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Uses, management and economic potential of *Irvingia gabonensis* in the humid lowlands of Cameroon

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Abstract

Irvingia gabonensis is one of the most preferred tree species by farmers in the humid lowlands of Cameroon. The kernel of the species figures prominently in international trade in West Africa. Although there exists empirical data on the volume of international trade of the kernel, no data are available at the farm-level. The species generally grows in the wild and very little efforts have been made to domesticate it. As part of a prioritization exercise a field survey was undertaken to quantify, at the farm-level, the economic importance of the species. Uses, management and farmers' improvement objectives were also identified. The results of the survey indicate that *Irvingia gabonensis* is propagated rather by transplanting wildlings than by planting of seedlings and is found mostly in tree crop fields (e.g. cocoa and coffee). The kernel or seed is highly traded and is also transformed into a paste which is used in the preparation of sauces. *Irvingia* wood is used for timber, its dead branches for firewood and the bark is used as medicine. The farm-level annual value of production for *Irvingia* averages US\$ 93.00–US\$ 15.00 from fruits and US\$ 78.00 from seeds – per grower/collector in some regions. Desired improvement objectives include increasing fruit size, improving the taste of fruits, increasing yield, reducing tree height and time to bearing. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Extensive tropical rain forests dominate the humid lowlands of Cameroon. These forests are known to be among the richest flora on earth. In addition to their

role in maintaining and enhancing environmental quality, they are also a reservoir of an enormous quantity of animal and plant communities that are vital for human existence and constitute an integral part of the rural economies. A study carried out in this ecozone identified a great number of species that local communities depend on for food, condiments, medicine and raw materials for various other uses (Duguma et al., 1990).

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Within the next few years forest products, especially non-timber forest products (NTFPs), will become of even greater economic importance for a number of reasons. First, demographic pressures on land resources have motivated land users to explore non-conventional sources for the provision of food to meet the needs of the rising population. Secondly, owing to population pressure and rural to urban migration, the fallow periods in many areas have declined from over 10 years to less than 5 years (1–3 years in most places except in the south and east) rendering the traditional low input system economically inefficient and ecologically unsustainable. There is, therefore, a need to introduce new components to revitalize the system. Thirdly, forest products provide opportunities for earning cash and, consequently, achieving the goal of income diversification as a strategy to minimize risks associated with their conventional farming practices. The cash crop production sector is negatively affected by the low and fluctuating market prices. Many of the products from the tropical rain forest are currently being traded on regional and international markets and can play an essential role in earning badly needed foreign exchange.

The effectiveness of NTFPs in meeting the needs of land-users depends largely on how well the trees can be integrated into the land use system. Multi-strata sequential and simultaneous agroforestry systems are potential strategies for achieving this goal (Cooper et al., 1996). In fact, in the context of West Africa, these systems already exist (Okafor and Fernandes, 1987). The existing multi-strata homegarden system is, however, characterized by low species diversity and inferior genetic materials, which are based more on the availability of planting material than on the economic value and genetic superiority, that hardly contribute to the well being of the farmers beyond the subsistence level. The current land use system provides ample opportunities for improvement relying on (1) a better understanding of farmers' indigenous knowledge of their ecosystem, (2) farmers' intended use of trees – preferred products and services – and the way trees are integrated in their land use system; and (3) the introduction of appropriate plant material.

Most of the trees that are of great importance to land users in the humid lowlands of Cameroon grow in the wild since they have not been domesticated. Recently, there has been a great awareness of the need to

domesticate indigenous tree species. Domestication is a dynamic process which develops from selecting the species to be domesticated, through background socio-economic studies, to the actual germplasm collections and genetic improvement by selecting and propagating superior lines and provenances (Leakey and Jaenicke, 1995). Domestication ensures that the valuable species are easily accessible to and manageable by land users.

