.

First, it was assumed that the length of the planning period would be 24 years. Secondly, the harvesting regime was viewed to be a cut and coppicing regime, rather than one involving the selective removal of patches of bark or branch bark from the maturing tree. In the chosen baseline scenario, it was assumed that the growing tree would be harvested at year 8, yielding 6 kg of air-dried bark; thereafter, coppices would arise and be cut every fourth year, generating a bark yield of 4 kg in each of years 12, 16, 20, and 24. The underlying rationale for such bark yield assumptions was the measurement of a small (n=6) sample of known age *Warburgia* trees and the analogy to wattle (*Acacia mearnsii*), a species for which specific bark yield information is available (Schonau, 1973). Although *Warburgia* is a shorter tree than wattle and grows more slowly, it is regarded to have thicker bark relative to wattle (Cunningham, pers. comm., 1999). In addition, to cover the possibility of over-optimistic bark yield assumptions, scenarios were also modeled using one-half, and one-quarter, of baseline bark yield respectively.

The assumed price scenarios were based on actual empirical evidence collected in May 1999 at three Zimbabwean markets: Harare, Mutare, and Chipinge area. Sixteen *Warburgia* bark (and three *Warburgia* powder) samples were purchased with a mean average value (n = 16) of Z$1,150 per kg. This equates to approximately US$33 per kg, using the exchange rate of Z$35 to US$1 as in 1999. It was assumed that the relevant farm-gate price of *Warburgia* bark would be some 70 to 75 percent of the foregoing retail level values, given that the bark is readily transported and stored. Further, it was assumed that *Warburgia* price levels would remain the same, in constant dollar terms, over the planning horizon. Consequently, the *Warburgia* price levels assumed in the analysis were low or pessimistic - $5 per kg; medium or baseline - $25 per kg; and high or optimistic - $50 per kg. The low price scenario was designed, in part, to reflect the possibility that marketing margins are much higher and farm-gate prices are lower than assumed in the baseline model. As well, this was to accommodate the possibility that large-scale commercial production might arise, adversely affecting price levels for the remote small holders with restricted plantings.

Returns and costs were generated on a per tree basis for both traditional healer and small-scale farmers. In addition to bark values, it was also assumed that healers, and to a lesser extent farm households, would gain modest benefits from the use and/or sale of leaves. After receiving very small initial benefits, healers were assumed to receive US$0.66 per month from the use of leaves from the tree, while farm households would receive an imputed gain of US$0.23 per month (beginning year 4 of the period).

Inputs and harvesting costs, primarily labor, were also included utilizing an agricultural wage rate of Z$2.57 (US$0.07) per hour. These input costs were relatively low, reflecting the less intensive production management practices seen in the answers to our open-ended questionnaire. What remains an important initial cost, however, is the cost of a seedling. This was subsidized considerably in the initial pilot planting, costing the grower only Z$10 per seedling. In our social analysis we assumed that the cost of a seedling, which could be relevant to future planting, would be five times higher at Z$50.

Finally, benefits/returns and costs were discounted using specified interest or discount rates. For the small scale farm holders, facing considerable risks, the individual or private rate of time preference (discount) was assumed to be 17%, a rate in line with other farm level studies in rural Zimbabwe. For the traditional healer/grower, typically from a higher income household with more assets and less risk, the private discount rate chosen was 10%. In the social benefit-cost analysis the chosen social rate of discount was 5%, reflecting social time preference arguments related to long-lived investments such as trees.

The empirical results of the benefit-cost studies for several scenarios are reported in Table 2. In each scenario, a summary benefit-cost ratio (in private terms) is shown for both the case of the traditional healer (n'anga) and the case of the small holder farmer. The results are extremely robust, giving evidence of very high benefit-cost ratios at both the healer and farmer levels, particularly under the baseline price and base yield scenario, and even more so under the optimistic price and base yield scenarios. For example, under the baseline price and yield assumptions, the private benefit--cost ratio relating to the growing and harvesting of *Warburgia* tree is over 42 to 1 for the healer and over 24 to 1 for the small holder. Even with the low price and ¼ base yield scenario the benefit-cost ratios remain relatively high at 13.3 to 1 and 4.5 to 1 for the healer and farmer, respectively.

We also undertook some scenario projections (not reported in Table 2) assuming base-line yields of bark and leaves, but assuming a *Warburgia* bark price of US$18 per kilogram, a more conservative price assumption but one useful for assessment purposes and farm planning. The resulting private benefit-cost ratio for the healer was nearly 34 to 1. The corresponding net present value, per tree, for the healer over the 24 year planning period was US$159.83. The calculated private benefit-cost ratio for the farmer was 18.4 to 1, with an associated net present value of US$60.86 per tree. A farmer with four *Warburgia* trees, for example, might expect a return, in net present value terms, exceeding US$240. The corresponding internal rates of return were 180 percent at the healer level and 108 percent at the farmer level. Such high internal rates of return indicate that *Warburgia* production could be an extremely profitable venture - at least when confined to limited production by small farm holders in the appropriate ecological niches in south-eastern Zimbabwe. Such economically attractive returns are particularly significant in a country where rural income per capita in remote areas is probably only US$1 per day.

