# BARK FOR SALE: THE ADOPTION POTENTIAL OF *PRUNUS AFRICANA* AS AN AGROFORESTRY TREE ENTERPRISE FOR SMALL-SCALE FARMERS IN CAMEROON

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**Abstract.** The bark of *Prunus africana*, a tree growing in African highland forests, has been exported from Cameroon to Europe since 1972 for the treatment of benign prostatic hypertrophy (BPH). Bark harvesting has had a devastating effect on the tree in Cameroon, Africa's largest *P. africana* bark exporter. This paper assesses the adoption potential of *P. africana* among small-scale farmers, that is, its profitability, acceptability and market potential. While not as profitable as *Eucalyptus* spp, an alternative enterprise, farmers want to grow *P. africana* because it is compatible with many crops and has multiple uses – bark sales, medicine, tools, poles, seed sales, and mulch. In fact, several thousand farmers have planted the tree. The availability of markets also appears high, as herbal treatments of BPH are popular and demand is likely to grow. Research is needed in four areas to help *P. africana* play a sustainable role in improving the livelihoods of small-scale farmers: domestication, understanding farmers' experiences growing and using the tree, market assessments, and tree tenure. Moreover, progress on promoting *P. Africana* as a smallholder enterprise is dependent on Cameroon meeting the demands of the European Union and the Convention on International Trade in Endangered Species to conserve and sustainably manage the tree.

**Key words:** Non-timber forest products, economics, marketing, Africa

## INTRODUCTION

The decline in forested area in the tropics has had, among others, two important effects: a reduction in populations of certain indigenous tree species found only in the forests and a decrease in incomes of people living nearby, who depend on forest products to supplement their incomes. Some claim that marketing forest products will help conserve tropical forests (Peters et al. 1989) but others have shown that marketed products are often not exploited on a sustainable basis (Hall and Bawa 1993; Belcher.and Schreckenberg 2007). Efforts to promote agroforestry, the planting of trees on farms, can help conserve indigenous species and help farmers to market tree products that were formerly collected from the forest. *Prunus africana*, an Afromontane forest tree (Rosaceae) provides a compelling case study of such a species in transition from wild harvest to cultivation. An important component of traditional medicine in the highlands of Africa, its bark has

been exported to Europe and North America for the last 40 years (Cunningham et al. 2002). The bark is used in herbal preparations for the treatment of benign prostatic hypertrophy (BPH), a common disease in older men (Chatelain, Autet and Brackman, 1999; O'Brien 2000; Stewart 2003). Nearly all of the trade has been from bark harvested from the wild, which has had a devastating effect on wild populations in such countries as Cameroon and Madagascar (Cunningham and Mbenkum, 1993; Walter and Rakotonirina, 1995).

Although many government and non-governmental organizations (NGOs) in Cameroon and elsewhere have begun promoting *P. africana* as a cash crop, no social or economic analysis of the enterprise has ever been published. Assessing the adoption potential of an agroforestry practice focuses on determining its profitability, acceptability and availabilility of markets for its products (Franzel et al., 2001; Russell and Franzel 2004). Assessments of adoption potential are key elements of a participatory, farmer-centered model of technology development. They improve the efficiency of the technology development and dissemination process, help document the progress made in disseminating new practices, demonstrate the impact of investing in technology development, provide farmer feedback for improving research and extension programs, and help to identify the policy and other factors contributing to successful technology development as well as the constraints limiting the achievements.

The objective of this paper is to assess the adoption potential of *P. africana* among small-scale farmers in Cameroon. First the study area and methods are described. Next, the results of the profitability analysis are presented. We then assess the acceptability of the enterprise, focussing on farmers' interest in planting the trees, their experiences thus far, and the problems they encounter in planting and managing the tree. We also examine the market for *P. africana* bark, both internationally and in Cameroon. Finally, recommendations for policy makers are presented.

## *PRUNUS AFRICANA*: HABITAT, PRODUCTION, AND TRADE

*P. africana* is the most important African medicinal tree, in terms of international trade, with exports from Africa valued at about $US 220 million (Cunningham et al. 1997). The quantity of dried bark exported annually from Cameroon ranged from 1400 tons to 1800 tons per year between 2004 to 2006 (WCMC, 2010). Cameroon accounted for over half of Africa;s exports during those years; other exporting countries included the Democratic Republic of Congo, Equatorial Guinea, Tanzania and Madagascar.

The distribution of the tree is limited to a few Afromontane forest 'islands' across the continent at altitudes above 1,500 m. These forest islands are in areas of high population density and are declining in area at a rapid rate. Deforestation and increased demand for *P. africana* bark have resulted in the destruction of many *P. africana* trees. Because of the difficulty of implementing and enforcing conservation measures or persuading local institutions to do so, sustainable bark harvesting of remaining stocks is considered unlikely (Cunningham et al. 2002). As a result, *P. africana* is listed in Appendix II of the Convention on International Trade in Endangered Species (CITES), which requires monitoring of *P. africana* bark exports (CITES, 2008).

*P. africana* trees are found at a relatively low density in the forest, about 5 trees per hectare (Eben Ebai et al., 1994). Trees grow to a height of 10-30 meters and have large spreading crowns. The bark harvest begins when trees reach about 13 years in age. The tree does not produce seeds until about the 15$^{th}$ year.

## STUDY AREA

The cool, mountain highlands around Kilum-Ijim Forest Preserve, Northwest Province, Cameroon, range in altitude from 2000 to 2900 m and receive about 2000-2500 mm rainfall per year. Soils are derived from recent volcanic deposits (andesitic basalts and trachyte rhyolites) and older, less fertile crystalline basement rocks. Market infrastructure is weak, and roads are extremely poor. The supply of inputs is highly variable and markets for farm products are unreliable. For example, farmers often suffer long delays, up to two years, in receiving payments for coffee supplied to cooperatives (Cunningham et al. 2002).

The Tikar ethnic group predominates and is organised into chiefdoms, ranging from single villages to areas covering many villages. Chieftainships are hereditary, with local chiefs ruling their communities in collaboration with traditional councils. In general, the chiefs and councils have much more power and authority in dealing with local issues, such as land disputes, than do civil authorities.

