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Peasants' perceptions on the uses and exploitation of *Tetracarpidium conophorum* (Mull. Arg.) Hutch & Dalziel in Cameroon

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Mots clés

Tetracarpidium conophorum ;
Services écosystémiques d'approvisionnement ;
Culture ;
Enquêtes.

Résumé

Tetracarpidium conophorum (Mull. Arg.) Hutch & Dalziel, liane de la famille des Euphorbiaceae, est l'une des nombreuses espèces végétales utiles des forêts tropicales, encore exploitée à l'état sauvage. L'objectif de cette étude était d'appréhender les perceptions paysannes sur les services écosystémiques d'approvisionnement et la pratique de la culture de *T. conophorum* au Cameroun, en vue de déterminer si l'espèce est propice à une domestication participative. L'approche méthodologique a consisté en des enquêtes ethnobotaniques réalisées auprès de 252 personnes réparties dans trois zones agro écologiques du Cameroun, ainsi qu'en des observations de terrain. Les résultats ont montré que 100% des répondants connaissent l'espèce qu'ils exploitent dans trois catégories d'usage, avec un large consensus pour l'usage alimentaire (Cs = 1), suivi par l'usage énergétique (Cs = 0,92) et l'usage médicinal (Cs = 0,17). L'exploitation de l'espèce procure des revenus jugés très importants par 69% des personnes interrogées. La méthode de récolte la plus répandue dans les zones d'étude est le ramassage des fruits, pratiqué par 100% des personnes interrogées. Une tendance régressive dans la dynamique de la population de *T. conophorum* est perçue par 44% des personnes interrogées. Selon 92% des répondants, les habitudes de culture de l'espèce sont quasi inexistantes en raison de la difficulté qu'ils éprouvent à la régénérer (51% des répondants), de la longue durée de la phase de croissance végétative (36%) et de l'incertitude de la production des fruits (13%). Toutes les personnes interrogées (100%) ont exprimé leur désir d'adopter la culture de l'espèce si des méthodes appropriées de propagation d'individus productifs leur étaient proposées. Cette étude montre que *T. conophorum* est propice à une domestication participative au Cameroun.

Keywords:

Tetracarpidium conophorum;
Provisioning ecosystem services;
Cultivation;
Surveys

Abstract

Tetracarpidium conophorum (Mull. Arg.) Hutch & Dalziel, a vine of the Euphorbiaceae family, is one of the numerous useful plant species of the tropical forests, and is still exploited in the wild. The objective of this study was to understand peasants' perceptions on the provisioning ecosystem services and the cultivation practice of *T. conophorum* in Cameroon, with a view to determining the suitability of this species for participatory domestication. The methodological approach consisted of ethnobotanical surveys carried out among 252 people spread across three agroecological zones of Cameroon, as well as field observations. The results showed that 100% of respondents know the species that they exploit for three categories of use, with a broad consensus for food use (Cs = 1), followed by energy use (Cs = 0, 92) and medicinal use (Cs = 0.17). The exploitation of the species provides income which is considered very important by 69% of respondents. The most common harvesting method in the study areas is fruit picking, which is practiced by 100% of respondents. A regressive trend in the dynamics of the *T. conophorum* population is perceived by 44% of respondents. According to 92% of respondents, cultivation habits of the species are almost non-existent due to the difficulty they experience in regenerating it (51% of respondents), the long duration of the vegetative growth phase (36%) and the uncertainty of fruits production (13%). All the interviewees (100%) expressed their desire to adopt the cultivation of the species if appropriate methods for propagating productive individuals were provided to them. This study shows that *T. conophorum* is conducive to participatory domestication in Cameroon.

Historic

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1. Introduction

The tropical rainforest contains a wide range of resources that makes it a global focus for biodiversity conservation. In addition to wood products, it abounds in non-timber forest products (NTFPs) of great importance to rural and urban populations [1, 2, 3]. According to Lescuyer [4], NTFPs are key livelihood products for people.

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For rural people, NTFPs are often the most obvious manifestation of the value of the forest [5]. Indeed, they play an important role in the food balance, the cultural identity, health care, and their exploitation constitutes income generating activities [6]. Thus, NTFPs have received considerable attention because of their contribution not only to food security, the household economy and some national economies [7], but also and especially to plant biodiversity [8].

The socio-economic importance of NTFPs induces considerable pressure on forest ecosystems. Thus, NTFPs, which were once abundant and allowed local residents to live for years without difficulty,

are now sought after by increasingly important social strata [9], to such an extent that the problem of the gradual extinction of forest species, their sustainable management and equity in their use is currently being addressed [10, 11, 12].