Owing to high costs, the number of species that can be improved at any given time is limited. The potential products of various species and their value to land users are key determinants of the species which should receive high priority for genetic improvement. Previous research has reported information on the type of products and species from which the various products are harvested in other regions (FAO, 1981; World Resources Institute, 1985; Okafor and Fernandes, 1987; Falconer, 1992). In a recent study, Ndoye and Tchamou (unpublished data) described the different uses of *Irvingia gabonensis* and the marketing of the tree's most important product, the kernels, also known as wild mango nuts, in the humid lowlands of Cameroon. Another study investigating the performance of NTFPs markets in the humid forest zone of Cameroon, reported that during the period from January to July 1995, 140 tons of the kernel of the species were traded in the region for a value of US\$ 302 000. This was based on the data collected from farmers, transporters and traders in 31 markets located in five provinces (CIFOR, 1996). Moreover, *Irvingia gabonensis* kernels figure prominently in international trade in West Africa. Gabon, Nigeria, Liberia, and Sierra Leone are the main destinations of the product. The humid lowlands of Cameroon, Nigeria, and Côte d'Ivoire are the main sources (ICRAF, 1995). However, despite recent efforts, empirical data on the relative economic importance of NTFPs are not available at the farm-level. Detailed quantification of the monetary value of commonly used NTFPs is essential for identifying key products and species that can improve the welfare of local communities. This information can be useful in identifying candidate species for genetic improvement research.

Research has been carried out to identify priority species for the genetic improvement research in the humid lowlands of Cameroon following guidelines developed by Franzel et al. (1996). The approach

involves a number of steps. It commences with a team-building and planning stage, followed by an assessment of clients' needs (step 2); an assessment of species used by clients (step 3); a prioritization of products (step 4); screening to identify four–six priority species (step 5); valuation survey and ranking of the priority species (step 6); and a workshop to reach consensus on the final choice. The process ensures a flow of information between the potential users (farmers) and researchers.

The results of steps 3–5 identified the following top 10 species in descending order as those farmers prefer most: *Irvingia gabonensis*, *Baillonella toxisperma*, *Dacryodes edulis*, *Elaeis guineensis*, *Riciodendron heudelotii*, *Alstonia boonei*, *Guibourtia demensei*, *Entandrophragma cylindricum*, *Garcinia lucida*, and *Chlorophora excelsa* (Mollet et al., 1995; Adeola et al., unpublished data).

The main objective of this paper is to assess, at the farm-level, the uses and management of *Irvingia gabonensis* together with its potential economic and social value to land users in the study area. It draws mainly on the results of the valuation survey (step 6 of procedure described above).

1.1. *Irvingia gabonensis* baill (*Irvingiaceae*)

I. gabonensis (bush mango) is a large (reaching 35 m in height and 120 cm in diameter) evergreen tree commonly found in West and Central Africa. The geographical distribution of the species extends from the Casamance region (Sénégal) to Angola and it is found in moist semi-deciduous forests. It does not exist in swampy areas. It is found in most parts of Cameroon.

The fruits are greenish yellow with fleshy fibrous pulp surrounding a large hard stone. The kernel is used in preparing sauces. The fruit pulp is eaten and the kernel is also used for medicinal purposes and as a source of oil for making soap (Shiembo et al., 1996). Fruiting occurs from April to July, and in September. The wood which is used as timber is hard, heavy and has fine grain. The bush mango tree is usually preserved on farms to provide shade for crops such as coffee and cocoa and is reported to restore the soil fertility (Shiembo et al., 1996).

Multiplication by seed is quite successful. Growth in young plants is relatively slow. Vegetative propaga-

tion techniques by stem cutting have also been developed (Shiembo et al., 1996).

2. Methods

2.1. Study sites

The humid lowlands are defined as areas below 1000 m altitude with an annual precipitation of above 1500 mm, a growing period of 270–365 days and covered by tropical moist forest vegetation. In Cameroon, the humid lowlands are divided into two zones: the coastal lines with an altitude of 0–300 m and the continental plateau with an altitude ranging between 600 and 800 m above the sea level (Tonye et al., 1986). The area delimiting the humid lowlands in Cameroon together with the study sites are shown in Fig. 1.

Using secondary data on market accessibility, population density, ethnic groups and infrastructure, the priority land use system was divided into three strata corresponding to three divisions (administrative units) located in three different provinces. The study was, therefore, conducted in Mvila (South Province), Lekié (Central Province) and Haut Nyong (East Province) administrative divisions of Cameroon. Table 1 presents relevant information about the study sites.