The main objective of the households in the study area is to obtain a reliable supply of preferred foods throughout the year. The next most important objective is to earn cash. Maize is the principle food staple. Other important food crops include potato (*Solanum tuberosum*), beans (*Phaseolus vulgaris*), huckleberry (*Solanum nigrum*), cocoyam (*Colocasia esculenta*), cowpeas (*Vigna unguiculata*), and sweet potato (*Ipomoea batatas*). Coffee (*Coffea arabica*) is the primary cash crop; many farmers also grow *Eucalyptus* spp in woodlots. Food crops are also sold. Livestock are few and are usually limited to chickens and goats, kept mostly for security (selling to meet urgent cash needs) or for ceremonial purposes.

Women provide the bulk of agricultural labour and are generally responsible for the cultivation of annual food crops. They also assist in the growing of tree crops, which is mainly done by men. Families generally live in villages, cultivating small plots around their homesteads and larger plots some distance away. Permanent crops, such as coffee, tend to be grown in fields near to the homestead, with strict tenure exerted over them by the farming family. Annual food crops are mostly grown on the further away fields, which are communally owned and which are administered by the chief and council. Rights to use these lands may be temporary or permanent.

Cultivable land is extremely scarce in most parts of the study area. As a result, fields are cropped continuously, and soil fertility is reported to be declining. Planting and growing of trees is a common practice and is much more common around the homesteads, where tenure is secure, than in fields further away. Overall, insecure land tenure is not an important constraint preventing farmers from planting trees. Nevertheless, land disputes are common, and insecure land tenure does constrain certain individuals from planting trees in certain fields.

## METHODS

Individual and group discussions, together with field observations, were used to collect relevant information concerning socio-economic aspects of farmer production of *P. africana*. A broad range of people were involved. They included small-scale farmers, traders buying and selling *P. africana* bark, top management of the pharmaceutical subsidiary (Plantecam) exporting *P. africana* bark extract, and staff of the Ministry of Environment, the Forestry Department and of various NGOs. The small-scale farmers interviewed were selected from production areas at Mt Ijim, Vekovi, and Mt Kilum/Oku, North West Province. Data on costs and returns were obtained from farmers in the village of Oku in 1995. Staff of on-going projects involved in planting *P. africana* identified most of the farmers who were interviewed. Other farmers not associated with *P. africana* related projects were also interviewed.

At the small-scale production level data were collected on:

a) nursery operations and costs - including year first started, number of seedlings produced, mortality rates and causes, sources and costs of seeds;
b) projected uses, quantities produced, and prices for *P. africana* products;
c) reasons for constraints on planting and production.

In order to undertake some comparative analysis, information was also gathered from farmers on the main alternative enterprise to *P. africana*: *Eucalyptus camaldulensis* woodlots. The decision to use eucalyptus to compare with *P. africana* was motivated by field observations which suggested that both enterprises would be undertaken on comparable land types, under similar spatial arrangements and with comparable objectives.

The conventional cost-benefit analysis technique was used to calculate the costs and returns over a 30-year period, the estimated age at which the trees would be felled. Inputs and outputs were valued at the prices that farmers faced (Table 1). Discounted net returns were calcuated to determine the net present value (NPV) of alternative investment strategies. A discount rate of 10% was used in the main analysis but results were assessed under discount rates of 20% and 30% as well. Farmers' labor was costed at 1995 wage rates in the study area. Prunus bark and other wood products were valued at their market prices. Estimates of prunus bark harvested from trees of different ages are from Cunningham et al., (2002). Sensitivity analysis was conducted to measure the effects of changes in key parameters on the profitability of the *P. africana* enterprise.

## RESULTS

### COMPARATIVE ANALYSIS OF THE PROFITABILITY OF SMALL-SCALE PRODUCTION OF *PRUNUS AFRICANA* AND *EUCALYPTUS CAMALDULENSIS*

For *P. africana* production (Table 1), the major costs were incurred on seedlings, land preparation, planting, weeding, debarking, and making handles for tools. Benefits were obtained

from the sales of construction poles (eighth year), bark (13th year and every five years thereafter), hoe and axe handles (beginning in the 18th year) and salvage value (end of the rotation). For eucalyptus, the costs included seedlings, land preparation, planting, and weeding and the value of maize lost in the area around the woodlot, because of competition with the trees. Benefits included construction poles and firewood beginning in the fourth year, electricity poles in the 20$^{th}$ year, and sawing logs in the 23$^{rd}$ year. Results of the flow of costs and benefits for small-scale production of *P. africana* and eucalyptus in the Oku area are shown in Tables 2 and 3, respectively. Each is assumed to be produced in a 0.018 ha woodlot. The *P. africana* woodlot contains 45 trees at planting (spaced at 2m x 2m) and is thinned to 22 trees (3m x 3m) in year 8. The eucalyptus woodlot contains 180 trees at planting (1m x 1) m) and is thinned to 90 trees (1m x 2m) in year 2.

The NPV of benefits for the production of *P. africana* at the farm-level is 29,010 FCFA (Francs de al Confederation Française Africaine) (US$60) using a 10% annual discount rate over the 30-year period. The positive NPV indicates that the investment is a profitable one. The flow of discounted net returns shows that the farmer incurs considerable losses in the first three years, during tree establishment. Benefits do not start until year 8 and it is only in the 18th year that the entire investment is repaid.

The NPV for a comparable eucalyptus enterprise is shown in Table 4. Over a 30 year period the NPV is 37,883 FCFA. This figure is 30% higher than that of *P. africana*. An examination of the flow of discounted net returns shows that the net gains and losses alternate at the rate of one to three. That is, three years of loss are followed by a year of net gain. Nevertheless, for the eucalyptus enterprise the investment is repaid by the fourth year. The high value of the construction poles produced more than compensates for the main cost component, the negative effect on crops grown around the woodlot.