Tetracarpidium conophorum, commonly known as the African walnut, belongs to the Euphorbiaceae family. It's a sarmentose shrub or strong woody vine and is among the most widely used non-timber forest products of plant origin (NTFPs) in the socio-economic activities of countries sharing the Congo Basin [9]. The fruits are greenish capsules containing one to five globose, oleaginous and edible seeds [13]. The plant is also used for various medicinal purposes [14]. Although the sale of *T. conophorum* products (fruits and seeds) in local markets provides income to farmers, the species is still exploited in the wild in the forests of several localities in Cameroon [15]. However, Because of this socio-economic importance, its domestication and the cultivation pratice in agricultural systems would increase the income from its exploitation and, at the same time reduce the pressure on the ressource in the natural forests.

As a prerequisis to the process of participative domestication of the species in Cameroon, the present study aimed at 1) getting insights related to farmers' perception on *T. conophorum* ecosystemic services and 2) characterizing the local know-how regarding its conservation and cultivation practices.

2. Material and methods

2.1. Study areas

The study was carried out in four villages among which two (Manjo and Manengole) in the Moungo administrative Division, one (Bafia) in the Mbam & Inoubou administrative Division, and one (Santchou) in the Menoua administrative Division of Cameroon. These administrative divisions are located respectively in the mono-modal rainfall humid forest, bi-modal rainfall humid forest and Western Highlands agro ecological zones of Cameroon (Figure 1). These villages were chosen on the basis of the following criteria: the density of *Tetracarpidium conophorum* population, the accessibility of sites and their proximity to urban markets, and the availability of peasants to respond to the questionnaire.

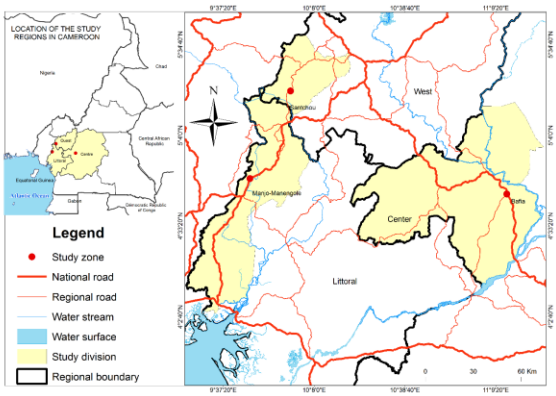

Figure 1: Location of surveyed villages

2.2. Characteristics of agroecological zones

The mono-modal rainfall humid forest zone is located in the southwest part of the country. The climate of the equatorial type, with an average temperature of 26°C, a rainy season which extends from March to October, and a dry season which extends from November to February. The annual rainfall ranges between 2500 and 4000 mm. The soils are volcanic and the sediments of rocky origin. The abundant crops in this agroecological zone are cocoa, banana, coffee, plantain, palm oil and ginger pepper [16].

The bi-modal rainfall humid forest zone has two rainy seasons which run from March to June and from August to October respectively. The annual rainfall is around 1500 mm. The temperature varies between 19.7°C and 25.5°C [17]. The soils are ferralitic, acidic, clay and low nutrient retention capacity. The abundant crops in this agroecological zone are cocoa, coffee, cassava, plantain, corn and pineapple [16].

The climate of the Western Highlands of Cameroon is of equatorial type, with two seasons: a dry season that extends from mid-November to mid-March and a rainy season that extends from mid-March to mid-November. Annual rainfall is between 1500 and 1800 mm, and the temperature is between 20 and 30 °C. The vegetation includes biafran forest, semi-deciduous forest and peri-forest savannah [18]. The soils are very fertiles and conducive to agricultural activities. The abundant crops in this agroecological zone are corn, beans, potatoes, cocoa and coffee [16].

2.3- Administration of the questionnaire

A previously established semi-structured ethnobotanical survey form was used to conduct the surveys. The populations surveyed were of both sexes, of different age groups, of different marital status, levels of education and professions. The individual interviews were completed by field observations. In total, 252 people were interviewed during the period from August 2022 to January 2023. The main lines of the interview guide were as follows: (i) *Tetracarpidium conophorum* and the population: This section collected information on knowledge, usage and impact of *T. conophorum* exploitation on the well-being of the population. (ii) Vulnerability of the species: This involved gathering information on the dynamics of the stands and knowledge of the factors that limit the presence of the species in the farming environment. (iii) Conservation strategies for *T. conophorum*: This involved gathering information, in one hand, on local know-how and practices in term of the cultivation of the species, and in another hand, on the factors that may encourage or discourage the willingness of farmer to adopt the cultivation of the plant.

