International Journal of Social Forestry (IJSF), 2009, 2(1):67-85
ISSN 1979-2611, www.ijsf.org

THE POTENTIAL OF *IRVINGIA GABONENSIS*: CAN IT CONTRIBUTE TO THE IMPROVEMENT OF THE LIVELIHOODS OF PRODUCERS IN SOUTHERN CAMEROON?

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Abstract
Non Timber Forest Product (NTFP) processing in Cameroon is still limited to traditional commerce, which mainly involves the supply of raw materials. Furthermore, lack of knowledge on the availability of NTFPs in their biotope does not allow for accurate planning to ensure sustainable management and their contribution to the fight against poverty. Based on a survey carried out in cocoa agroforests in Southern Cameroon and an evaluation of Irvingia gobonensis kernels processing chain, we argue that, on the one hand, the resource is not as abundant as is generally thought and that processing can improve incomes of households at local, national and even regional levels on the other hand. Processing of I. gabonensis kernels and consumer reactions to the derivative products are also discussed. It will also be illustrated that, with results from laboratory analyses, the further-processed products are of good quality and are safe for human consumption.

Keywords: *irvingia gabonensis, NTFP, sustainable management, agroforestry, processing, commercialization, health, Cameroon.*

Background and Problem

Since the 1992 Earth Summit held in Rio de Janeiro on biodiversity, more attention is being paid to Non Timber Forest Products (NTFPs) globally. They have several names: Non Wood Forest Products (NWFP) (Tchatat *et al.*, 1999), local products or special products (MINEF, 1994), minor products or secondary forest products (Charles 1998). These terms refer not only to products of a biological origin, but also to timber, forest further-processed products, woodlands and trees beyond the forest (FAO 1999). NTFPs include

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fruits, seeds, nuts, exudates, barks, game and its derivative products, and are used as food, medicine, fodder, timber and craft wood, decorative plants or shade plants (Vivien & Faure 1996, Ndoye *et al.* 1997). They constitute a significant source of income for the people (Ndoye 1995, Ndoye *et al.* 1997).

Given the fall in cocoa and coffee prices and the devaluation of the CFA franc in 1994, the demand for NTFPs has sky rocketed significantly (Bikié *et al.* 2000), leading to intense and abusive exploitation of some resources; this, in turn, results in their progressive extinction, hence the need for sustainable management. Conservation strategies centre on two elements: the inventory that makes it possible to verify wild stock; and the non-consumptive utilisation of products which is instrumental in preventing post-harvest losses. Nowadays, agroforestry is providing solutions and, for several years now, some institutions such as the World Agroforestry Centre (ICRAF) are trying to identify and domesticate priority species in West and Central Africa. To this effect, seven species have been identified: *Irvingia spp., Dacryodes edulis, Ricinodendron heudelotii*, *Chrysophyllum albidum, Garcinia kola* and *Cola spp.* (Tchoundjeu *et al.* 1998). From the ranking exercise, *I. gabonensis* was classified at the top.

I. gabonensis is a very important species to the people of the humid forest zones of West and Central Africa; its bark is an excellent medicinal product (Van Dijk, 1999), the mesocarp of its fruit is consumed fresh and the kernels extracted from the fruit are used as basic soup ingredients. These kernels are often converted to paste (Etima ando'o in Bulu and odika in Gabon). A type of oil is extracted from the hot almond paste and can be used as a cosmetic product, as food or in pharmacopoeia**.** There are primarily two species of kernels: *I. gabonensis* whose fruit mesocarp is edible and *I. wombulu* which is less consumed because of its bitter mesocarp. Ndoye *et al.* (1997) reveal that *Irvingia* spp. kernels rang among the first four NTFPs exploited at the national level. This product is sold in sub-regional (Gabon, Nigeria and Equatorial Guinea) and European markets (Tabuna 1998).

In 2000, Tchiegang *et al.* noted that in developing countries the problem of developing local products is compounded by the lack of knowledge on their potential and the undervaluation of their impact on the national economy. The existence of many marketing levels results in major incomes losses for farmers who are at the very bottom of the chain. They sell them in their raw state and at low prices meanwhile some urban based merchants sell them in a semi finished state at more reasonable prices. In the Mfoundi market in Yaoundé, a kilogram of processed (into cakes) *Irvingia kernels* sells at 2, 510 FCFA, while raw kernels sells at 1, 900 FCFA (Manirakiza 2002), that is a difference of 32.1 %. From the foregoing, it is logical to seek an explanation for the low enthusiasm observed in the processing of the bush mango. Besides, in a natural environment, is there any potential likely to support processing on a

large scale today? We will first try to show the current potential in the cocoa agroforests of Mkoemvone village (southern Cameroon), next the converting processes and finally the market value of *I. gabonensis* derivative in order to highlight the negative forces hampering this sector.