In all three divisions, the rainfall pattern is bimodal, with two rainy seasons occurring during mid-March–mid-July and mid-August–mid-November. Mean annual rainfall ranges from 1650 mm in Haut Nyong to 1860 mm in Mvila. During the rest of the months, referred to as main (mid-November–mid-March) and minor (mid-July–mid-August) dry seasons, total monthly rainfall hardly exceeds 50 mm.

In Lekié, where the population pressure is high, most of the economically important trees have been removed from the landscape. Farm activities are very intensive and, therefore, the dominant vegetation type is of degraded secondary forest or fallow lands with patches of grass fallow increasing from south to the north. Tree species such as *Musanga cecropioides* and *Albizia zygia* dominate the landscape. *Chromolaena odoratum* and *Panicum maximum* are the common fallow species and are associated with the practice of short fallow cycle.

In Mvila and Haut Nyong, both secondary and primary rain-forests are still found. The vegetation

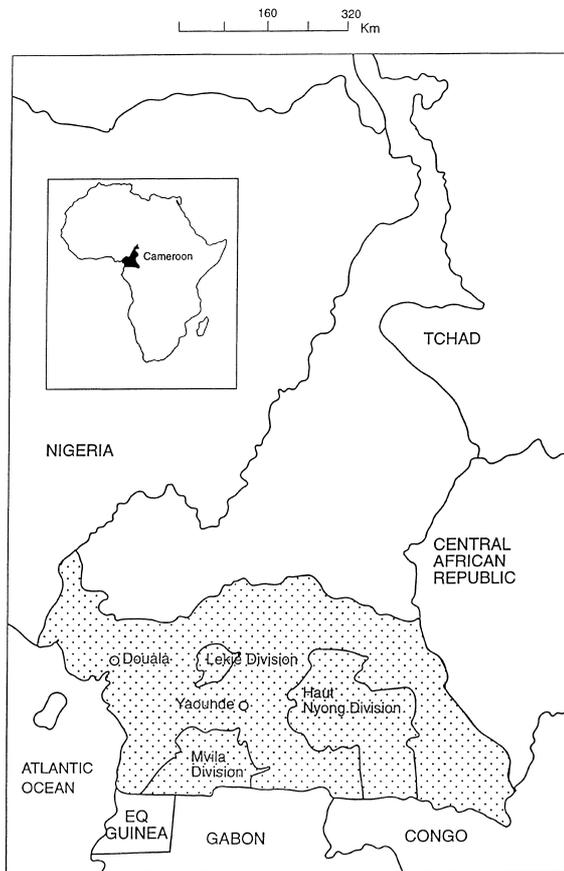


Fig. 1. Study sites in the humid lowlands of Cameroon.

is essentially evergreen rain forest with mosaic of raffia swamps near rivers and logging areas. Dominant tree species include *Albizia* sp., *Ficus exasperata*,

Milicia excelsa, *Terminalia superba*, *Triplochiton scleroxylon*, *Ceiba pentandra*, etc.

The dominant soil types in all three divisions are ultisols and oxisols. However, there is a marked micro variability between the three sites. The soils of Lekié are more fertile and moderately acidic (pH 1:1 H₂O=5–6) compared to the very acidic (pH 1:1 H₂O=<5), low cation exchange capacity and high aluminium saturation (>40%) associated with the soils of Mvila and Haut Nyong divisions.

The cropping system of all three divisions include the fallow based food crop production system, the semi-permanent cash crop production system and the multi-strata home garden system. The food crops include egusi melon (*Cucumeropsis mann*), cassava (*Manihot esculenta*), maize (*Zea mays*), groundnuts (*Arachis hypogaea*), plantain (*Musa* spp.) etc. The main tree crops are coffee (*Coffea robusta*) and cocoa (*Theobroma cacao*), both constitute the principal cash crops in the area. In home gardens, farmers plant several crops ranging from vegetable crops such as green pepper to large fruit trees such as mango (*Mangifera indica*), Safou (*Dacryodes edulis*) and *Ricinodendron heudelotii*.

