

Peasants' perceptions on the socioeconomic importance and cultivation practice of *Canarium schweinfurthii* Engl. (Black olive tree) in the Western Highlands of Cameroon

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Abstract

Canarium schweinfurthii is one of the agro-forestry tree species with multiple uses in the subtropical countries which is still exploited wild. The purpose of this study was to get insights related to peasants' perceptions on the socio-economic importance and cultivation practice of the species in the Western Highlands of Cameroon. The methodology consisted of surveys among people spread over 7 villages. Two hundred (200) people who were involved in *C. schweinfurthii* exploitation were selected in the study area following a random approach and interviewed using a structured questionnaire. In addition to the identification of respondents, the information collected from interviewees focused on: 1) knowledge, uses, harvesting methods and the impact of the exploitation of the species on the well-being of people; 2) the trend of the population's dynamics of the species and, 3) the know-how and practices in the cultivation of the plant. The results showed that almost all the interviewees (99%) knew the species that they exploit in six categories of use (food, medicine, handicraft, construction, timber industry and firewood supply), with a broad consensus ($C_s = 0.98$) for the use in food. The degree of consensus remained low for its use in medicine ($C_s = -0.18$), firewood supply ($C_s = -0.21$), timber industry ($C_s = -0.65$), construction ($C_s = -0.77$) and handicrafts ($C_s = -0.84$). According to 80% of respondents, income from the sale of the fruits significantly contributes to household welfare. The most cited harvesting method was fruits picking, which does not endanger the species. Only 37% of the interviewees perceived a regressive trend in the dynamics of the species' population over the last decade. For 71% of the respondents, the cultivation practice by farmers is rare or even non-existent. The main reasons for non-cultivation of the species are the uncertainty that the planted trees will bear fruits (80% of respondents) and the long duration of the vegetative growth phase (55% of respondents). 90% of respondents expressed their willingness to adopt the cultivation of the species if these constraints are circumvented. These findings showed that *C. schweinfurthii* would be an interesting candidate for participatory domestication in the Western Highland of Cameroon, for the intensification of agro-forestry systems. For this purpose, the establishment of an efficient protocol for asexual propagation of fruit-producing individuals is needed.

Historic

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1. Introduction

Non-timber forest products (NTFPs) of the subtropical regions, including Cameroon, contribute to the daily life of many people with whom they coexist [1]. In this area, more than 20 million people are entirely dependent on NTFPs for their food, health, and incomes [2]. According to Awono et al. [3], the massive exploitation of NTFPs at the local and national level generates incomes that improve the standard of living of all stakeholders in the exploitation chain. This overexploitation, combined with deforestation, leads to the disappearance of certain species whose natural regeneration is difficult. It is therefore necessary to preserve the producing species or to improve them, in particular through sylvicultural actions [4].

Several species have been identified as priority candidates for domestication, including *Irvingia gabonensis*, *Dacryodes edulis*, *Riciniadendron heudelotii*, *Garcinia kola* and *Chrysophallum albidum* [5, 6]. Domestication is the process of taking a wild plant species and bringing it under management and cultivation. Apart from the above mentioned priority species for domestication, many other species such as *Terminalia* spp, *Chlorophora excelsa*, *Albizia* spp, *Entandrophragma* spp, and *Canarium schweinfurthii* are generally maintained and protected in plantations either for their useful products, the shade that they provide, or for moisture maintenance etc. [7, 8]. The domestication of NTFP-producing tree species with the objective of increasing the productivity and sustainability of agro-forestry systems would certainly contribute to the conservation and preservation of forest resources. This would be an interesting approach to overcome the problem of

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overexploitation of the most economically important NTFPs producing species such as *Canarium schweinfurthii* [9].

Canarium schweinfurthii (Engl.), a member of the Burseraceae family [10] is one of the many African tree species with multiple uses. Its common names in English include: Torchwood, Black olive, Bush candle tree and Forest pear [11, 12]. It is a tall, upright tree that grows up to a height of 50 m and a trunk diameter of more than 1.5 m. It is widely distributed throughout the western, the central and the eastern Africa [13] where its fruits are traded in local markets and beyond [14].

Despite the apparent socio-economic importance of *C. schweinfurthii* in Cameroon, there is a few literature related to the cultivation practices of the species. Previous research work has been mainly focused on fruit characterization and marketing [15]. The domestication of *C. schweinfurthii* in existing farming systems would contribute to significant increase of income generated from its exploitation, notably by ensuring sustainable NTFP production while preserving biodiversity. A participatory domestication program is only possible if the actors (peasants) have on the one hand a favorable perception on the goods and services provided by the species, and on the other hand some know-how in term of its conservation and propagation practices.