Study Area

The study was carried out in Southern Cameroon, more precisely at Nkoemvone and in the city of Ebolowa. Nkoemvone is about fifteen km from the city of Ebolowa. This city is situated at longitude 2°49′ North and latitude 11°08′ East, in the heart of the tropical rainforest. With respect to climate, this locality belongs to the traditional Guinea type equatorial climate, characterised by heavy rainfall and average temperatures below 20° C.

There are many reasons for choosing Nkoemvone village as the study area. The first reason takes into account the fact that this rural area has a processing unit for NTFPs among which is *I. gabonensis*. Secondly, the village is situated between the provincial capital of the South and the neighbouring Abang Minko and Kye-Ossi markets.

Methodology

Material

In order to carry out this project, we used a 50m long decameter to measure surfaces, a girth tape to measure the DBH (Diameter at the Breast Hight) of the trees inventoried, a machete for weeding and setting up plots, three rolls of 200m long binding thread each to mark off the surfaces to be inventoried, a scale to measure the quantity of processed products and biological material such as kernels.

Procedure

Assessment of the Availability of I. gabonensis in Cocoa Agroforests

The systems in which the inventories are carried out were chosen from among agroforests. This study was carried out in two stages. Firstly, we set up 200m x 40m quadrats subdivided into two 200m x 20m subquadrats on an area of 10.4 ha in the cocoa agroforests. Next, we effectively counted and measured the tree DBH followed by a floristic survey of all timber species with a view to estimating the proportion of NTFPs in comparison with all the timber found in the agroforests inspected. Considering the irregular surface of this plant formation, we decided to set up one more quadrat in each agroforest. The sub quadrats were set up on either side of a plumb wire stretched over a 200 m distance, measured using a double decameter and demarcated by a wire. With reference to the floristic survey, a 25m x 25m quadrat was adopted for each cocoa plantation and this study was carried out in 16 agroforests. Two local guides contributed their knowhow to the

realisation of this task. The targeted species in the quadrats were counted and their DBH measured using an area tape. The rest of the timber species in the cocoa plantation were counted and their circumferences measured.

Data Collection, Seeds Processing Methods and Data Analysis

In the Ebolowa area, questionnaires were designed and distributed to a sample of 100 consumers of wild mango kernels, 25 years old and above. This age grouping was chosen for results reliability reasons. The questionnaires contained questions relating to the different ways *I. gabonensis* products are used, their supply, preservation and quality. As far as processing evaluation is concerned, a suitable questionnaire was distributed to members of CIGs involved in that activity. During the kernel processing phase, the various stages were respected, the material used indexed, their prices and production time noted. This information helped in assessing the profitability of the finished product (*I. gabonensis* cake and flour). This involved assessing all production costs, noting the sales prices and calculating the marketing margin (MC) using the formula: MC = PV – PR where PR is the Markup Price, and PV the Sales Price. The depreciation of the material used was estimated and the post depreciation Value-Added obtained by the formula: MCn = MC– Am; Am for Depreciation, MC for Marketing Margin and MCn for Net Marketing Margin. To evaluate the quality of I. gabonensis products, the surveys carried out on consumers revealed their quality preferences and the shelf life of the product. Samples of products transformed and packaged by the CIGs were left at room temperature away from moisture for three months. Next, they underwent microbiological analyses several times and at their expiry date at the Centre Pasteur in Yaoundé. These analyses were welcome as they gave the chance to know whether the product, during processing, was free from microbial infection and if its sanitation was *de rigueur*. For data analysis, Excel and SPSS were used. For inventories, the following indexes were used:

- The total number of individual (N) species within a community. This is the total number of trees of this species in that community.
- The density (D) of the species which is the total number of trees/ha;
- The area in ha (S); D=N/S. These diameters were grouped into different classes (Zapfack 2005).