The NPVs computed above are useful for comparing investment alternatives, such as *P. africana* and eucalyptus, that involve flows of costs and benefits over long periods. However, they are fairly abstract and do not really answer the question, how much money can a farmer make? Table 2 shows that a farmer planting 0.018 ha (45 trees) of *P. africana* spends about 9,000 FCFA during the first 3 years to plant and manage them and then earns 6,600 FCFA in the eighth year from thinning. He/she earns a further 11,500 FCFA in the 13$^{th}$ year and about 15,000 FCFA per year from year 18 through year 29, from sales of bark and tool handles. Eucalyptus, in contrast, is a lower-cost, quicker return enterprise. Establishment costs are only 2,150 FCFA over the first two years and returns start in year 4, with earnings of about 22,000 FCFA from construction poles and firewood. Similar earnings take place every four years, and additional earnings take place in years 23and 24 from electricity poles and sawing logs.

This analysis indicates that although the NPV for eucalyptus exceeds that of *P. africana*, there is still a profit for investing in *P. africana*. There are also reasons why one might rather invest in *P. africana* instead of or in addition to eucalyptus. Farmers indicated that crop yield is not affected by the presence of *P. africana* in the fields. Our field observations indeed support this assertion, with the exception of maize, which did not perform well in the presence of *P. africana*. Eucalyptus, on the other hand, depresses crop growth far more severely. It should have been reasonable to include a positive gain attributable to crop value in the returns side of the *P. africana* enterprise, since

crops can be grown underneath the trees, particularly in the first few years following establishment. Secondly, the medicinal value of *P. africana* was subsumed in the bark sales value to avoid double-counting. Although this is proper, this may in fact lead to an under-estimation of the value of the species for rural households as a medicinal plant.

In fact, small-scale farmers prefer to diversify their farming operations; that is why a single household in the Oku area (and indeed throughout Africa), generally manages a dozen or more farm enterprises. They are thus likely to want to plant both *P. africana* and eucalyptus because each provides different products and helps the household to manage risk. An important advantage of *P. africana* over eucalyptus is that it does not depress crop growth; farmers may thus prefer to grow it in association with crops, along internal and external farm boundaries. Eucalyptus, on the other hand, can only be grown in woodlots because it interferes too much with crop growth.

A sensitivity analysis was undertaken to determine how the NPVs of the two enterprises are affected by changes in key parameters such as bark price, pole price, labour cost, and the discount rate. Table 5 shows the NPVs thus calculated. A number of remarks can be made from the results. First, both eucalyptus and *P. africana* have positive NPVs at 20% discount rate; at 30% however, the NPV for the medicinal plant is negative, whereas for eucalyptus it is still positive. Secondly, the results are not very sensitive to changes in bark prices or to changes in labor prices. Even if bark prices increase by 50%, eucalyptus is still a more profitable enterprise than *P. africana*. Finally, the most remarkable change in NPV occurs when the pole price of eucalyptus is changed. A 50% decrease in pole prices causes eucalyptus profitability to dip far below that for *P. africana*.

## THE ACCEPTABILITY OF PRUNUS AFRICANA: FARMERS' INITIATIVES AND PERCEPTIONS

The economic potential for introducing *P. africana* as a smallholder crop, described in the previous section, is confirmed by the high level of enthusiasm among farmers in North West Province for planting the tree. The data we collected show that by 1995, just 6 years after projects and NGOs started promoting the tree, at least 4,250 farmers had planted. About half were associated with projects and half were not (Table 5). But the actual number of farmers planting was far greater; some organizations promoting *P. africana* that we visited were unable to give estimates of numbers of farmers planting and we know that there were several other organizations promoting the tree that we were unable to visit. Most of the farmers planting through development projects and NGOs received free seed and subsidised inputs for nursery development. But in all cases, farmers contributed their own labour, indicating their strong interest. Bark collection in forest areas greatly increased during the 1990s, and farmers have become aware of the opportunities of producing and selling bark.

### Local and NGO initiatives in *Prunus africana* production

In the Oku area of Bui Division, the Kilum Mountain Forestry Project has been assisting farmers since 1989 to organise nurseries and plant *P. africana* and other species on their farms. In 1994, there were 35 functional group nurseries, ranging in size from five to over 100 farmers. Group members share the seedlings, planting most on their farms, selling some to other farmers and some

to the project, which uses them for forest enrichment planting. Most farmers also give seedlings to relatives and neighbours. Initially, the project provided free seeds and polythene bags for potting the seedlings but has phased out these subsidies. The high prices for seed and seedlings in the Oku area are indicative of their high demand. The project purchases potted seedlings on contract at 25 FCFA/seedling, whereas farmers sell seedlings to local persons at 50 FCFA (bare-rooted) or to persons from outside Oku at 100 to 200 FCFA (potted). Demand generally outstrips supply in Oku, although in some instances the project has helped transport surplus seedlings to be sold in other areas, such as Bamenda. Seed sells for 250/kg to local persons and 500/kg to outsiders.

In 1993, *P. africana* was the most important species in the Oku nurseries, accounting for one-third of all the seedlings grown. In 1994, 23 of the 35 groups were producing *P. africana*; lack of seed was the most important reason some were not planting. The groups produced about 14,000 *P. africana* seedlings in 1994, half bare-root and half potted. The project purchased 5,348 seedlings for forest enrichment plantings; farmers planted most of the rest on their own farms. Some seedlings were sold.

In the Ijim Mountain Forestry Project in the Kom area of Boyo Division, about 60 nursery groups, composed of about 10 farmers each, produced and planted about 9,600 *P. africana* seedlings by 1995. In 1993, the project collected 200 kg of seed from farmers, paying 500 FCFA per kg. In 1994, 75 kg was collected. All seed was distributed among the nurseries, free of charge. In addition to planting seed in nurseries, some farmers transplant wildings from forest areas. HELVITAS (Swiss Association on International Cooperation) assists local communities to improve water supplies and management of watersheds in several areas in the North West Province, including Bambui, Guzang, Belo, Nso, and Biamey. One small component of these projects is the provision of *P. africana* seedlings to farmers for planting, mainly on communal areas. In Bambui, the project supports 9 nurseries and has trained 120 farmers in nursery management.

Rural Training Centre, Mfonta, Bambui, receives provides training to farmers from all over the province. The centre collects *P. africana* seed and distributes it to its trainees (about 200 per year) and sells to to NGOs and development projects. The Centre collected about 10 kg of seed per year in the early 1990s and reported in 1995 that demand far outstripped supply.