2.2. Field survey

A field survey was undertaken in April 1995 to validate the results of previous steps of the prioritization guidelines described above. The survey was aimed at collecting data on production, consumption and marketing of main tree products so as to determine their economic potential and social value. Production data were for the July 1993–June 1994 production

Table 1
Descriptive variables for study area

Variables	Division		
	Haut Nyong	Lekié	Mvila
Location	Between latitude 2°0'N and 4°30'N and longitude 12°30'E and 14°40'E	Between latitude 3°50'N and 4°30'N and longitude 11°0'E and 12°0'E	Between latitude 2°22'N and 2°29'N and longitude 10°17'E and 12°14'E
Mean monthly temperatures	22.5°C	25°C	24°C
Ethnic group	Maka, Bama, Pygmies	Eton	Bulu
Market accessibility	Low, poor infrastructure	High, good infrastructure	High, export area but poor infrastructure
Population density	Low	High	Medium

year. The sample size is bigger, the sampling is more rigorous, and the data are more comprehensive than for the preference surveys reported by Mollet et al. (1995).

A multi-stage procedure was used to choose the villages and farmers from the identified strata. On the basis of grids laid over a divisional area map, grid cells of 100 square km ($10 \times 10 \text{ km}^2$) were formed. The division was then split into four quadrants each containing an equal number (4–5) of contiguous grids. From each quadrant a grid cell was selected randomly from which a village was also randomly selected. Thus, in each division, four villages were selected. Upon arrival in the village, 7–8 households were randomly chosen. Both male and female members of the household were interviewed. Eighty interviews, in all, were held with individuals or groups of individuals. Key informants were also identified from each village and were asked an additional set of questions pertaining to growth, production, gender roles and processing of the species. This enabled us to collect information on relative quantities marketed, the nature of the demand for different fruits, and market channels. The selected villages in the respective divisions were Nkolfeb, Eman, Lobo and Tala (Lekié division), Djouyaya, Ntolock, and Bayong 1 (Haut Nyong division) and Mefoup, Ebolobola, Mang and Yama (Mvila division).

The interview team consisted of an ICRAF staff and three scientists from the national agricultural research programme of Cameroon – the ‘Institut de Recherche Agronomique pour le Développement’ (IRAD). The team was split into two groups for the implementation of the survey.

The value of production was estimated as the product of quantity and the price/unit of production. Quantity produced is a sum of quantity sold and quantity consumed plus other uses which includes gifts. Production and value data were obtained from 10, 5, and 12 growers/collectors in the Lekié, Haut Nyong and Mvila divisions, respectively. Farm-gate prices used for this analysis were obtained by deflating the reported market prices by 20% if the distance to markets where the products were sold was greater than 20 km, otherwise it is the observed market price. From the results of this survey the potential farm-level economic value of the species was estimated for each division.

3. Results and discussion

Information on the mode of propagation, niches, uses, management and farmers’ improvement objectives of *Irvingia gabonensis* are summarized in Table 2.

3.1. Mode of propagation and niches

Irvingia is propagated by all the commonly known modes of propagation such as transplanting of wildlings, planting by seeds and retention. Retention/protection, however, is by far the preferred mode of propagation in all the three divisions.

Farmers also plant *Irvingia gabonensis* even though the corresponding proportions in the divisions are not as high as for retention or as high as for planting like in the case of other species such as *Dacryodes edulis* (Ayuk et al., unpublished data). When farmers plant seeds, the main seed sources are from a selected tree on their own farm, from a market place or from neighbours.

Most criteria for selection of tree or fruit for propagating are common across all three divisions. They are: trees with large fruits, fruits with good taste, and high yield. Two additional criteria, regular production and early maturity are important in Haut Nyong and Mvila divisions.

Tree crop fields are the most important niches in all divisions. The average number of trees per grower/collector is highly variable ranging from four in Lekié division to 13 in the Mvila division. *Irvingia* is also present in food crop fields, fallow areas and virgin forests. The percentages of farmers collecting from the forest are 13, 45 and 21 in Lekié, Haut Nyong and Mvila, respectively. Collection from forest is low in Lekié because, as mentioned earlier, the secondary forests remaining there are degraded. All farmers who collected from the forest also had the trees in their own farms. This suggests that, for this group of farmers, production on their farms does not satisfy their needs.