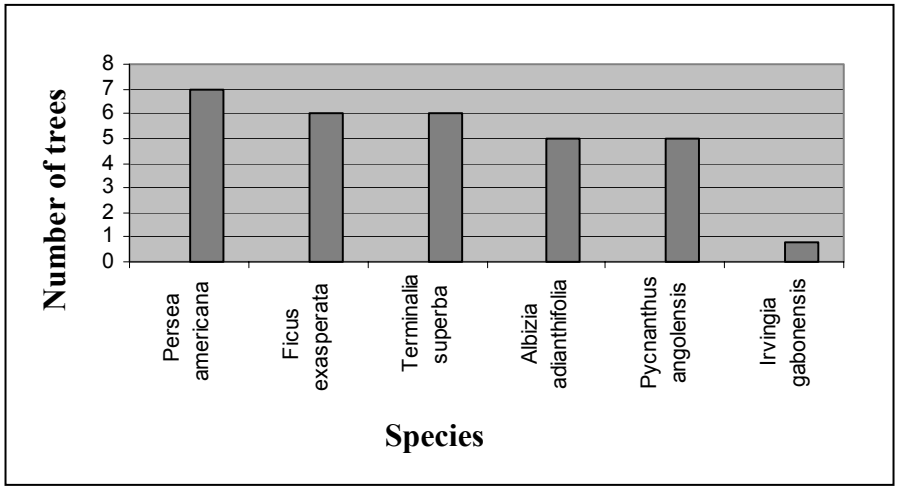
Research Results

Inventories

The analysis of data obtained in the Nkoemvone cocoa agroforests reveals that on a total surface of 10.4 ha, nine *I. gabonensis* trunks were observed, that is less than a trunk per hectare. These results indicate that this species is sparsely present in the Nkoemvone agroforests. Similar results obtained on *I. gabonensis* by Zapfack and Ngobo (2000) at Djoum, and Van Dijk (1999) in the

Bipindi area, Akom II, reveal a low density of this species in anthropogenic formations. According to these authors, human action might be the cause of this low density. In effect, these agroforests are old systems dating back to at least 35 years. When these farms were created, the exploitation of these species was negligible. They were primarily used as food and eventually in traditional pharmacopoeia. The farmers overlooked the commercial value of *I. gabonensis*. Therefore, we can logically consider two hypotheses namely, that some trees were felled when the system was created and that others were destroyed when the young cocoa trees were growing. These farmers maintained but a few individual plants in this cropping system, meant only for consumption. In addition to *I. gabonensis*, other timber and non timber species are present in the cocoa plantations. About 63 species were identified on the parcels of land explored.

Figure 1: The Density of *I. gabonensis* and Other Species Most Common in Cocoa Agroforests.



The most common species of this system (Figure 1) have a representativeness of at least five plants per hectare. *Persea americana* ranks first with seven trunks per hectare, followed by *Ficus exasperata* and *Terminalia superba*. However, in spite of its importance to the population, *I. gabonensis* (Figure 2) has at least one tree trunk per hectare. This species is included in the preceding diagram as a guide.

Figure 2. *Irvingia gabonensis Tree*

Note: Picture from A. Djouguep

Percea americana is an edible exotic fruit tree with a very short conservation period. The leaves of *Ficus exasperata* serve as a sponge for washing dishes in households. *Terminalia superba,* serves as timber when mature.

In effect, viewed generally, the majority of these species are useful, but not as much as *I. gabonensis.* Although not ranking first, it is still present as shown in Figure 1 above. Individual *I. gabonensis* studied have diameters ranging from 1 and 80 cm. They figure among the small diameter class; this shows that they are progressively regenerating. Their young plants would benefit from retention and maintenance, a conservation method used by most farmers in Cameroon (Ayuk *et al*. 1999).

Production, Processing and Conservation of I. gabonensis Kernels

Farmers in southern Cameroon use NTFPs either as food or for commercial purposes. For this reason, they endeavor to upgrade them during conservation in order to make some profits. Such is the case of *I. gabonensis* exploiters. The seeds or kernels of this species are transformed into cakes and then into flour. This flour is packaged to make it more attractive (Figure 4). Regarding distribution of the product, it is done locally around Ebolowa. The local organisations, the CIGs that do not as yet have partners outside the city of Ebolowa deliver the product to a local supermarket when ordered. The members of these CIGs equally engage in direct sales. The supermarket

occupies a strategic place in the distribution circuit given often patronized by inhabitants and visitors of the city. *I. gabonensis* products can be conserved as seeds, cake or flour. During the harvest period that generally occurs from June to September, to ease the gathering of the fruits, farmers clear around the foot of the tree, an area equivalent to the vertical projection on the ground of the crown of the tree. Picking is not practiced because of the height of the trees (30 m or more). Each time farmers stop by the foot of the tree, they gather fallen fruits and take them home. This harvesting method has little or no effect on the survival or regeneration of sample units. Healthy *I. gabonensis* fruits (Figure 3) are sorted for consumption or sales, while the less attractive ones are directly split open or piled so they get soft to be cracked later. It is important to note that the seeds of consumed fruits are equally extracted from the endocarp. The decomposition of the mesocarp eases kernel extraction because the endocarp becomes more visible and thus easy to crack. The endocarp is split open along a more fragile longitudinal line (Figure 3) with a knife or machete. The kernel surrounded by a dark brown coating is exposed.