The present study aimed at understanding peasants' perception on *C. schweinfurthii*'s ecosystem services in the Western Highlands of Cameroon, and characterizing the local knowledge and practices regarding the cultivation of the species.

2. Matériel et Méthodes

2.1. Area of study

The study was carried out in four administrative divisions (Mifi, Koung-khi, Bamboutos and Menoua) located in the Western Highlands of Cameroon. In the study area, 7 villages were explored: two in Mifi (Bafoussam and Baleng), one in Koung-khi (Bandjoun), two in Bamboutos (Mbouda and Babadjou), and two in Menoua (Bansoa and Balessing). These villages were selected on the basis of the following criteria: the density of the *Canarium schweinfurthii* population, the accessibility of the sites and the proximity of these sites to urban markets.

2.2. Description of the study area

The study area (Figure 1) is located between latitudes 4°30' and 7° North and between longitudes 9°25' and 11°40' East. The climate of the Western Highlands of Cameroon is of equatorial type, with two seasons: a dry season which extends from mid-November to mid-March and a rainy season which extends from mid-March to mid-November. The average annual rainfall ranges between 1500 and 1800 mm, and the average temperature is between 20 and 30°C. The vegetation comprises Biafran forest, semi-deciduous forest and peri-forest savannahs [16]. The major activity practiced in the rural areas of the western highlands of Cameroon is agriculture, which occupies more than 80% of the active population. The land is generally occupied by a combination of perennial crops (coffee and other fruit trees) and annual poly-cropping (maize, beans, peanuts, etc.) [17]. The remaining 20% of the active population is made up of traders, breeders, teachers, skilled and unskilled manual workers, health personnel, etc. [18].

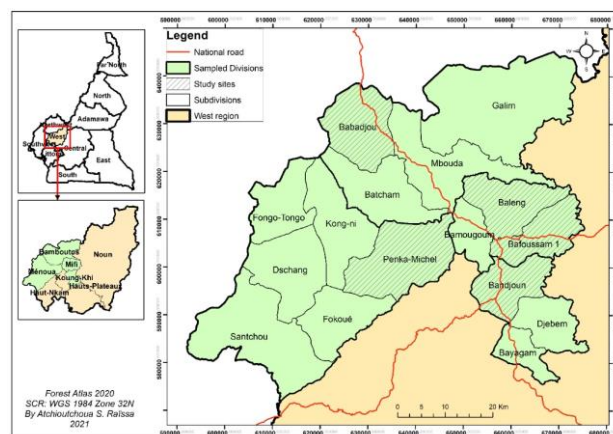


Figure 1: Map of the study area

2.3 Administration of the questionnaire

Two hundred (200) people who were selected following a random approach were interviewed using a structured questionnaire. The chiefs of the seven targeted villages served as key informants in order to have information on the main actors in the chain of exploitation of the species. The 200 respondents sampled randomly and independently of their age, sex, marital status and social class [19] were made up of tree operators and/or owners, members of households involved in the collection and commercialization of *C. schweinfurthii* products. The questionnaire adopted had four main parts: (1) Identification of the respondent; this was intended to establish a climate of trust between the respondent and the interviewer. (2) *Canarium schweinfurthii* and the population; this heading made it possible to collect information on the knowledge, the usage and impact of the exploitation of *Canarium schweinfurthii* on the well-being of the populations. (3) The vulnerability of the species; the aim here was to gather information on how the peasants perceived the dynamics of *C. schweinfurthii* populations. Here, the respondent had to indicate whether in his opinion the dynamics of the *C. schweinfurthii* population had an increasing, decreasing or stable trend. (4) *C. schweinfurthii*'s cultivation; this was to identify local know-how, practices and perceptions with regard to the cultivation of the species. The individual interviews were supplemented with field observations. These surveys were conducted between June and October 2018.

2.4. Data processing and analysis

The forms were examined, and then the data were coded and organized in a database using SPSS.21 software. Prior to analysis, affirmative (Yes) and negative (No) answers were encoded into numerical binary variables "1" and "0" respectively. The quantitative approach of ethno-botanical characterization consisted in determining the relative frequencies of citations (RFC) calculated according to the formula below [20]:

$RFC = (S \div N) \times 100$, where S = Number of people who cited a given use, N = Total number of respondents.