The Trees for the Future project, based in Kumbo, Bui division, includes 63 groups with a total of about 1,950 members. By 1994, 275,000 trees were reported planted by these groups, and *P. africana* was the third most commonly planted tree, accounting for about 25,000 of them.

Other groups in North West Province reported to be assisting farmers in planting *P. africana* but which we did not contact include: MESG, Shishong; VCP, Bafut; PAPSEC, Bamenda, and in South West Province: Greenfield Common Initiative Group, Bova, and the Mosake Common Initiative Group, Buea. There are also many farmers planting *P. africana* independent of development projects. These farmers can be divided into two groups. First, is a small group of pioneer farmers who first planted *P. africana* many years ago, for different reasons. For example, Shey Kinsam, in Tadu, Nso, planted about 21 trees in the late 1970s, primarily for firewood. Some farmers in the Oku area have *P. africana* trees that they, their fathers or grandfathers planted in

their compounds, primarily for medicine. Charles Lukong, a retired *P. africana* bark harvester for Plantecam, planted over 100 trees on his farm in Vekovi in the 1970s and 1980s, with the objective of selling the bark.

The second group is composed of relatively high-income and progressive farmers who have recently become aware of the market for *P. africana* bark. These farmers have bought seed, often from Nso or Oku, and have planted on a fairly large scale (200 trees or more). Of the 70 persons in North West Province who have obtained permits for buying *P. africana* bark, about 10 have planted. One farmer, Mr. Luta Albert in Santa, is reported to have 5000 trees. Plantings have also been extensive in Mendankwe, a village adjacent to the provincial capital, Bamenda, probably because farmers have better access to information on markets and prices than farmers in areas further away from Bamenda. In Mendankwe, a farmer reported having purchased seed from Nso for 4000 FCFA francs/kg. Another reported a sure sign that the tree was highly valued: his potted seedlings had been stolen from his compound during the night, a few days after he obtained them!

Farmers' reasons for planting and perceptions of benefits

Farmers' reasons for planting and perceptions of benefits varied across the region. The most commonly mentioned reasons are the need for:

- A cash-earning enterprise. When discussing reasons for planting, many farmers mentioned their disappointment with coffee, the main cash crop of North West Province, because of the marketing problems mentioned above. Farmers have also experienced problems selling eucalyptus poles, as the supply of poles has outstripped demand in some areas (Institut de la Recherche Agronomique 1988). The issue is not so much whether *P. africana* is as profitable as coffee or eucalyptus, but whether *P. africana* has a role as a supplementary cash-earning enterprise for farmers. As mentioned above, small-scale farmers operate a complex farming system composed of many enterprises. The main reason for having so many different activities is to meet household subsistence needs, to minimise risk and to reduce labour and cash bottlenecks throughout the year. Farmers are eager to invest in new enterprises that earn cash and fit their resource endowments. Surprisingly, they are not discouraged by the long wait required before *Prunus africana* bark can be harvested.

- An important medicine for home consumption. In Oku, Nso, and around Mt. Cameroon, *P. africana* bark is an important component of many medicines (Stewart 2003). Traditional doctors use it, as well as individuals treating themselves or their family members. In Oku, traditional doctors use some *P. africana* bark in preparing nearly all traditional medicines; it is especially important as an aphrodisiac and as a cure for gastrointestinal problems, body pains, malaria, and hypermenorrhea (Stewart 2003) . It is never used alone, but rather is boiled together with other ingredients. Use of the bark to treat stomach ache is also recorded from East Africa (Kokwaro 1976) and elsewhere in Cameroon (Letouzey 1978).

- An enterprise that fits well into their farming system. *P. africana* requires relatively low levels of land, cash and labour. Farmers can plant a few or many trees; there is no minimum level of investment. Moreover, farmers find the tree to be relatively easy to establish. They also

reported that there appeared to be little if any competition between adult trees and most crops (beans, coffee, and potatoes). On one farm we noted considerable competition with crops, perhaps because the soil on this farm was less fertile than on the others. Farmers also noted that maize does not grow well near the tree.

- An enterprise that has multiple products. In contrast to coffee, which provides no benefits if the berries cannot be sold, *P. africana* has several useful products in addition to bark:

  - handles for axes and hoes. The strength of the wood is the main reason the species is suited for these tools. Farmers with adult trees were producing handles for both home use and sale.

  - mulch and green manure. Three of the farmers with adult trees claimed that the leaves were useful as mulch and manure for crops.

  - firewood. Women claimed it is an excellent firewood species, because the wood burns for long periods of time, at high intensity.

  - poles. None of the respondents had actually used *P. africana* for poles. But based on its straightness, taper, and strength, they felt that it would be superior to eucalyptus, the most common pole species.

  - seed sales. Only two of the five farmers having adult trees had trees that produced seed. But neither was aware that there was a strong market for *P. africana* seeds; thus they did not collect them. Other producers stated that they hoped to sell seed when the trees matured.

On-farm tree management and problems encountered by farmers

Farmers with reproductively mature *P. africana* trees generally had established them from wildings that they had collected in the forest. Reproductively mature trees were generally scattered in crop land, including annual crops and coffee. Farmers mentioned that the trees were easy to establish and performed well even on infertile soils. The only observed production problem on farms with mature trees was that of wood-borer on two of the five farms surveyed in Nso. In one of these cases, the farmer did not consider wood-borer as a problem, while on another it was constraining growth and had probably spoiled the wood for use in construction. Of the three farmers with mature trees who were not associated with a project, two were expanding their plantings using wildings from their own farm, and the other was using wildings from the forest.

Farmers associated with projects were establishing nurseries as project staff had shown them. Most of the nurseries were group nurseries, generally serving 5 to 15 members. Numbers of seedlings ranged from 300 to 3000, and both potted and bare-rooted seedlings were being produced. Bare-rooted were primarily for planting by members, whereas potted seedlings were for sale to persons transporting the seedlings before planting them (bare-rooted seedlings need to be planted within a few hours after removal from the seed bed). In the Oku project, farmers also sold seedlings back to

the project for enrichment plantings in the forest. Seedling management was generally good; no problems were reported concerning germination of seeds. However, in the Oku area, there were problems with aphids destroying seedlings in the dry season and survival rates varied between 20% and 90% (median = 60%). Farmers' problems reported in nurseries were the scarcity and high costs of polythene bags, and the high amount of labour required, especially for watering. The Oku and Mt. Ijum projects had originally paid for all cash inputs (seed, bags, and spray) but were in the process of phasing out subsidies.