Figure 3. *Irvingia gabonensis* Fruits.

Note: Picture from Institut de Recherche Agronomique et Forestière (IRAF) du Gabon

The *I. gabonensis* kernels obtained are sold fresh or dried either after dry off or exposure on wickerwork shelves, with or without the seed coat. The farmers we interviewed noted that the seeds must be dried off when the sun is mild. They appear white while those dried on wickerwork shelves become black from smoke. This drying is an important operation because it prevents bleaching and the risk of a fungal attack during storage. The processing of seeds into cakes is done both in households and in CIGs factories. The dried

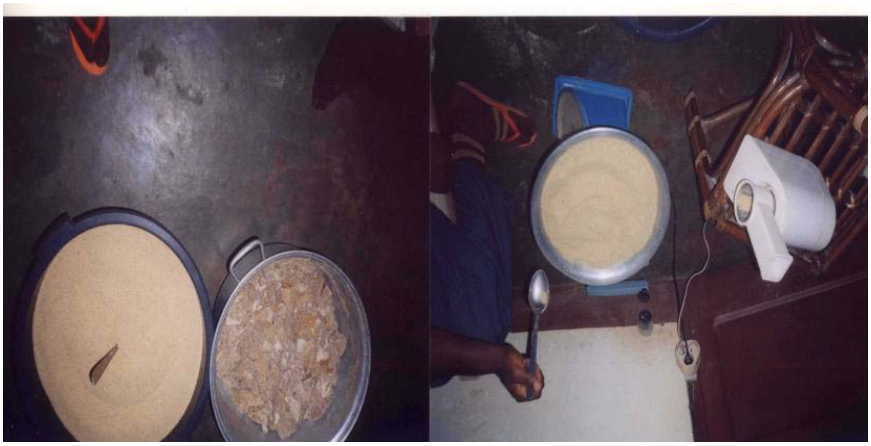
seeds are sieved; those dried with the seed coat are washed to take out the coating and then dried. The seeds are baked in two ways: a few drops of palm oil are sprinkled on them or they are completely immersed in oil heated for about 5 minutes to an average temperature; this second method is very delicate and more time consuming. The heated seeds are later pounded hot in a mortar or ground cold in a machine. The resulting paste is placed in a mold and heated for 24 or even 48 hours. As soon as the paste becomes hardened, it is removed from the mold (Figure 4a). The cake thus obtained is called "Etima" in Bulu. In households, the seeds are pounded hot in a mortar, while CIG members let them cool for 5 hours with the aim of grinding them in a machine to obtain the cake (Figure 4a). The digestive enzymes in the seeds are inhibited by the heating. However, the chemical reactions that take place during heating are a cause for concern as they may affect the quality of the seeds.

Figure 4a. *I. gabonensis* Kernels and Cakes

Note: Picture from IRAF

The last stage of processing consists of grating the *I. gabonensis* cake and packaging the flour (Figure 4b and 4c) thus obtained. After processing is over, the derived product is either taken to the market or directly consumed. In households, the cake is transformed into flour just before boiling with a grating machine. CIGs break the cake into small pieces, which are put in an electric grater that cuts them into fine particles (Figure 4b).

Figure 4b**.** *I gabonensis* Flour and Grinding Machine



Note: Picture from A. Djouguep

This flour is then be parceled in sachets. The flour is generally put in plastic wrappings using a ladle, and then the entire packet is weighed to obtain the desired net weight. These sachets are double coated in order to insert labels, and then sealed with a laminator. The flour obtaining and parceling process shows three processing and conservation levels.