3.2. Effect on tree and food crops

Table 3 summarizes the perceived effect of *Irvingia* on both tree and food crops in the study sites. A large percentage of farmers feel that the effect on tree crops is negative and due to shading. The positive effect perceived in Lekié may be due to better intensification strategies resulting from land shortages.

Table 2
Uses, niches and management of *Irvingia gabonensis* in the humid lowlands of Cameroon

	Division		
	Lekié ($N^b=15$)	Haut Nyong ($N^b=19$)	Mvila ($N^b=30$)
Local names	Azang, Andok beti (Eton)	Ogno'k (Mpong Mpong)	Andooh (Bulu)
% Farms with tree	54	95	94
Average # of trees/grower	4	9	13
Mode of propagation ^a	Retain/protect–10 Plant seeds–4 Transplant wildings–2	Retain/protect–10 Transplant wildings–2 Plant seeds–1	Retain/protect–13 Transplant wildings–4 Plant seeds–2
Main source of seeds, if planted ^a	Own farm, selected tree–3; market place–3; own farm, any tree–2; neighbours–1	Own farm, selected tree–4; own farm, any tree–2	Own farm, selected tree–3; own farm, any tree–3; neighbours–3; market place–1
Criteria for selection of fruit or tree ^a	Good tasting fruit–6; large fruit tree–5; good production–1	Large fruit tree–3; good tasting fruit–3; good production–2; yearly production–2; early maturity–2	Large fruit tree–6; good tasting fruit–5; good production–3; yearly production–1
Niches ^{a,c}	Tree crop fields–11 (4); fallow land–2 (1); home garden–1 (1); food crop fields–1 (1)	Tree crop fields–6 (2); food crop fields–5 (1); fallow land–3 (1); virgin forest–3 (7); home garden–1 (1)	Tree crop fields–16 (7); fallow land–10 (4); food crop fields–5 (3); virgin forest–3 (2); home garden–2 (1)
Uses (non-food) ^a	Firewood–7; poles–6; medicinal use–4 (hernia, yellow fever, dysentery, diarrhea); bark; timber–4; stakes–1; fodder–1; Kernels sold	Firewood–7; medicinal use–4 (antipoison); bark; poles–4; stakes 2; timber–1; fodder–1. Kernels sold	Firewood–15; medicinal use–2 (yellow fever); bark; timber–2; poles–2; stakes 1; fodder–1. Kernels sold
Management tasks undertaken ^a	Harvesting (gather)–11; processing–11; pruning–3; harvesting(climb)–3; disease/ insect control–1	Harvesting (gather)–9; processing–8; fertilization–1; pruning–1; disease/insect control–1	Harvesting (gather)–14; processing–9; fertilization–2; harvesting(climb)–7
Improvement objective ^a	Fruit size–8; good tasting fruit–8; high yield–7; reduce time to bearing–4; Improve storability–3	Good tasting fruit–6; fruit size–5; high yield–4; regularity–3; reduce tree height–3	Fruit size–13; high yield–9; good tasting fruit–8; reduce time to bearing–7; regularity–3

^a All numbers denote the number of respondents making particular choice.

^b Number of growers/collectors.

^c The number in parentheses is the average number of trees (to the nearest non-zero integer) in the given niche.

Table 3
Effect of *Irvingia gabonensis* tree on different crops in the humid lowlands of Cameroon (% of respondents)

		Division		
		Lekié	Haut Nyong	Mvila
Tree crop	Increase	13	9	11
	Reduce	7	64	26
	Mixed	0	0	5
Food crop	Increase	0	0	5
	Reduce	0	36	26
	Mixed	7	9	16

% do not add up to 100 because respondents did not provide answers for all questions.

The effect on food crops is also generally perceived as negative, especially in the Haut Nyong and Mvila Divisions. A small percentage of farmers attribute a mixed effect of *Irvingia* on food crops. That is, the effect is sometimes negative and sometimes positive, which may be due to the observed density. As with tree crops the main reason for the negative effect is the shade.