2.4. Data processing and analysis

The survey forms were processed manually, then the data were coded and organised in a database using SPSS 21 software package. Positive response (Yes) and negative response (No) were coded into numerical binary variables "1" and "0" respectively before analysis. The quantitative approach of ethnobotanical characterisation consisted in determining the relative frequency of citations (RFC) of the different responses, expressed according to the formula: RFC= (S÷N) ×100, where S is the number of people who cited a given response; and N is the total number of respondents [19]. Similarly, the consensus value for the different categories of use types (Cs) was calculated. It measures the degree of agreement between respondents regarding the uses made of the species [20]. It's expressed as $Cs = (2n_i \div n)-1$, where n_i is the number of people using *T. conophorum* in a given use category and n is the total number of respondents. This value ranges from -1 to 1. If $n_i = 0$, then Cs = -1 and if ni = n then Cs = 1. This reflects the degree of consensus among respondents on a given use.

3. Results

3.1. Socio-demographic profile of respondents

Table 1 shows that 78% of respondents were men while 22% were women. The most representative age group was 25-50 years old with 62% of respondents, followed by 50-75 years old with 25% of respondents. Most of the respondents (53%) were married, while 47% were single. The literacy rate was 79.7%, 10.7%, and 5.9% for

secondary, primary, and higher education respectively, and 3.5% of the population surveyed had never been to school. The most representative professions among respondents were farmers (72.6%), traders (13.08%) and student (8.7%), whereas housewives, agronomist and teachers represented respectively 3.5%, 0.78% and 0.78% of respondents.

Table 1: Socio-demographic profile of the surveyed populations

Variables	Modalities	Menoua		Moungo		Mbam & Inoubou		Total (%)	
		Size of population (n)	Relative frequency (%)	Size of population (n)	Relative frequency (%)	Size of population (n)	Relative frequency (%)	Size of population (n)	Relative frequency (%)
Age group	≤ 25	17	6.74	7	2.77	9	3.57	33	13
	] 25 – 50]	78	30.95	39	15.47	39	15.47	156	62
	] 50-75]	5	1.98	54	21.42	4	1.58	63	25
Sex	Male	78	30.95	76	30.15	42	16.66	196	78
	Female	22	8.73	24	9.52	10	3.96	56	22
Educational level	Unscooled	0	0	5	2	4	1.58	9	3.58
	Primary	2	0.79	12	4.76	13	5.15	27	10.7
	Secondary	93	36.9	77	30.55	31	12.30	201	79.75
	Higher	5	2	6	2.38	4	1.58	15	5.96
Marital statut	Single	62	24.60	23	9.12	33	13	118	47
	Married	38	15	77	30.55	19	7.53	134	53
Profession	Farmer	75	29.76	70	27.77	38	15.07	183	72.6
	Traders	12	4.76	14	5.55	7	2.77	33	13.08
	Student	9	3.57	8	3.17	5	2	22	8.74
	Housewives	2	0.79	6	2.38	2	0.39	10	3.56
	Agronomist	1	0.39	1	0.39	0	0	2	0.78
	Teacher	1	0.39	1	0.39	0	0	2	0.78

3.2. Knowledge of the species

All the respondents (100%) claimed to know the species. The majority of respondents (98%) knew its common name in French as "arbre à noisettes". The local name of the species varied from one socio-cultural group to another. No respondent knew the scientific name (*T. conophorum*).Three habitats were cited for the species, namely forest (12% of respondents), crop field (32% of respondents) and both forest and crop field (56% of respondents) (Fig. 2). According to the respondents, the season of full maturity lasts about 3 months, from July to September.

Table 2: Local names given to *T. conophorum* by respondents from different localities of origin

Localities of origin	Local names
Santchou	Keck, kasso
Manengole/Mandjo	Kèh
Bafia	Gas
Mbouda	N'gack
Dschang/ Bangangté	Ngack
Bamenda	Kasso
Baham/Bandjoun	Gack

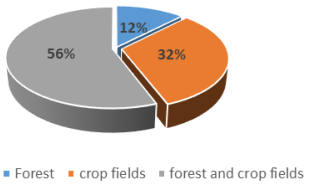

Figure 1: Frequency of citation (% of respondents) of the different habitats of *T. conophorum*

3.3. Uses of the species

The results indicated that the different organs of the plant are subject of three different categories of use, namely: food, medicine and energy supply. In the food use, the cited organ is the seed (100% of respondents). These seeds are used both for direct consumption and as ingredient in the preparation of a sauce. In addition to its use as food, the seed is also used as medicine (40% of respondents). Medicinal use also involves leaves (52.38% of respondents) and bark (2.38% of respondents). In the study area, the seed is used to treat digestive disorders and to increase men's sexual performance. Leaf and bark decoctions are also used to treat sexual weakness. The infusion of the leaves alone helps to treat typhoid and dysentery. According to 100% of respondents, the trunk and the branches are used as firewood for energy supply.