Conservation of I. gabonensis Kernels and Derivative Products

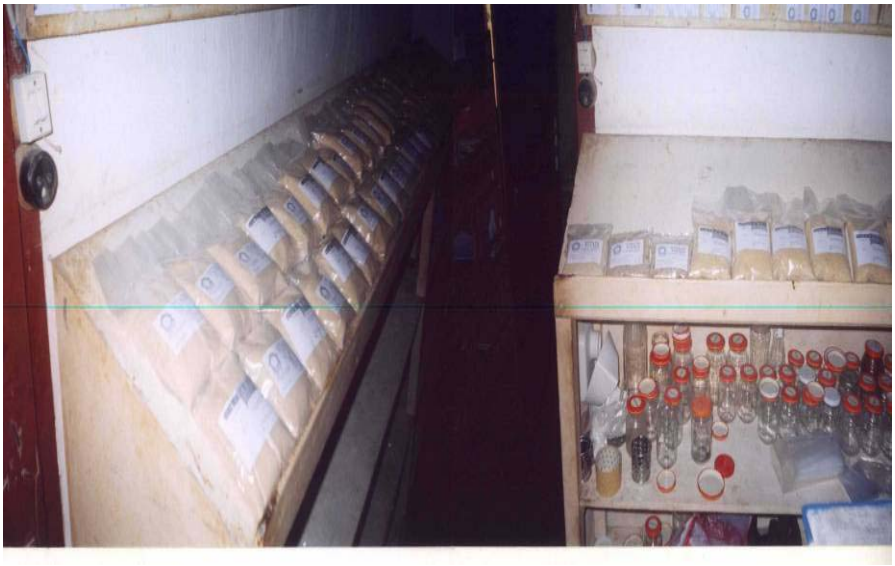
The first conservation method consists of storing the kernels. It can be done in two ways: Dried kernels are put in a bag and a plastic is placed at its opening and hermetically sealed before being preserved in a granary or in a storage room. Besides, the kernels can be put inside a "*dame-jeanne*" (a glass container) before being subjected to the same process. To prevent moisture, the bag should not touch the ground. Kept in a storage room, these kernels would be dried after every two months by mild heat from the sun, while in the granary, drying poses no problem. Based on this method, the average seed conservation period by the farmers ranges from 6 to 12 months. Ayuk et *al*. (1999) demonstrated that if they are totally dry, whole *I. gabonensis* kernels may be preserved for more than a year. Nevertheless, these kernels are liable to attack by insects (weevils) such as *Oryzaphilus mercato* grain beetles (Ainge & Brown 1998). Some farmers claimed to have encountered problems relating to weevils and mold during storage. Concerning consumers of *I. gabonensis* kernels, 39% of people conserve them for 1 to 6 months and 7% do so for more than 12 months (Table 4). In the cases of 100% of consumers who preserved these kernels beyond 12 months, the latter remained in good condition.

The second seed conservation method is reducing it to paste to form a cake (Figure 4a). This paste may be preserved in or out of cakes. Like the

kernels, the paste can also be attacked by mold or weevils. The conservation period of this paste varies with consumers: 39% of persons interviewed conserve it for periods ranging from 6 to 12 months. The limiting of the conservation period of this product by consumers to 12 months is not always as a result of conservation problems, but it is imposed by stock-outs. Consumers have a stake in storing this product for long periods because if they are uncertain as to the level of abundance of the product during the coming season, they are always convinced the new product would find its way into the market at any time.

The third conservation method consists of transforming kernels into powder (Figure 4c). It looks more elaborate and its packaging apparently protects it from various biological attacks. Unfortunately, only 11% of consumers buy *I. gabonensis* in this form. Many people do not buy it either as a result of ignorance of its existence or because of its high cost as compared to that of kernels and cakes. Among flour preserving consumers, 20% revealed they do so for up to 6 months and 20% for more than 6 months. Others, mostly salaried workers, (at least one member of a working family) are more oriented towards immediate consumption, which explains the high percentage of flour conservation observed in 6 months. Some consumers who think the majority of processed kernels have lost their quality as a result of biological attacks do not really like the further-processed products (cakes and flour).

Figure 4c. Processed *I gabonensis* Flour



Note: Picture from A. Djouguep

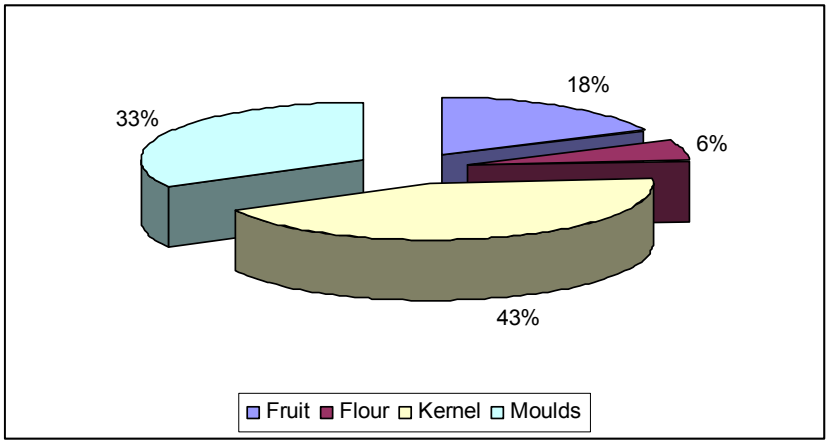
Tchoundjeu *et al.* (2005) show that, 78% of farmers conserve *I. gabonensis* kernels for less than a year. This visible difference is the result of the fact that these authors worked with the farmers gathering the fruits while the data used to get these results were obtained from consumers, the majority of whom get their food supply primarily from the market.