Sensitivity analysis was undertaken to assess the importance of benefits from leaves in the benefit-cost analysis under the low bark yield (1/4 base-line) and pessimistic price (US$5) assumptions. The results for full leaf benefits, one-half leaf benefits, and no leaf benefits are reported in the first three columns of Table 3. At low bark prices and yield, of course, the relative importance of leaves to the grower increases. Even so, in the absence of any benefits from leaves at all (Column 3 in Table 3), the private benefit-cost ratios remain greater than one, though barely so for the farmer (B/C ratio = 1.04).

Table 2: Benefit-cost ratios for alternative scenarios regarding *Warburgia* bark price and yield (per tree basis), Mount Selinda Area, Chipinge District, Southeastern Zimbabwe

	Price US$/kg	Yield of bark per tree (main crop & coppice) Base yield (6 & 4 kg) Full leaf benefits	½ Base yield (3 & 2 kg) Full leaf benefits	¼ Base yield (1.5 & 1 kg) Full leaf benefits
Healer	$5	17.9	14.8	13.3
Farmer		7.6	5.5	4.5
Healer	$25	42.2	27.0	19.4
Farmer		24.2	13.8	8.6
Healer	$50	72.6	42.2	27.0
Farmer		45.0	24.2	13.8

Warburgia production is not only highly profitable in private terms but also in social terms. In our simplified social analysis, a much lower social discount rate (5%) is used and the influence of seedling subsidies is removed. Even so, under the low price and low yield scenario, the social benefit-cost ratios remain relatively high, 10.3 at the healer level and 3.2 at the farmer level (Column 4 of Table 3) (farmers and healers differ in the leaf benefits they realise).

Table 3: Comparison of private and social benefit-cost ratios for *Warburgia* production under pessimistic scenarios (per tree basis): Low bark yield (1/4 Base) and low bark price (US $5) assumptions, and varying leaf benefit assumptions

	Private B/C ratios			Social B/C ratios[1]	
	Full leaf benefits	½ Leaf benefits	Zero leaf benefits	Full leaf benefits	Zero leaf benefits
Healer	13.3[1]	7.4[1]	1.52[1]	10.3[3]	1.18[3]
Farmer	4.5[2]	2.8[2]	1.04[2]	3.2[3]	0.74[3]

[1]Calculated with private discount rate (r) set at 10%, and seedling price set at Z$10.
[2]Calculated with private discount rate (r) set at 17%, and seedling price set at Z$10.
[3]Calculated with social discount rate (r) set at 5%, and seedling price set at Z$50; leaf benefits differ between healers and farmers.

Under stronger price and yield assumptions, the economics of *Warburgia* production is even more attractive both socially and privately. It is only under a worse case scenario - low bark yield (1/4 baseline), low bark price (US $5), and no benefits from leaves whatsoever - that *Warburgia* production becomes socially infeasible, and then only at the farmer level (B/C ratio = 0.74).

The foregoing analysis strongly suggests that expanded *Warburgia* production, particularly in the context of small holder agriculture in the remote, hilly region of southeast Zimbabwe, is clearly very economically attractive, and conducive to improving rural incomes and livelihoods in that locale. It is certainly possible to "kill the goose that lays the golden egg"; through larger scale commercial production by commercial farmers, greatly expanded supplies of *Warburgia* could flood the market, depress the price, and harm the small holders. At the moment however, there is considerable scope for the managed release of more

Warburgia seedlings to the small farm holders in the moister, hilly zone near Mt Selinda. Simultaneously, rural incomes could be improved, absolute poverty decreased, inequality possibly diminished, rural lives and communities further empowered, and the re-introduction of an endangered plant species accomplished. Thereby, many of the dimensions of sustainable development, in this case through the increased use and commercialization of an important medicinal tree, may be achieved.

The way forward

The interest expressed by all farmers growing *Warburgia* trees during household surveys and the economic projections from our study indicate that despite some problems such as loss of trees due to termites, cultivation of this tree species is a viable proposition from both a social and an economic perspective. We suggest that four main needs should be addressed to expand *Warburgia* cultivation from a pilot-study level to production on a scale that would meet rural and urban demand for medicinal products from this species. These are:

- Propagation of cuttings at a village level.
- Provision of extension information to local farmers on best practices for tree management (eg: bark and leaf use, particularly the role of coppicing, and how to deal with pests - for example the possible use of Mexican marigold and commercial chemicals to control termites).
- Maintenance of product quality, efficacy and safety.
- Expansion of the market for new products: e.g. herbal extracts which can be used to prevent insect predation on crops, due to the natural occurrence of insect anti-feedant compounds in Warburgia leaves, molluscicides which kill off freshwater snails that carry bilharzia (Appleton et al., 1992) or subject to stringent health safety standards, even herbal extracts produced from *Warburgia* leaves and sold in standardized doses in capsules.

The re-introduction of *Warburgia salutaris* (*muranga*) in south-eastern Zimbabwe appears to have much potential to enhance conservation of an endangered species and, simultaneously, improve the livelihoods of local rural people.

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