The high demand for seed and seedlings is reflected by their high market prices. Seed prices ranged from 250 FCFA/kg to 4000 FCFA/kg, but markets are highly imperfect. As mentioned above, farmers in some areas where seed was available were unaware that there was a market for seed. At the same time, organisations and individuals in Bamenda were unable to acquire the quantities of seed they needed. Seedling prices also varied, from 25 FCFA to 250 FCFA, depending on the location and whether the seedlings were potted or bare-rooted. In some places, such as Njinikijem, farmers were also buying and selling wildings.

Planting niches also varied widely. *P. africana* was commonly mixed with other species in woodlots (4 of 10 farmers) on land where crops had not performed well. Other common niches, each planted by 4 of 10 farmers, included in coffee plantations, on boundaries, and scattered in food crops. Most farmers had planted 100 to 200 trees and all but one was still interested in expanding. Survival rates in the field ranged from 20% to 100% (median was 80%). The most important problem was browsing by goats; drought at the time of planting was also mentioned. Farmers were generally impressed with the growth of the trees in their fields; trees reached 3 to 5 m in height after 4 years.

Farmers with mature trees managed them in several ways. Some were cutting branches for axe and hoe handles from trees of about 18 years or older. One farmer pruned his trees frequently, claiming that frequent pruning promoted growth of branches and increased the number of hoe and axe handles available. Only one of six farmers with mature trees had harvested bark, although all intended to. Several farmers were uncertain about their rights to harvest bark from their own trees. They were not clear on whether they needed permission from the government before harvesting. In fact, Cameroonian law is ambiguous about farmers' rights. Although people have the right to harvest products from any tree they or their family have planted on their own farm, it is not clear how they prove that they or their family had planted a particular tree.

Two farmers, one from Vekovi and one from Mendankwe, had had bark exploited from their trees without their permission. In one case, a son had sold the bark without his father's permission and in the other case, thieves had stripped bark from trees at night. One farmer had given bark to a traditional doctor in exchange for a chicken. This same farmer had also allowed bark harvesters to strip bark from his trees in exchange for money. But the harvesters had stripped over 3/4 of the bark off the tree and it was possible that the tree would die. The farmers did not have information about the maximum amount of bark that should be removed or how to remove the bark so as not to injure the tree. Nor did they have adequate information about prices.

In summary, farmers are highly enthusiastic about *P. africana* and several thousand have planted the tree on their farms. The principal problems farmers are experiencing with the tree include stem borer, especially in lower altitudes, aphids on seedlings in nurseries, theft of bark and seedlings, the high cost and scarcity of polythene bags, browsing of newly planted seedlings by goats, and lack of information about rights to remove bark and prices of bark and seeds.

## AVAILABILITY OF MARKETS: INTERNATIONALLY AND LOCALLY

### International demand for *Prunus Africana*

At least 23 different companies sell brand name herbal preparations made from *P. africana* bark. Most of these are based in Europe, with others located in North America and Latin America (Cuningham et al. 1997). Bark processing and the export of bark extract are dominated however by a few main companies. Groupe Fournière (France), which markets the product 'Tadenan', and the Italian companies Indena. and Inverni della Beffa, which produce 'Pigenil', are among the most important.

The future market is a critical consideration, particularly given the relatively long, 12-18 year period before commercial harvest of bark is advisable. Forecasting so far into the future is always uncertain; nevertheless there are several factors which should give reassurance to current and potential growers:

- As prostate gland hypertrophy and benign prostatic hyperplasia (BPH) become more common among men in western Europe and the USA, so will the market demand for treatment of this problem. Phyto-therapeutic treatments for prostate gland hypertrophy and BPH are popular and provide a lucrative market that is likely to grow. Grunwald and Buttel (1996) projected increases in sales of herbal preparations to be 8-15% per year for the period 1993-1998;

- Most *P. africana* based products are currently produced and sold within the European Union and not in the potentially large and lucrative markets of North America and Japan. With the combination of its rapidly growing and lucrative market for herbal preparations to treat prostate problems without surgery, North America is a major potential market for herbal preparations from *P. africana*. Several companies advertise *P. africana* products for sale on the Internet. This is a particularly rapidly growing trend in the USA, where the products can only be sold as 'dietary supplements', pending formal testing as medicines. If the Food and Drug Administration (USA) approves *P. africana* products for sale as medicines, then a big increase in demand for *P. africana* bark can be expected.

Even if the international market for *P. africana* bark were to collapse, farmers would still have a local market for the many other products that this tree produces, including axe and hoe handles, firewood and timber. The local cultivation of *P. africana* also assures local self-sufficiency and possible sales of a popular traditional medicine that has been severely depleted from the wild.

### Local trade in Cameroon

Prior to 1972, only small-scale harvesting of *P. africana* bark occurred for local medicinal use. This changed dramatically in 1972 when Plantecam, a subsidiary of the French company Laboratoires Debat, obtained a monopoly over the commercial trade in *P. africana* bark. Although commercial harvesting started to take place, only Plantecam employees were allowed to harvest bark and they did so in a sustainable fashion. This worked relatively well until 1985 when the Government of Cameroon, under pressure to "democratize" the bark trade, issued additional licences for bark exploitation to 50 entrepreneurs (Cunningham and Mbenkum, 1993). At no stage during this process were quotas based on forest inventories or assessments of sustainable harvest.

From 1985 to 1992, most of the bark sold to Plantecam was from North West Province, Cameroon (Cunningham and Mbenkum, 1993). By 1994, there were 70 permittees in the province and each was allowed to transport 100 tons of bark. Each special-permit holders was supposed to have had a monopoly over bark harvesting in its designated area, but boundaries were ignored. The disadvantage of this system was that there was no incentive for a permittee to seek to maintain stocks in his area. It was effectively an open-access situation. In North West Province, there was a big increase in bark exploitation and many *P. africana* trees were felled, causing considerable depletion.