Marketing of I. gabonensis and Consumer Preferences

The sampling of consumers in Ebolowa comprised 76% women and 24% men. This high percentage observed in women reflects their desire to answer questions and their enthusiasm for local products. These results almost parallel those of Ndoye *et al*. (1997) in whose case about 96% of people involved in the use of NTFPs are women. The difference in percentages arises from the fact that the data of this work was obtained from consumers while Ndoye *et al*. (*op cit*.) dealt with traders. The people use the fruits, bark and leaves of *I. gabonensis* as food, medication, fuel or as a source of income. The fruits are the part mostly used: as food (72.9%), as a source of income (14.3%), as a source of oil (1.6%), as firewood (0.8%); its bark and leaves are the least used (10.5%). The fruit's mesocarp is directly consumed since its juice is sweet. The endocarp contains the kernels which are a significant source of food and income for households. They are used to thicken soup and are thus a primary ingredient (the Ndo'o sauce prepared with either meat or fish). The oil extracted from the kernels is not well known in the locality and the use of the other parts - the leaves and bark- in traditional pharmacopoeia is almost negligible. Boiled and used as mouthwash, these latter parts reportedly treat toothache, while the dried seed coat is used as fuel. For the people of this locality, a significant agroforest achievement would be the vegetative propagation of *I. gabonensis*, having bulky fruits that will produce large kernels that they value. Ndoye *et al*. (*op cit*.) demonstrate the significance of these kernels in Cameroon and the Central African subregion, while Tabuna (1998) does the same in Europe. ICRAF has developed vegetative propagation methods for these species aimed at speeding up production time while retaining the most important genotypes and phenotypes.

The products sold or consumed by the persons interviewed came from markets (48%) and farms (34%) respectively, and a few were gifts or bought from grocery stores (17%). The market is therefore the main source of food supply for 48.4% of persons interviewed. This might be explained by the fact that being close to a rural area, the population of Ebolowa, for the most part, is made of civil servants. In the markets, *I. gabonensis* kernels are sold in the form of kernels as well as cakes and flour, their derivative products. The kernels outnumber the cakes and flour, obtained after processing the former. On the average, the people buy 43% in kernels against 33% in cakes 18% in fruits and 6% in flour (Figure 5).

Figure 5. Marketing of *I. gabonensis* Products, According to Their State of Transformation.



There is a close relationship between the purchase rate and the degree of knowledge of the various products in the market. Insufficient promotion of this recent initiative and the low production deemed inadequate in relation to demand may explain the really low representativeness (6%) of flour. The high demand for kernels may, among many other reasons, be primarily due to: food security (22%), health security (26.7%), and lack of information on marketed derivative products (28.2%). Actually, many people use these kernels because they are relatively less expensive. Cakes are in high demand because of their conservation advantage (58%) and usability (22.3%). Flour is sought after, because of its great usability (64%) and its packaging (27%).

In the market, the availability of the different forms of the product varies according to the seasons, and kernels remain the form that is most abundant and most bought. This variation is inevitably reflected in the prices and that is why further-processed products (cake and flour) of *I. gabonensis* kernels are more expensive. In times of shortage, a kilogram of kernels may sell for up to 1,665 CFAF against 865 CFAF during periods of abundance. Such is not the case for flour whose price is higher but stable. The comparison of the prices of different products of same quantity shows that flour is the most expensive product while kernels are the cheapest. A kilogram of kernels costs about 1,700 CFAF during times of shortage against 2,500 CFAF for cakes and 2,860 CFAF for flour. These different products go through many stages before getting to consumers.