The consensus value for the different categories of use types (Cs) was calculated. This value measures the degree of agreement between respondents with respect to the different types of use made of the species [21]. It is expressed as:

$Cs = (2ni \div n) - 1$, where ni is the number of respondents who cited a given category of use, and n is the total number of respondents.

The value of C_s ranges between -1 and 1. If $n_i = 0$, then $C_s = -1$ and if $n_i = n$ then $C_s = 1$. This value of C_s reflects the degree of consensus of the respondents on a given use category.

3. Results and discussion

3.1. Results

3.1.1. Socio-demographic profile of respondents

The socio-demographic profile of the respondents (Table 1) shows that each of the sexes represented 50% of respondents. The most representative age group was 25-50 years old with 64% of respondents, followed by 50-75 years old with 33% of respondents. Most of the respondents (75%) were married, while 25% were single. The literacy rate was 67%, 22%, and 3% for secondary, primary, and higher education respectively, and 8% of the population surveyed had never been to school. The most representative professions among respondents were traders (43%) and producers (41%), whereas housewives and teachers represented each 8% of respondents.

Table 1: Socio-demographic profile of the surveyed populations

Variable	Modality	Size of population (n)	Relative frequency (%)
Age group	< 25 years old	4	2
	25-50 years old	126	64
	50-75 years old	66	33
	≥75 years old	4	1
	Total	200	100
Sex	Female	100	50
	Male	100	50
	Total	200	100
Marital status	Married	150	75
	Single	50	25
	total	200	100
Level of education	Illiterate	17	8
	Primary	45	22
	Secondary	133	67
	University	7	3
	Total	200	100
Profession	Farmer	85	43
	Shopkeeper	82	41
	Teacher	17	8
	Housewife	16	8
	Total	200	100

3.1.2. Knowledge of the species

Almost all respondents (99%) claimed to know the species that they usually encounter in the forest and in the crop fields. The majority of respondents (98%) knew its French common name: "*arbre aux fruits noirs*". The local name (name in local dialect) of the species varied according to locality and especially in pronunciation. Most respondents (98%) claimed that "Black fruits tree" is its common name. Only 4% of respondents knew the scientific name (*C. schweinfurthii*).

3.1.3. Uses of the species

The results revealed that the organs and products (fruit, seeds, leaves, bark, sap, trunk, branches) of *C. schweinfurthii* are subject to six categories of use; namely in food, traditional medicine,

handicrafts, constructions, timber industry and firewood supply (Figure 2). The plant parts which are used as food are fruits (99% of respondents) and seeds (24% of respondents). The fruits are consumed as snacks or as a complement to some traditional dishes, while the seeds are used in the preparation of some sauce. The organs cited for medicinal use were the leaves (15% of respondents), seeds (41% of respondents), bark (13% of respondents) and roots (19% of respondents). In handicrafts, the cited parts were the branches, the trunk and the sap, with respectively 26%, 10%, and 10% of citations. The trunk and branches are used in the manufacture of mortars, hoe handles, ladles and stools. The sap is used as glue and is also burned in houses to repel evil spirits. Apart from their artisanal use, the branches and trunk are also used as lumber, firewood and in construction.

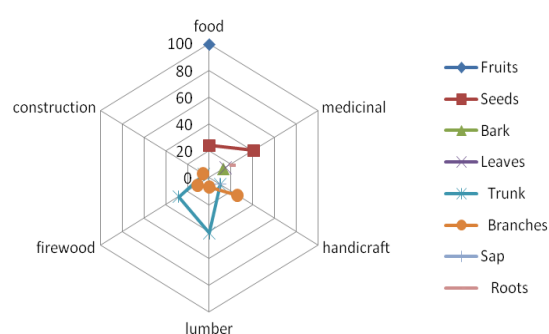


Figure 2: Relative Frequency of Citations (% of respondents) of the different uses of different *C. schweinfurthii*'s organs

Table 2: Degree of consensus among respondents for the different categories of use of *C. schweinfurthii* in the Western Highlands of Cameroon

Usage	Consensus value (C_s)
Food	0.98
Medicinal	-0.18
Handicraft	-0.84
Timber	-0.65
Firewood	-0.21
Construction	-0.77

Table 2 shows that there was a high level of consensus ($C_s = 0.98$) for the use as food, while the consensus was low for the uses in medicine ($C_s = -0.18$), handicrafts ($C_s = -0.84$), construction ($C_s = -0.77$), timber industry ($C_s = -0.65$) and firewood supply ($C_s = -0.21$).