By the mid-1990s, Mt Cameroon in South West Province became the national focus of bark exploitation, due to the depletion of *P. africana* populations in North West Province. In 1994, this over-exploitation resulted in the Cameroonian government ending Plantecom's monopoly over bark harvest on Mt Cameroon and on bark export. The government issued export licences to three Cameroonian entrepreneurs, reportedly in response to an order they had received for 2000 tons of bark from an Italian company. The result was a spate of uncontrolled bark exploitation, which focussed on the major remaining source of bark in the forests of Mt Cameroon.

Since 2000, the bark market has been characterized by considerable uncertainty . In 2000, Plantecam closed Cameroon's only bark extraction factory and left the country, following the government's reduction in bark harvest quotas. Bark harvests and exports continued, both legally through licensed exporters and illegally (Stewart, 2003). In 2006, CITES recommended that the bark trade be banned until Cameroon developed an effective plan to manage and conserve Prunus Africana. The EU, the destination for nearly all of Cameroon's bark, suspended imports the following year (Stewart, 2009). As of 2010, Cameroon had completed a management plan with the help of several international organizations and was planning to submit it to CITES (CIFOR, 2010).

Farmers who planted *P. africana* in the early 1990s were likely ready to start harvesting and selling their bark around the time the ban went into effect. No information is available on whether or not they started harvesting and marketing their bark or on what their current plans are.

The only analysis of market chains and returns of bark traders was conducted in 1995 (Cunningham et al., 2002). Traders paid bark harvesters 30-70 FCFA per kg of bark and sold to Plantecam, at bark prices ranging from 104 FCFA/kg to 270 FCFA/kg, depending on bark quality and moisture content. Although this margin seems high, traders' costs were also high, including transportation, drying, loss of weight during drying, and interest on capital invested. Net returns as a percentage of capital invested ranged from 13% to 42% over the three months between purchase

and sale, probably not inordinately high, given the high risks traders face and the scarcity of capital in rural Cameroon (Table 6). But market conditions changed considerably after the study was completed: bark from forests became less available, there is no longer any processing of bark in Cameroon, and exports to the EU were suspended . It is therefore not possible to use past data to evaluate current or future marketing conditions.

## CONCLUSIONS

Bark exploitation and forest encroachment have severely damaged wild populations of *P. africana*. Meanwhile, farmers have shown a high degree of enthusiasm for planting the tree on their farms, in expectation of future benefits from bark sales. It is apparent that in Cameroon, the tree has a far brighter future on farmers' fields than it does in forests. Several authors discuss recommendations for maintaining viable populations of *P. africana* in forests, establishing field gene banks for ex situ conservation, and managing bark harvests from wild populations (Besong et al., 1991; Cunningham and Mbenkum 1993; Nurse et al., 1994; Hall and Sinclair 2000; Cunningham et al. 2002; Stewart 2003; 2009; Betti, 2008) In this section, we focus on recommendations for assessing and promoting *P. africana* as an agroforestry tree for small-scale farmers. Our recommendations depend heavily on the EU lifting its ban on importation of Purnus bark, which should happen if CITES approves of Camerooon's management plan for the tree. Provided that happens, actions will still be needed in four areas to promote Prunus Africana as a farmer enterprise in Cameroon:: domestication, understanding farmers' experiences, marketing, and tree tenure:

Domestication research.
Seeds currently being distributed to farmers and planted are from forest trees; no improved planting material is available. The advantage is that a wide range of genetic material has apparently been planted but the disadvantage is that no superior planting material is available. There is evidence of considerable phenotypic, genotypic, and chemical variation among and possibly within *P. africana* populations. This variation offers scope for selecting improved cultivars that are superior to the varieties currently being planted. Critical selection criteria, for which there appear to be much variation, are fast growth, ease of bark removal, and the concentration of active ingredients for treating BPH. Experienced farmers and bark harvesters need to be consulted on desirable selection criteria and the degree of likely variation in tree populations (Cunningham et al. 2002).

Researchers of the World Agroforestry Centre have made considerable progress in vegetative propagation of *P. africana*. Tchoundjeu et al. (2002) have identified the best conditions for promoting the rooting of cuttings, including rooting medium, leaf area of cuttings, and optimum applications of auxin for promoting rooting. They have also been able to reduce the age at which the tree starts to produce seed from 15 years to 3 years through marcotting, that is, a method of vegetative propagation in which roots are inducede to grow on a small branch while it is still attached to the larger tree (Future Harvest 2000). Further research is needed, especially on tree propagation and tree management. Rather than conducting expensive long-term experiments on tree management, researchers could superimpose treatments on farmers' existing stands of *P.*

*africana*. For example, researchers could assess the effect of *P. africana* woodlots on crop yields from a sample of fields by measuring yields at different distances from a woodlot on each field.

Understanding farmers' experiences.
Research is needed to document farmers' experiences planting and managing *P. africana,* their perceptions of the tree's benefits, and the profitability of the tree. Farmers' problems need to be fed back to researchers so that they can solve them or conduct research on the ones they cannot solve. Farmers' knowledge and perceptions, concerning for example, which crops are compatible with the trees, need to be fed back to extension staff and new farmers planting the tree, so that they can learn from previous experience. Finally, as mentioned above, domestication researchers need to know the tree characteristics that farmers value so that they can include them in their selection programs.

Market assessments.
Little information is available about market channels in Cameroon for selling bark and the opportunities available for improving farmers' earnings from bark sales through improved harvesting, post-harvest handling, and marketing. Market chain studies are needed to assess how bark moves from bark harvesters and farmers to the international market, and how government and non-governmental organizations can help improve market performance. A key concern of such studies should be the preferred characteristics of the product at each point of the chain starting with the consumers/users, and processors. Another key question, as bark supplies from on-farm sources increase, is whether it is possible to attract private enterprise, local or foreign, to produce bark extract, as Plantecam did until 2000.