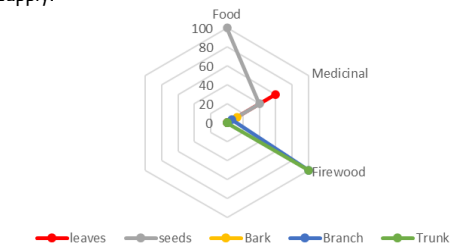

Figure 2: Relative frequency of citation (% of respondents) of the different uses of *T. conophorum* organs

Table 3 shows that there were high levels of consensus for the uses as food (Cs = 1) and firewood supply (0.92), while the consensus was low for the uses in medicine (Cs = 0.17).

Table 3: Degree of consensus among respondents for the different use categories of *T. conophorum*

Use	Consensus value (Cs)
Food	1
Medicinal	0.17
Firewood	0.92

3.4. Farmers' perception on the importance of income from the exploitation of *T. conophorum*

More than half of the population surveyed (55%) stated that they harvest the species for both personal use and for sale. For 75% of respondents, sales of the species' seeds are made in local markets. Income from the species is perceived as very important by 69% of respondents, important by 29% of respondents and negligible by 2% of respondents (Figure 4). The fully mature fruit is the most commonly traded part of the plant in the surveyed localities. According to 95 % of respondents, the fruits harvested are entirely sold on the markets or consumed. For 84% of respondents, the prices of these fruits are rising because of their scarcity on local and urban markets, and the increasingly high cost of living.

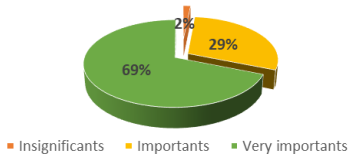

Figure 3: Relative frequency of citation (% of respondents) of different levels of importance attached to income from the sale of *T. conophorum* seeds

3.5. Farmers' perceptions on the impact of harvesting methods

The most common harvesting method in the study area is fruit collection from the ground, practised by 100% of respondents. Defoliation, cited by 62 % of respondents, is the second most common method (Figure 5). Other harvesting methods are only rarely mentioned. These are fruit gathering from the tree (11% of respondents), tree cuting (4% of respondents) and debarking (2%). For 100% of respondents who collect fruit from the ground, this method of harvesting poses no threat to the survival of the species.

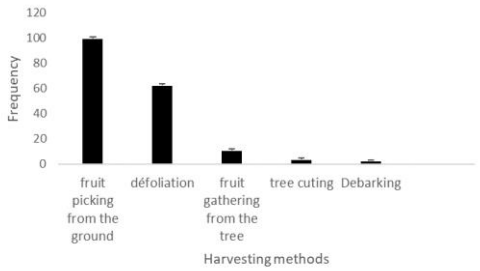

Figure 4: Relative frequency of citation (% of respondents) of different harvesting methods of *T. conophorum* organs

3.6. Perception on the dynamics of *T. conophorum* population

For 44 % of respondents, there has been a decrease in *T. conophorum* individuals over the last decade, whereas for 34% of respondents the tree population has remained stable (Figure 6).

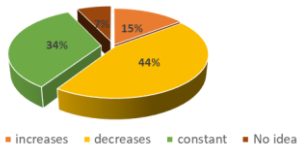

Figure 5: Frequency of of citation (% of respondents) on the population dynamics of *T. conophorum* over the last ten years

However, 15% of respondents perceived an increase in the population of this species, while 7% had no idea about the trend of tree populations of this species over the last ten years,

3.7. Means of acquiring *T. conophorum* trees by peasants

In the villages surveyed, the trees encountered were generally isolated stands in the courtyard of concessions, in the forests or in the cultivated fields. Indeed, 56 % of respondents had inherited it from their parents, 34% had acquired the trees by protecting seedlings found in their fields and 10% of respondents had planted their own trees (Figure 7). The survey revealed that for 92% of the respondents, the practice of growing *T. conophorum* is uncommon.