3.3. Uses, management and improvement objectives

The kernel of *Irvingia gabonensis* is the most important product. It is used in preparing sauces

and in making some kind of cakes which are highly valued by the people.

Although mentioned only by a small proportion of the farmers in all three divisions, some medicinal value is associated with *Irvingia gabonensis* for the treatment of hernia, yellow fever, dysentery and diarrhoea and can be used as an antipoison agent. The most commonly used part of the tree for medicine is its bark. Other non-food uses that were identified include firewood (dead branches), timber, poles, stakes and leaves as fodder.

A broad range of management tasks are undertaken on *Irvingia*. Most frequently cited are pruning, harvesting by climbing, harvesting by gathering, processing, fertilization and disease/insect control. Processing of the seeds of *Irvingia gabonensis* involves a number of steps. First the fruit is split in halves with a cutlass and the split cotyledon is removed with the help of a knife. The cotyledons are then dried under the sun so that they contain no moisture. The dried seed is finally ground and used in sauces and in making cakes mentioned above. It is common in the region for a group of 3–4 women to come together to undertake the processing. The dried

seeds can be stored for a long period of time and used as needed. Pigs are sometimes fed with the pulp of the bush mango.

3.4. Economic value and potential

The following economic assessment is based on the production data for the period July 1993–June 1994, a year in which, according to key informants, the harvest for this species was poor in Mvila division, average in Lekié and very bad in the Haut Nyong.

A huge seasonal variation in prices for the products of the species, fruits and kernel, was observed. Early in the season prices are usually high. The lowest prices are observed in the middle of the season. Due to the observed variation in prices, a seasonal break down of the value of production is presented (Table 4).

Mean annual production of *Irvingia* fruits per grower/collector is highest in Haut Nyong (835 kg). In Mvila division, it is 165 kg. Mean production of *Irvingia* fruits in the Lekié division is 112 kg, the lowest of the three divisions. The high levels in Haut

Table 4

Mean annual production estimates (kg/grower or collector) and yearly value of production (FCFA^a/grower or collector) of *Irvingia gabonensis* fruits and seeds in the humid lowlands of Cameroon

Variables	Division					
	Lekié		Haut Nyong		Mvila	
	Fruits	Seeds	Fruits	Seeds	Fruits	Seeds
Production (total)	112	32	835	27	165	110
Sales ^b	23 (21%)	15 (46%)	328 (39%)	12 (46%)	90 (55%)	56 (51%)
Consumption ^b	54 (48%)	17 (54%)	456 (55%)	15 (54%)	73 (44%)	49 (45%)
Other ^b (e.g. gifts)	35 (31%)	0 (0%)	51 (6%)	0 (0%)	2 (1%)	5 (4%)
Value of production ^{c,d}						
Using beginning of season prices	14 560 (4660)	22 560 (2470)	20 875 (17 875)	6210 (2 560)	22 275 (12 450)	76 450 (15 350)
Using middle of season prices	4480 (1430)	9 600 (1050)	12 525 (10 725)	3645 (1500)	7 425 (4150)	39 050 (7840)
Using end of season prices	8960 (2870)	18 720 (2040)	8350 (7150)	6210 (2560)	11 550 (6455)	35 750 (7180)

^a US\$ \cong 500FCFA.

^b Figures in the parenthesis are percentages of total production.

^c Number in parenthesis is standard error. All figures are rounded to nearest 5FCFA.

^d Deflated farm-gate prices used are for *Irvingia* fruits: 130FCFA/kg, 40FCFA/kg and 80FCFA/kg for beginning, middle and end of season, respectively, in Lekié; 25FCFA/kg, 15FCFA/kg and 10FCFA/kg for beginning, middle and end of season, respectively, in Haut Nyong; 135FCFA/kg, 45FCFA/kg and 70FCFA/kg for beginning, middle and end of season, respectively, in Mvila; for *Irvingia* seeds: 705FCFA/kg, 300FCFA/kg and 585FCFA/kg for beginning, middle and end of season, respectively, in Lekié; 230FCFA/kg, 135FCFA/kg and 230FCFA/kg for beginning, middle and end of season, respectively, in Haut Nyong; 695FCFA/kg, 355FCFA/kg and 325FCFA/kg for beginning, middle and end of season, respectively, in Mvila.