3.1.4. Farmers' perception on the importance of income from the exploitation of *C. schweinfurthii*

More than half of the respondents (53%) stated that they use the species for personal consumption and for sale. The sale of the species' products provides income that is considered important for 80% of respondents, very important for 12% and negligible for

8% (Figure 3). Fruit is the most widely marketed plant product in the surveyed area. According to 95% of respondents, the quantities of fruits harvested are sold entirely on the markets. Farmers sell the fruit to wholesalers in 50 kg bags at 36 USD per bag, which corresponds to 0.72 USD per kilogram. A *C. schweinfurthii* tree can yield around 500 kg per production year. Thus, the income generated per tree and per year for the producer can reach 360 USD. These fruits are in turn resold by retailers at almost double the purchase price. For 71% of the interviewees, these prices are increasing because of the increasing demand of fruits on the local and urban markets.

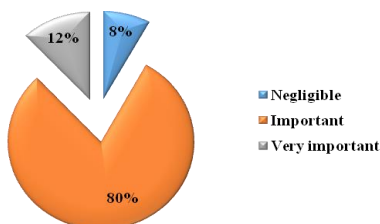


Figure 3: Relative frequency of citation (% of respondents) of the different levels of importance given to income from the sale of *C. schweinfurthii* products

3.1.5. Perception on the impact of harvesting methods

Results from figure 4 shows that the most commonly used harvesting method is picking and gathering the fruit, which is practiced by 92% of respondents. This is followed by felling the tree (39% of respondents), which is only practiced on larger trees for their use in timber supply or handicrafts. Other harvesting methods are only minimally mentioned. These include debarking (12% of respondents), leaf removal (9% of respondents), and root removal (19% of respondents), for use in traditional medicine. However, field observations showed that the intensity of the latter harvesting methods was very low.

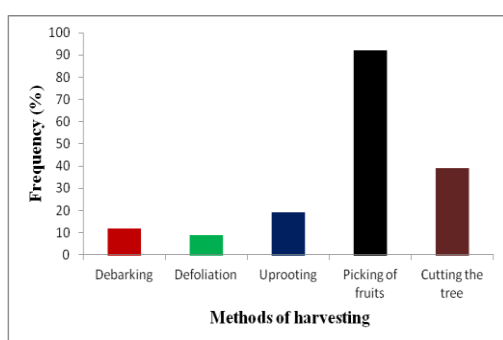


Figure 4: Relative frequency of citation (% of respondents) of the different harvesting methods of *C. schweinfurthii*'s organs

3.1.6. Perception on the dynamics of *C. schweinfurthii* population

In the surveyed areas, 37% of the respondents found that the number of trees of the species has decreased over the last decade. For 38% of respondents, the tree population has remained stable, whereas 13% of respondents had no idea about the population trend over the last ten years. However, 12% of

respondents felt that the population of this species had increased (Figure 5).

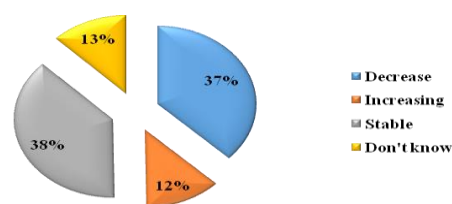


Figure 5: Frequency of respondents according to the dynamics of the *C. schweinfurthii* population over the last ten years

3.1.7. Means of acquiring *C. schweinfurthii* trees by peasants

In the villages surveyed, the trees encountered were generally isolated individuals either in courtyard of concessions, in sacred forests, or in cultivated fields. Indeed, it turned out that more than half of the people interviewed had at least one *C. schweinfurthii* tree in their possession. Of these, 42% had acquired the stands by protecting seedlings found in their fields, 41% of respondents had inherited trees from their ancestors, and 17% of respondents had planted their own trees (Figure 6). The survey revealed that for 71% of respondents, *C. schweinfurthii* cultivation is rare or even non-existent.