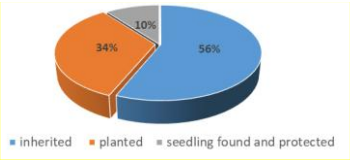

Figure 6: Relative frequency of citation of *T. conophorum* tree means of acquiring

3.7. Perception on the reasons (causes) of non-cultivation of *T. conophorum*

92% of respondents mentioned that *T. conophorum* cultivation is not a common practice in their locality. Respondents mentioned three main reasons for not cultivating the species (Figure 8). These included the difficulty to raise the plant from seeds (51% of respondents), the long duration of the vegetative growth phase, which lasts more than five years (36 % of respondents), and the uncertainty of fruits production by planted individuals (13% of respondents). The respondents mentioned that not all stands would produce fruits at maturity. All respondents (100%) were willing to cultivate the species if appropriate methods for propagating productive individuals were provided.

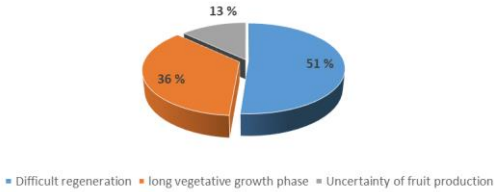

Figure 7: Relative frequency of citation (% of respondents) of the different causes of disinterest in *T. conophorum* cultivation

3.8. Influence of the sociodémographic profil on the différent perceptions

Table 5 shows that the possession of *T. conophorum* trees was influenced by the age ($\chi2$ = 6.47, p = 0.039) and village ($\chi2$ = 12.41, p = 0.0061) of respondent. Thus, the owners of *T. conophorum* stands were most abundant in 25-50 years age group and in Santchou.Peasent's perception on the income generated by the species was influenced by genus ($\chi2$ = 11.79, p = 0.002). In the villages surveyed, it was noted that more women (27%) than men (3%) estimated the income generated important while 50% of men considered it very important compared to women (19%).

The respondents' perception on the sustainability of harvesting methods is influenced by the marital status (p = 0.0006), the village surveyed (p = 0.0326) and the age of the respondent (p < 0.0001). Indeed, most of respondents who felt that the harvesting methods are sustainable were married people surveyed in Santchou and belonging to the 25-50 years age group.

Table 5: Khi^2 independence test between the socio-demographic profil of the populations surveyed and their different perceptions

	Level of income	Use	Possession	Cultivation habits	Survival
Age	$\chi2$ = 2,511	$\chi2$ = 5,991	$\chi2$= 6,479	$\chi2$ = 0,101	$\chi2$ = 39,66
	p = 0,285	p = 0,213	p = 0,0392*	p = 0,9507	p = <0,0001*
Gender	$\chi2$ = 11,79	$\chi2$= 9,488	$\chi2$ = 3,797	$\chi2$ = 3,196	$\chi2$ = 2,975
	p = 0,0027*	p = 0,866	p = 0,051	p = 0,2023	p = 0,0845
Marital	$\chi2$ = 0,452	$\chi2$ =10,88	$\chi2$ = 1,134	$\chi2$ = 4,122	$\chi2$ = 3,439
Status	p = 0,7975	p = 0,0043*	p = 0,2569	p = 0,1273	p = 0,0006*
Profession	$\chi2$ = 4,891	$\chi2$ = 6,33	$\chi2$ = 6,296	$\chi2$ = 4,122	$\chi2$ = 3,535
	p = 0,4293	p = 0,7868	p = 0,2785	p = 0,1273	p = 0,6181
Education	$\chi2$ = 0,3286	$\chi2$ = 1,272	$\chi2$ = 0,345	$\chi2$ = 41,97	$\chi2$ = 0,355
level	p = 0,8485	p = 0,866	p = 0,8412	p = <0,0001*	p = 0,1868
Villages	$\chi2$ = 3,360	$\chi2$ = 9,124	$\chi2$= 12,41	$\chi2$ = 0,578	$\chi2$= 8,763
surveyed	p = 0,3393	p = 0,1667	p = 0,0061*	p = 0,9015	p = 0,0326*

* Significant influence

4. Discussion

The present study reports that different organs of *T. conophorum* are subject to three different categories of use in the study area, namely the uses as food, medicine and fuelwood. These uses are part of the ecosystem services of supply. They also reflect people's interest in the species and confirm the idea that rural people make good use of the forest's ecosystem services to which they are closely linked. These results corroborate those of Séguena *et al.* [21], Vroh *et al.* [22], Mbakop *et al.* [23], and Atchioutchoua *et al.* [24] who reported that the most cited ecosystem services of supply are usualy food, medicine, energy supply and handicrafts.

In the usage as food, the organ cited is the seed, which is consumed raw or after boiling, or used as ingredient in the preparation of a sauce. These usages have also been reported by several authors [25, 16]. In the same vein, Ngom *et al.* [16] reported that in Senegal these seeds are either consumed directly or used to make drinks.