Nyong and Mvila divisions are largely due to the fact that secondary and primary forests are still available in these divisions. As mentioned earlier, these production data are for growers and those who collect from the forest. Growers represent 54, 95 and 94% of sampled households in the Lekié, Haut Nyong, and Mvila Divisions, respectively. The quantity of fruits sold is less than 40% of the total harvest except in Mvila where about 55% of the fruit is sold. Consumption of the fruits is relatively high, ranging from about 44% in Mvila to 55% in Haut Nyong.

The mean annual production of *Irvingia* seeds per grower/collector is highest in the Mvila division with about 110 kg of which about 51% is sold and the remainder is consumed. The average production of seeds in Haut Nyong is about 27 kg of which 54% is for household consumption and the rest is sold. In the Lekié division about 32 kg are produced on average per grower of which 46% is sold and the rest is consumed. These figures show that *Irvingia* contributes significantly to the diet of the people and, therefore, plays a major part for their food security and is a source of additional income.

Irvingia fruits and seeds have a high value of production in all three divisions (Table 4). On the basis of middle of the season prices (which are the lowest during the year), it can be noticed that the value of the seeds is several times the value of fruits, except for the case in Haut Nyong. On the other hand, fruits are produced in greater quantities than the seeds. Average values of seeds per grower/collector ranged from 3645FCFA (US\$ 7.00) in Haut Nyong to 39050FCFA (US\$ 78.00) in Mvila. Fruits ranged from 4480FCFA (US\$ 9.00) in Mvila to 12 525FCFA (US\$ 25.00) in Haut Nyong. Seeds are more important in the Lekié and Mvila Divisions because of the urban demand (Yaoundé) in the former and the export demand (Gabon) in the latter.

4. Conclusion and further research needs

The attractiveness of *Irvingia gabonensis* is derived from the highly valuable by-product of the fruit – the kernel – which has a high commercial value and is widely traded. The value of production for fruits and kernels combined is highest in Mvila where about 46 475FCFA (US\$ 93.00) is the potential contribution

to household revenue per year. In Haut Nyong, the comparable figure is 16 170FCFA (US\$ 32.00) and 14 080FCFA (US\$ 28.00) in the Lekié division. The high prices for seeds and the corresponding value of production in Mvila is most likely due to its location and the trade of *Irvingia* seeds in neighbouring countries such as Gabon. *Irvingia gabonensis* is more valuable in Mvila than other important species in the region such as *Dacryodes edulis*, *Garcinia kola*, *Ricinodendron heudelotii* (Ayuk et al., unpublished data). Both fruits and seeds of the species are consumed and therefore play an important role for food security in the humid lowlands of Cameroon. Women are highly involved in the processing of the product and use it frequently in the preparation of meals.

The bark of *Irvingia gabonensis* is known to be used for the treatment of various ailments such as hernia, yellow fever, dysentery, diarrhoea, and as an antipoison agent. It is also known to provide firewood, timber, poles, fodder and stakes to land users of the area. The added value from these other uses has not been quantified in the present study.

Although there is some evidence that *Irvingia gabonensis* may have a negative effect on both tree and food crops, the species can play a major part in agroforestry systems as tree and field crops fields are important niches for this species. However, in this context, appropriate management techniques and integration of identified superior or improved materials into the land use systems need to be examined.

The results from this study suggest that there is a need for research on enhancing the quality and quantity of fruit and seed production of *Irvingia gabonensis*. The reproductive biology of priority species also needs to be understood so as to ensure that sufficient quantities are available at suitable time periods. The recent work by Shiembo et al. (1996) contributes significantly to our understanding of proper propagation techniques of this species. Among improvement objectives identified by farmers, particular attention should be given to increasing fruit size, improving the taste of the fruits, increasing yield, improving regularity and reducing time to bearing. Studies to improve our understanding of marketing channels of the species and the associated market margins should be undertaken. Methods need to be developed to quantify the value of non-food uses of the species.

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