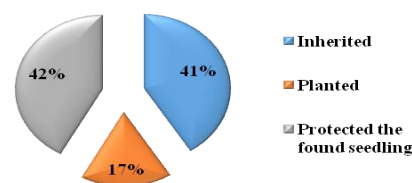


Figure 6: Relative frequency of citation (% of respondents) of different means of acquiring *C. schweinfurthii* trees

3.1.7. Perception on the reasons (causes) of non-cultivation of *C. schweinfurthii*

Three main causes for the non-existence of *C. schweinfurthii* cultivation practice were cited by interviewees (Figure 7). For 80%

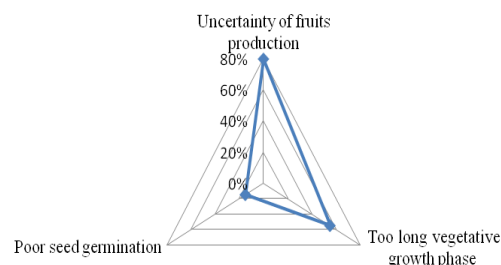


Figure 7: Relative frequency of citation (% of respondents) of the different causes of disinterest in the cultivation of *C. schweinfurthii*

of respondents, cultivation of the species is non-existent because of uncertainty that the plant raised from seeds or transplants will bear fruits. Others (55%) blamed the long vegetative growth phase, while some (15%) attributed the lack of cultivation to difficulty in germinating seeds in the nursery. Almost all of the

people surveyed (90%) declared themselves ready to cultivate the species if appropriate methods for propagating fruit-producing individuals were provided to them.

3.2. Discussion

People in rural areas of Cameroon are aware of the ecosystem services provided by forest tree species [22]. The present ethnobotanical study showed that people in Western Highlands of Cameroon have a thorough knowledge of *C. schweinfurthii*. Six categories of use that are part of the ecosystem services of supply were cited by respondents, namely the used in food, traditional medicine, constructions, firewood supply, timber industry and crafts. These categories of use reflect the interest of the populations for the species and confirm the idea that the populations of the peri-forest areas make good use of the ecosystem services to which they are closely linked. These results are in agreement with those of Seguena *et al.* [23], Vroh *et al.* [24] and Mbakop *et al.* [25] who reported that the ecosystem services of supply generally mentioned by the population included food, pharmacopoeia, construction, handicrafts, timber and firewood. Fruit was the most cited organ (99%) used for food. This can be explained by the fact that fruit from this plant is its most popular product found in the country's towns and cities. These results are consistent with those of Njoukam [26] and Tsewoue *et al.* [27], who reported that in Cameroon, the most commonly used organ of *C. schweinfurthii* is the fruit. The fruits are softened in hot water and consumed by the populations either alone, or as an accompaniment to cooked couscous in some localities or manioc tubers in others. The most medicinally used parts of the species were the leaves, bark, seeds and roots. In the study area, the decoction of the leaves, roots and bark is used for the treatment of malaria and typhoid fever. The infusion of the seeds previously burned is used as gargle in the treatment of pharyngitis (sore throat). The bark is also burned as incense for the treatment of mystical diseases. The findings of the present study are in line with those of Zima [28] and Zanh *et al.* [29], who reported leaves, bark and roots as the most commonly used plant parts in traditional pharmacopoeia. Income from the sale of *C. schweinfurthii* products were said to be important for 80% of the population interviewed. This is in agreement with previous reports from Njoukam and Peltier [7] in the Western Region of Cameroon, Tsewoué *et al.* [27] in the Bamboutos Division of Cameroon and Traoré *et al.* [14] in Burkina Faso. Despite the importance of income generated from the sale of *C. schweinfurthii*'s fruits, cultivation of the species is rare. Stands which were exploited in the field were either inherited from relatives (41%), or evolved from seedlings which were found in farm and protected by farmers during the establishment of agricultural systems (42%). These results are consistent with those of Tsewoue *et al.* [27] who reported that in Bamboutos Division (a locality within the Western Highlands of Cameroon) most of the farmers limit their conservation strategy to the protection of wild *C. schweinfurthii* seedlings which are found in their land, rather than planting the species. From the present study it is shown that the most cited reason for not planting the species is the uncertainty of fruits production. This can be explained by the

fact that the species is dioecious. Indeed, only female stands produce fruits whereas male stands are unproductive. During the vegetative growth phase which last at least eight year, there is no index that makes it possible to distinguish male stands from female stands [7]. The peasants are stymied the fact that they may plant individuals that will never produce fruits.

Conclusion

Peasants in the Western Highlands of Cameroon are familiar with *C. schweinfurthii*, which they exploit on a daily basis in six categories of use. These peasants perceive the exploitation of the species as contributing significantly to their well-being. They would like to undertake the cultivation of this plant to increase their income, but refrain from doing so because of the long period of vegetative growth phase and the uncertainty of the fruiting of the planted trees. These findings clearly indicate that *C. schweinfurthii* would be an interesting candidate for participatory domestication in the Western Highland of Cameroon, for the intensification of agro-forestry systems. For this purpose, the establishment of an efficient protocol for micro propagation of fruit-producing individuals is needed.

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