In the study area, the respondents reported that the seeds, leaves and bark have medicinal properties. These usages have previously been reported by Zima *et al.* [26], Ngoye [27], Zanh *et al.* [28] and Sambou *et al.* [29]. These authors also mentioned that in African pharmacopoeia, the most widely used plant parts are bark, leaves and seeds. Our results are consistent with these findings. Local populations of the study area are aware of the medicinal virtues of this plant that they use for their daily care because of the high costs of drugs from the pharmaceutical industry. Indeed, more than 80% of the populations in Africa use medicinal plants for their health care [30]. Surveys conducted in this study did not report any use of the roots in traditional medicine. This contrasts with Igboko [31] who reported that the roots were used for haemorrhoids, scorpion bites and varicose ulcers. For Ayoola *et al.* [32], the roots are also used in Nigeria to control high blood pressure and diabetes. The infusion of the leaves is used to treat diseases such as typhoid and dysentery. These results corroborate those of Ajaiyeoba and Fadare [33] who also reported the use the leaves to relieve dysentery in Nigeria. In addition to their dietary value, the seeds are reported to increase male sexual performance and to cure indigestions. These results corroborate those of Enujiugha [34] and Ikpemel [35] for whom the seeds have a significant effect on the level of testosterone and estradiol and also those of Alade and Umukoro [36] for whom the seeds would increase sexual performance. In addition, Tapsell *et al.* [37] reported that the seeds of the species are used to treat indigestion, constipation and diarrhoea. For Nwaoguikpe [38], consumption of *T. conophorum* seeds is reported to increase protection against proliferative diseases, oxidative stress and endothelial dysfunction. All these medicinal properties of *T. conophorum* are attributed to its high content in phenolic compounds such as gallic acid, catechin, chorogenic acid, caffeic acid, coumarins, rutins [39].

Respondents mentioned that the trunk and branches are used as fuelwood. These findings are in line with Sarr *et al.* [40], PND [41] and Mbakop *et al.* [42], who reported wood fuel in the form of firewood and charcoal as the main source of household energy in rural Africa.

Fruit collection from the ground was cited as the most common harvesting method, while fruits picking from the tree was the least common. According to respondents, picking fruits causes the death of the tree, whereas collecting from the ground guarantees its survival. Moreover, the colour of the fruit doesn't change when it ripens. So, the only way to be sure of the ripeness of the fruit is when it detaches itself from the mother plant.

Income from the sale of *T. conophorum* seeds was considered very important by most of respondents. This is in line with the findings of Jiofack *et al.* [17], following socio-economic surveys in the Mbam & Inoubou administrative Division, which revealed that the commercialisation of conophor nuts provides valuable income. Similarly, Mezajoug [43], and Gambi *et al.* [9], reported that in rural areas, in addition to being used in African diet, *T. conophorum* seeds also provide peasants with substantial income through their sale in local markets.

Despite the importance of the income generated by the sale of *T. conophorum* fruits, the cultivation of the species was reported as being not common. The exploited stands in the field are mostly either inherited from parents or found and protected during the establishment of agricultural plots. These results are consistent with those of Jiofack [44] who reported that in Mbam & Inoubou Division, one of the study areas of the present study, most farmers limit their conservation strategy to protecting *T. conophorum* wildings, rather than planting the species.

The almost non-existent practice of cultivating the species is largely attributed to the difficulty of germinating the seeds. According to Baskin and Basking [45], the inability of a viable seed to germinate when placed in conditions favourable to germination is called dormancy. These seeds would therefore have a dormancy problem. Further investigations are needed to confirm this. Another reason for the lack of cultivation of the species is the uncertainty of seed production. Indeed, according to the respondents, all the individuals of the species do not produce fruits. This is common in many higher plants, and precisely in dioecious species such as *Canarium schweinfurthii* [46], of which only the female stands are capable of producing fruits. During the vegetative growth phase, which may last many years, there is no index to distinguish male from female individuals.

5. Conclusion

In Cameroon, peasants are familiar with *Tetracarpidium conophorum*, which they use for food, medicine and energy supply. These peasants perceive the exploitation of the species as contributing significantly to their well-being. This indicates that *T. conophorum* would be an interesting candidate for participatory domestication in the areas where it is still exploited in the wild, for the intensification of agro-forestry systems. For this purpose, further studies aiming at enhancing seed germination in one hand, and establishing an efficient protocol for vegetative propagation of fruit-producing individuals in another hand are needed.