Tree tenure.
Cameroonian law (the 1994 Forestry Law) discourages farmers from planting trees on their farm, because they are only allowed to harvest products from trees they have planted. The problem is that they are unable to prove which trees they have planted, opening the door to exploitation from forestry and other officials. Many farmers believe that they are not allowed to sell bark or other products from *P. africana* trees that they have cultivated. The original intent of the law was probably to protect trees on farm but it is having the opposite effect -- it discourages farmers from planting and protecting trees. Legislation needs be revised to enable farmers to sell products from all trees grown on their farms. They should also be allowed to cut down trees on their farms, as without this right they will be reluctant to plant trees.

In the late 1980s, it seemed reasonable to predict the imminent extinction of *Prunus africana* in Cameroon, due to forest encroachment and widespread debarking. Extensive tree planting by small-scale farmers since then has not only extended the life of the tree in Cameroon, but has given hope that it can play an important and sustainable role in improving the livelihoods of small-scale farmers. Assistance by research and development organizations can help fulfil this promise.

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TABLE 1. DATA USED IN COST AND BENEFIT ANALYSES FOR WOODLOTS OF EUCALYPTUS AND *PRUNUS AFRICANA*, SMALL-SCALE FARMERS, OKU (MONETARY VALUES ARE IN FCFA[1])

A. *Prunus Africana*

| | |
|---|---|
| Quantity of bark harvested/tree ( kg in yr 13) | 6 |
| Quantity of bark harvested/tree (kg in yr 18) | 8.5 |
| Quantity of bark harvested/tree (kg in yr 23) | 11 |
| Quantity of bark harvested/tree (kg in yr 28) | 13.5 |
| Quantity of bark harvested/tree (kg in yr 30, after felling) | 100 |
| No of axe handles/yr/tree (before yr 18) | 1 |
| No. of axe handles/yr/tree (yr 18 and after) | 3 |
| No. of hoe handles/yr/tree (yr 18 and after) | 5 |
| No of hoe handles/yr/tree (before yr 18) | 2 |
| No of trees/ha at planting | 2500 |
| No of trees/0.018 ha(yrs 1-8) | 45 |
| No of trees/0.018 ha(yrs 9-30) following thinning in year 8 | 22 |
| Value of poles/0.018 ha, yr 30 | 12000 |
| Price per poles obtained after thinning | 300 |
| Bark price/kg | 100 |
| Price of Hoe handle | 250 |
| Price of Axe handle | 400 |
| Cost/seedling | 50 |
| Survival rate (%) | 65 |
| Wage rate (labour cost/day) | 500 |
| Land prep. and planting/0.018 ha (hrs) | 2 |
| Weeding and pruning/0.018 ha (hrs) | 3 |
| Debarking time(days)/tree –before year 18 | 0.16 |
| Debarking time(days)/tree –year 18 and after | 0.25 |
| Debarking time (days)/tree year 30 | 0.5 |
| Handle prep. time (days)/tree | 0.25 |
| Salvage value /tree | 5000 |

B. *Eucalyptus camaldulensis*

| | |
|---|---|
| Price for a construction pole | 150 |
| Value of branches per tree for firewood | 50 |
| Price of electricity pole | 1,500 |
| Price of sawing log | 3,500 |
| Price of firewood pole | 100 |
| Discount rate | 10% |
| No. of construction poles//0.018 ha/ yr (yrs 4,8,12) | 122 |
| No of firewood poles/0.018 ha/yr (yrs1-12) | 31 |
| No of construction poles/0.018 ha /yr (yrs 16,20) | 113 |
| No. of firewood poles/0.018 ha/yr (yrs13-23) | 28 |
| No of construction poles/0.018 ha /yr (yrs24,28) | 103 |
| No of firewood poles/0.018 ha/yr (yrs24-30) | 26 |
| No of sawing logs/0.018 ha | 28 |
| No of electricity poles/0.018 ha | 3 |
| % coppices good for poles | 80 |
| % coppice good only for firewood | 20 |
| % of 20-year trees used | 10 |
| Cost per 100 seedlings | 200 |
| Labour cost/day | 500 |
| No of packages of 100-seedlings | 2 |
| No of days for land preparation, 0.16 ha | 1.5 |
| No of days weeding & planting, 0.16 ha | 1 |
| Yield per hectare(kg maize) | 1,000 |
| Area of crop loss ($m^2$) | 520 |
| Estimated crop loss ( %) | 33 |
| Quantity of maize loss (kg) | 17.16 |
| Price of maize | 67 |

[1]$US 1.00 = 490 FCFA (1994)

TABLE 2. *PRUNUS AFRICANA* WOODLOT: COSTS AND RETURNS OF A SMALL-SCALE FARMING ENTERPRISE IN THE OKU AREA.

| | COSTS (FCFA/hectare) | | | | | | RETURNS (FCFA/hectare) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Period (Year) | Seedlings | Land prep. & planting | Weed-ing & pruning | Debark-ing | Handles preparation | Total | Bark sales | Hoe handle sales | Axe Handle sales | Poles sales after thinning |
| 1 | 2,250 | 1,000 | 1,500 | | | 4,750 | | | | |
| 2 | 790 | | 1,500 | | | 2,290 | | | | |
| 3 | 515 | | 1,500 | | | 2,015 | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | 6,600 |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | 1,760 | | 1,760 | 13,200 | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | 1,760 | 5,625 | 7,385 | 18,700 | 27,500 | 26,400 | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | 8,800 | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | 11,000 | 8,800 | |
| 23 | | | | 2,750 | | 2,750 | 24,200 | | | |
| 24 | | | | | | | | | 8,800 | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | 11,000 | 8,800 | |
| 27 | | | | | | | | | | |
| 28 | | | | 2,750 | | 2,750 | 29,700 | | 8,800 | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | 11,000 | 8,800 | |

Net present value = 29,010

TABLE 3. EUCALYPTUS WOODLOT: COSTS AND RETURNS OF A SMALL-SCALE FARMING ENTERPRISE IN THE OKU AREA, NW CAMEROON.