Profitability of New Products Obtained from the Processing of Irvingia gabonensis Kernels

The kernel processing task demands a lot of time and effort. If we take into consideration the time spent, the profitability appears to be not proportional to the sacrifice made. This is due to the insignificant quantities resulting from low processing techniques. A real profit would certainly come from improved equipments and great quantities of flour. It cost 22,395 CFAF and took six (6) days of work to process 14 kilograms of *I. gabonensis* kernels. The production cost provided a way to calculate the net marketing margin; this quantity of kernels was processed many times and during the same timeframe. The average annual expenditure of a CIG relative to seed flour production is about 468, 695 CFAF. The packaging of 14 kilograms of processed kernels required about sixty plastic wrappings and printed and multiplied labels. The flour is packaged in packets of 175 g, 350 g and 700 g, then distributed in Ebolowa in grocery stores or sold directly to consumers by the members of the CIG. These products were sold for about 40,000 CFAF each month. The farmers' production card showed an annual value of 293 kg of *I. gabonensis* flour for an income of 837, 142 CFAF. These different values eased the calculation of the gross marketing margin by the formula MCb = PR – CT where MCb stands for the gross marketing margin, PR for cost and CT for processing cost.

MCb = 17, 605 CFAF

MCb / year =368, 448 CFAF

The material used in processing *I. gabonensis* kernels includes, on the one hand, small materials (Colander, Stockpot, Ladle, Cuvette and Saucepan) that can be replaced at any moment, and, on the other hand, big materials (Scale, Electric chopping machine and a packaging machine) which can be replaced after 5 years. This equipment and its related prices obtained from the market provided a way to find the depreciation value which is 19,200 CFAF calculated according to the formula: Tc = 1/N, where N is the material's life span.

The net marketing margin (MCn) is calculated by the formula:

MCn = MCb – A

MCn / year = 349, 248 CFAF

That is a marketing margin of 1, 192 CFAF/Kg per month.

Though the current profit can be considered not so important by some external actors, it is considerable for the farmers who indicated that with the money they receive from that business, they are able to solve several problems, such as school fees and heath of family members. As it is easier to conserve derivative products, they can sell them along the year, which is a great advantage. It should be noted that, in addition to these activities, those farmers are always engaged in other income generating activities.

Quality of I. Gabonensis Further-Processed

The quality of the products was determined based on the opinion of consumers and micro biological analysis. According to consumers, recognising the product's good quality is contingent upon many criteria that differ with individuals. The first group of criteria concerns the appearance as well as the colour, thickness, degree of moisture (mildew), parasite induced perforation, shape, resistance and finesse of the product. The second group of criteria is invisible, and relates to odour and taste (Table 1).

Table 1. The Consumer Preferences on Different Products (%).

Quality Criteria	Kernels	Cakes	Powder
Colour	59	51.9	61.5
Odour	16	1.9	7.7
Taste	7.9	25.5	-
Size	4.9	-	-
Mildew	7.2	7.5	-
Perforation	5	13.2	-
Fineness	-	-	7.7
Package	-	-	23.1
Total	100	100	100

The product nothwithstanding, the consumer's choice is primarily based on colour (59, 51,9 and 61% respectively for kernels, cakes and powder). Based on the colour of the kernels, he can determine the drying method (sun, wickerwork shelf). Regarding the flour and the paste, their colour depends on the degree to which the kernels were heated, and it makes it possible to determine if they are glutinous (pale, when underheated) or not (dark, when overheated).

The results of microbiological analyses of *I. gabonensis* flour, carried out at the Centre Pasteur in Yaoundé revealed aerobic flora, total coliform counts and heat-resistant coliforms were missing. Yeast, mildew, Bacillus, pathogenic staphylococcus, sulfate-reducing anaerobes and Salmonella were absent in the samples analysed. In view of these results, the quality of this product is satisfactory and it is therefore fit for consumption. However, given the short duration of our internship, the analyses on *I. gabonensis* flour preserved for more than 4 months were not carried out as required.

Discussion

Rational Use or Waste of Resources

Some farmers increase the value of their production by transforming untreated products into high value-added products and by obtaining more marketable products from the same land surface. This is the case with these farmers for whom the fate of NTFPs begins with the gathering of fruits (Tchatat 1999), picking or debarking (Nguedje 2000). The *I. gabonensis* fruits are gathered by the farmers and no fruit is left at the foot of the tree during the harvest season. These products are collected and conserved by the latter for future consumption and/or for a subsistence economy; this effort, however, is not a cause for concern. Fruits gathered from the farms are sold fresh, eaten or left to putrefy. The farmers who leave their fresh fruits to putrefy lose their juice while the kernels of fruits sold fresh are equally lost. Fresh kernels are directly eaten, sold, conserved as they are or processed. They are often conserved under poor conditions and are susceptible to biological attacks. In this case, they increasingly are not meeting the demands of the market since the quality drops with time. It is proper, in view of the pain the producers undergo in the production of the African mango, that the price of this product be increased. According to Awono *et al*, however, the average price per bag (2002) is 106, 760 CFAF, which is twice higher than the value of a bag of cocoa: 40, 000CFAF. This explains why the women sometimes cover very long distances to find Ndo'o.