References

1. Marshall E., Newton A.C. & Schreckenberg K. 2003. Commercialization of non timber forest products: First steps in

analysing the factors influencing success. *Int. For. Rev.* 5 (2):128-137.
2. Debroux L., Hart T., Kaimowitz D., Karsenty A., Topa G. 2007. Forest in post-conflict in Democratic Republic of Congo: Analysis of a Priority Agenda. CIFOR, the World Bank and CIRAD.
3. Babulo B., Muys B., Nega F., Tollens E., Nyssen J., Deckers J. & Mathijs E. 2009. The economic contribution of forest resource use to rural livelihoods in Tigray, Northern Ethiopia. *For. Policy Econ.* 11: 109-117.
4. Lescuyer G. 2010. Importance économique des produits forestiers non ligneux dans quelques villages du Sud-Cameroun. *Bois for. trop.* 304 (2) : 15-24.
5. FAO 1999. Les Produits Forestiers Non Ligneux et la création des revenus. FAO, Rome, 125 P.
6. Awono A., Manirakiza, D. & Ingram 2008. Étude de base de *Prunus africana* dans les provinces du Nord-ouest et du Sud-est Cameroun. Projet "mobilisation et renforcement des capacités des petites et moyennes entreprises impliquées dans les filières des Produits Forestiers Non Ligneux en Afrique centrale". FAO, CIFOR et SNV, 104 P.
7. Biloso A. & Lejoly J. 2006. Etude de l'exploitation et du marché des produits forestiers non ligneux à Kinshasa. *Tropicultura* 24 (3): 183-188.
8. Apema R., Mozouloua D. & Madiapevo S.N. 2010. Inventaire préliminaire des fruits sauvages comestibles vendus sur les marches de Bangui. In: X. van der Burgt, J. van der Maesen & J-M. Onana (eds), Systématique et conservation des plantes africaines, Proceedings of the 18th AETFAT congress, Yaoundé, Cameroon, pp 313-319.
9. Gambi K.G., Moganga B.B., Mweru J.P.M. 2021. Contribution à l'étude de la filière « Kasu » *Tetracarpidium conophorum* (Mull.Arg) Hutch & Dalz (Euphorbiaceae) : un des produits forestiers non ligneux de Kisangani et ses environs (R.D. Congo). *J.Bbus. Manag.* 7 (1): 31-48.
10. Noubissie E., Tieguhong, Julius J.C. & Ousseynou N. 2008. Analyse des aspects socioéconomiques des produits forestiers non-ligneux (pfnl) en Afrique centrale, FAO, IJRDO.
11. Kouakou K.A., Barima Y.S.S., Kouakou A.T.M., Sangne Y.S., Bamba I. & Kouamé N.F. 2015. Diversité végétale post-conflits armés de la Forêt Classée du Haut-Sassandra (Centre-Ouest de la Côte d'Ivoire). *J Anim Plant Sci.* 26: 4058-4071.
12. Betti J.L. 2016. Monitoring the implementation of *Prunus africana* (Rosaceae) management plans in Cameroon: Respect of National Norms. 33P.
13. Ehiagbanare J.E. & Onyibe H.I. 2007. E**ff**ect of pre-sowing treatments on seed germination and seedling growth of *Tetracarpidium conophoru**n*** Mull. *Afr. J. Biotechnol.* 6(6): 97–698.
14. Burkill H.M. 1984. The useful plants of West Tropical Africa: Families E-I. *Royal Botanical Garden Kew* 2**:** 127–128.
15. Jiofack T.B.R, Fokunang C., Guedje M.N., Kemeuze V., Fongnzossie E., Nkongmeneck B.A., Mapongmetsem P.M. & Tsabang N. 2010. Ethnobotanical uses of medicinal plants of two ethnoecological regions of Cameroon. */ Int. J. Med. Med. Sci.* 2(3): 60-79.
16. Ngom D., Charahabil M.M., Sarr O., Bakhoum A. & Akpo L.E. 2014. Perceptions communautaires sur les services écosystémiques d'approvisionnement fournis par le peuplement ligneux de la Réserve de Biosphère du Ferlo (Sénégal). *VertigO : la Revue Electronique en Sciences de l'Environnement* 14 (2) Doi : 10.4000/vertigo.15188.
17. Jiofack T.B.R., Lejoly J., Tchoundjeu Z. & Guedje M.N. 2012. Agroforestry and socioeconomic potential of a non-conventional liana: *Tetracarpidium conophorum* (Müll. Arg.) Hutch. & Dalz. in Cameroon. *Bois for. trop.* 313 (3) : 35-45.
18. Lambi M.C.., Neba N.E. 2009. Ecology and Natural Resource Development in the Western Highlands of Cameroon: Issues in Natural Resource Management. *African Books Collective*, pp 62–63.