| | COSTS (FCFA/hectare) | | | | | RETURNS (FCFA/hectare) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Time Period (year) | Seedlings | Land prep.& planting | Weeding & Pruning | Crop loss value | Total | Construction poles | Firewood from construction poles | Firewood poles | Electricity poles |
| 1 | 400 | 750 | 500 | | 1,650 | | | | |
| 2 | | | 500 | | 500 | | | | |
| 3 | | | | 575 | 575 | | | | |
| 4 | | | | 575 | 575 | 18,360 | 1,530 | 3,060 | |
| 5 | | | | 575 | 575 | | | | |
| 6 | | | | 1,150 | 1,150 | | | | |
| 7 | | | | 1,150 | 1,150 | | | | |
| 8 | | | | 1,150 | 1,150 | 18,360 | 1,530 | 3,060 | |
| 9 | | | | 1,150 | 1,150 | | | | |
| 10 | | | | 1,150 | 1,150 | | | | |
| 11 | | | | 1,150 | 1,150 | | | | |
| 12 | | | | 1,150 | 1,150 | 18,360 | 1,530 | 3,060 | |
| 13 | | | | 1,150 | 1,150 | | | | |
| 14 | | | | 1,150 | 1,150 | | | | |
| 15 | | | | 1,150 | 1,150 | | | | |
| 16 | | | | 1,150 | 1,150 | 16,920 | 1,410 | 2,820 | |
| 17 | | | | 1,150 | 1,150 | | | | |
| 18 | | | | 1,150 | 1,150 | | | | |
| 19 | | | | 1,150 | 1,150 | | | | |
| 20 | | | | 1,150 | 1,150 | 16,920 | 1,410 | 2,820 | 4,650 |
| 21 | | | | 1,150 | 1,150 | | | | |
| 22 | | | | 1,150 | 1,150 | | | | |
| 23 | | | | 1,150 | 1,150 | | | | |
| 24 | | | | 1,150 | 1,150 | 16,920 | 1,410 | 2,820 | 4,650 |
| 25 | | | | 1,150 | 1,150 | | | | |
| 26 | | | | 1,150 | 1,150 | | | | |
| 27 | | | | 1,150 | 1,150 | | | | |
| 28 | | | | 1,150 | 1,150 | 15,480 | 1,290 | 2,790 | |
| 29 | | | | 1,150 | 1,150 | | | | |
| 30 | | | | 1,150 | 1,150 | | | | |
| Net present value = 37,883 | | | | | | | | | |

TABLE 4: SENSITIVITY ANALYSIS SHOWING THE EFFECT OF CHANGES IN KEY VARIABLES ON NET PRESENT VALUES FOR *PRUNUS AFRICANA* AND EUCALYPTUS ENTERPRISES

| VARIABLE/ENTERPRISE | Net Present Value (FCFA) | | | |
|---|---|---|---|---|
| Discount rate | 10% | 20% | 30% | |
| *Prunus africana* | | 29010 | 302 | -3887 |
| Eucalyptus | 37885 | 16565 | 9161 | |
| Bark price | | | | |
| *Prunus africana*: | | | | |
| 50% increase | 34985 | 1543 | -3547 | |
| 50% decrease | 23036 | -939 | -4226 | |
| Construction pole price | | | | |
| Eucalyptus: | | | | |
| 50% increase | 55855 | 24988 | 14087 | |
| 50% decrease | 19911 | 8141 | 4235 | |
| Labour Cost | | | | |
| *Prunus africana*: | | | | |
| 50% increase | 25523 | -1945 | -5699 | |
| 50% decrease | 32498 | 2548 | -2074 | |
| Eucalyptus*:* | | | | |
| 50% increase | 37108 | 15870 | 8532 | |
| 50% decrease | 38658 | 17259 | 9790 | |

TABLE 5. SELECTED PROJECTS ASSISTING FARMERS TO PLANT *PRUNUS AFRICANA* AND NUMBERS OF FARMERS PLANTING, NORTH WEST PROVINCE, CAMEROON. 1995[1]

| Project or NGO | Area | No. farmers planting in the project | No. farmers planting outside of the project | Total numbers of farmers planting |
|---|---|---|---|---|
| Kilum Mountain Forest Project | Oku area, Bui Division | 350 (35 nursery groups) | 1050 | 1400 |
| Ijim Mountain Forest Project | Ijim Mountain Forest Project | 600 (60 nursery groups) | 600 | 1200 |
| Helvitas Watershed Conservation Project | Bambui, Belo, Guzang, Nso, Biamey, Besiavum | * (9 nurseries in Bambui alone) | * | * |
| Rural Training Centre, Mfonta | Sites throughout province | 600 (200 farmers/ year have received seed since 1992) | 600 | 1200 |
| Trees for the Future | Nso, Bui Division | 470 | 470 | 940 |
| None | Mendankwe, Mezam Division | 0 | 50 | 50 |
| Total | | 2020 | 2230 | 4250 |

1 * = no estimates available. Numbers of farmers planting in projects are from project records; numbers planting outside of projects are estimates from key informants.

TABLE 6. COSTS AND RETURNS FOR A SPECIAL PERMIT HOLDER TRADING IN PRUNUS AFRICANA BARK, BAMENDA, CAMEROON, 1995.

**COSTS (FCFA)**

| | |
|---|---|
| Buys 16.5 tons wet bark at 70 FCFA/kg | 1,155,000 |
| Collection costs | |
| 2 laborers for 1 month 500 FCFA/day | 30,000 |
| Transport to organize collection (500 km at 200 FCFA/km) | 100,000 |
| Transport Banso-Bamenda (50,000/11 Tons) | 75,000 |
| Drying costs (1 labourer for 1 month 500 FCFA/day) | 15,000 |
| Transport Bamenda-Mutengene 250,000/11 Tons) | 250,000 |
| Tax (2 shs/kg) | 22,000 |
| Miscellaneous (10%) | 165,000 |
| Interest on capital (10% for 3 months) | 181,000 |
| Total costs | 1,993,000 |

**RETURNS (FCFA)**

| | |
|---|---|
| Scenario a) Revenue earned from sale of 11 tons (250 FCFA/kg dry bark) | 2,750,000 |
| Net returns (Revenue minus costs) | 757,000 |
| Net returns as percentage of capital invested | 42% |
| Scenario b) Revenue earned from sale of 11 tons (200 FCFA/kg dry bark) | 2,200,000 |
| Net returns (Revenue minus costs) | 270,000 |
| Net returns as percentage of capital invested | 13.5% |