Regarding processing, it is done on a very limited scale; cakes are made in households solely for direct consumption while the flour is produced in an old-fashioned manner in CIGs for commercial purposes. It is true that processing kernels into flour is more profitable to farmers, but gathering and hulling are so tedious to the extent that many farmers prefer to stop at this point.

Major Obstacles Identified in the Exploitation of Irvingia in Southern Cameroon

There are many obstacles to the production and distribution of bush mango kernels in Cameroon. *I. gabonensis* stems are lacking in the production zones. This explains why producers generally walk long distances to obtain large quantities. Furthermore, this species bears fruit following the natural cycle. Consequently, supply is unstable. In view of the central role played by this product in the economy of households in the rural areas of the regions sampled (Schreckenberg *et al.* 2006, Leakey *et al.* 2003, Ndoye et *al.* 1997) already estimated that the marketing of four NTFPs (*Dacryodes edulis*, *Irvingia gabonensis*, *Cola acuminata* and *Ricinodendron heudelotii*) in Cameroon and neighbouring countries involved 1, 100 traders and US$ 1.75 million in the first half of 1995. This illustrates the extent to which instability in production

could affect social equilibrium. Moreover, the tools used in the production of *I. gabonensis* kernels are undeveloped, thus extending production time and increasing production costs. Lastly, the systematic gathering of fruits that fall after maturity especially limit the natural regeneration of the species.

Conclusion

The density of *I. gabonensis* in the cocoa agroforests proved to be low. Given the importance of this species in the lives of the people and in view of the role it plays in the economy of households in the South, their exploitation stretches in the native forest where lots of them are gathered indiscriminately. This situation underscores the necessity to integrate these and other important local species into different cropping systems in order to reduce the pressure on the species in the native forest. *I. gabonensis* provides various NTFPs: leaves, fruits, barks, which are useful to the people as medication, food or fuel. The fruit is the most important part because of its endocarp that provides the seed and its further-processed products: cake flour and oil. The purchase ratios of these projects are: 43% for kernels, 33% for cake and 6% for flour. Generally, the seed's price is lower than that of its derivative products and cherished by housewives. Although they are more costly, the paste and the flour offer the advantage of reduced cooking time. To ensure that demand is maintained through out the year, producers have developed conservation techniques primarily based on draining. The description of the product's procession stages shows three conservation levels: the kernels, the cake and the flour. This work is not really energy demanding, but time consuming as a result of the inadequate material used by the farmers. These difficulties notwithstanding, Nkoemvone farmers have improved in the packaging of seed flour; this improvement made it possible to increase sales prices, although these do not completely cover processing costs. It is therefore important to increase production capacity, and to extend its distribution to other cities and regions since, given its value, *I. gabnonensis* might rang among cost-effective products. According to consumers, quality analysis revealed that a good product can be known by many criteria and that sole colour criterion applies to kernels and to their further-processed products. According to consumer and trading standards, the seed flour's quality is satisfactory and its expiry date remains known. Nevertheless, the result of the micro biological analysis of a four-month flour sample illustrates the product's resistance during this period. The processing of *I. gabonensis* kernels provides more information on this product and underscores its importance to the neighbouring people who are the primary beneficiaries. Efforts must be made to see that these products in particular and NTFPs in general are ecologically sustainable, economically viable and attuned to the socio cultural practices of the people.

Recommendations

Recommendations likely to contribute to the improvement of the *I. gabonensis* subsector equally reflect the necessity of increasing the natural potential while improving the quality and the volume of the further-processed products, in order to meet the marketing standards capable of guaranteeing cost effectiveness:

It is paramount that the farmers be trained on modern asexual propagation techniques such as layering or grafting in order that this specie is integrated more easily into agricultural land bases, giving farmers more opportunity to make their project of creating useful species agroforests a reality.

The state should therefore pay great attention to initiatives relating to the processing of bush mango by volunteers who are financially weak by channeling investments into this sector, and encouraging efforts that would lead to the modernisation of processing units that may thus become modern companies capable of offering many jobs to youths.

It is also vital that the state implement an incentive-based policy in the NTFP products processing sector in general and for bush mango in particular by reducing the heavy taxation that is weighing down on the sector.

An effort should be made by the different actors to improve the distribution of the derivative products, supplying as much information as possible. It is by this means that the promotion of new products may be ensured. The laboratory analysis of these further-processed products should run its course, especially the one relating to their expiry date which we could not carry out since we did not have much time.

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