19. Dossou M.E, Houessou G.L., Lougbégnon O.T., Tenté A.H.B., Codja J.T.C. 2012. Etude ethnobotanique des ressources forestières ligneuses de la forêt marécageuse d'Agonvè et terroirs connexes au Benin. *Tropicultura* 30(1): 41-48.
20. Thomas E., Vanderbroek I., Sanca S., Van Damm P. 2009. Cultural significance of medicinal plant families and speciesamong Quechua famers in Apillapampa, Bolvia. *J Ethnopharmacol.* 122 (1): 60-67.
21. Seguena F., Soro K., Soro D., N'Guessan K. 2013. Savoir-faire des populations locales des taxons du Jardin Botanique de Bingerville, Côte d'Ivoire. *J Appl Biosci.* 68 : 5374-5393.
22. Vroh B.T.A., Ouattara D & Kpangui K.B. 2014. Disponibilité des espèces spontanées à usages traditionnels dans la localité d'"Agbaou, Centre-Ouest de la Côte d'"Ivoire. *J Appl Biosci*. 76: 6386-6396.
23. Mbakop N.C. 2021. Etude ethnobotanique et caractérisation de la germination des graines et du bouturage des tiges chez *Diospyros mespiliformis* Hochst. (*Ebenaceae*) au Tchad. Thèse. Université de Dschang, 135 P.
24. Atchioutchoua S.R., Kanmegne G. & Tsopmbeng N.G.R. 2022. Peasants' perceptions on the socioeconomic importance and cultivation practice of Canarium schweinfurthii Engl. (Black olive tree) in the Western Highlands of Cameroon. *Cameroon J Exp Biol.* 16(1): 61-66.
25. Vivien J. & Faure J.J. 1985. Arbres des forêts denses d'Afrique Centrale. Ministère des Relations extérieures, de la Coopération et du Développement, Paris, France, ACCT, 565 P.
26. Zima G.G.S. 2009. Intérêt socio-économique du pourghère (*Jatropha curcas*. L) : Utilisations actuelles et potentielles dans les villes de Brazzaville (République du Congo) et de Bangui (République Centrafricaine). Mémoire, Université de Bangui, 59 P.
27. Ngoye A. 2010. Revue bibliographique sur les produits forestiers non-ligneux (PFNL): cas du Gabon, Establishment of a Forestry Research Network for ACP Countries (FORENET), 59 P.
28. Zanh G.G., Barima Y.S.S., Kouakou K.A. & Sangne Y.C. 2016. Usages des produits forestiers non-ligneux selon les communautés riveraines de la forêt classée du Haut-Sassandra (Centre-Ouest de la Côte d'ivoire), *Int J Pure Appl Biosci*. 4(5): 212-225.
29. Sambou A., Camara B., Goudiaby A.D.K., Coly A. & Badji A. 2018. Perception des populations locales sur les services écosystémiques de la forêt classée et aménagée de Kalounayes (Sénégal). *Revue Francophone du Développement Durable* 6: 69-86.
30. Mpondo M.E., Ngene J.P., Som M.L. & Loe E.G. 2017. Connaissance et usages traditionnels des plantes médicinales du département du Haut Nyong. *J Appl Biosc.* 113: 11229-11245.
31. Igboko D.O. 1983. Phytochemical studies on *Garcinia Kola* Heckel. MSc Thesis, University of Nigeria, Nsukka, 202 p.
32. Ayoola P.B., Onawumi O. & Faboya P.O. 2011. Chemical evaluation and nutritive values of *Tetracarpidium conophorum* (Nigerian walnut) seeds. *J Pharm Biomed Sci* . 11(15): 1-5.
33. Ajaiyeoba E.O. & Fadare D.A. 2006. Antimicrobial potential of extracts and fractions of the African walnut—*Tetracarpidium conophorum*. *Afr. J. Biotechnol.* 5 (22): 2322–2325.
34. Enujiugha N.V. 2003. Changes during the fermentation of African oil bean (*Pentaclethra macrophylla* Benth) seeds. *Pak. J. Nutr.* 2 (5): 320-323.

35. Ikpemel E.V., Ekaluo U.B., Udensi O., Ekerete E.E., Ekpo P.B. & Asuquo B.O. 2014. Sperm quality and hormone profile of male albino rats fed with seeds of African walnut (*Tetracarpidium conophorum*, Mull.). *Annu. Rev. Res. Bbiol.* 4(9) : 1379–1386.
36. Alade A.C. & Umukoro S. 2011. Physopharmacological properties of an aqueous extract of *Tetracarpidium conophorum* Hutzh and Dalziel in mice. *J Nat Med.* 65(3-4):411-416.
37. Tapsell L.C., Gillen I.J. & Patch C.S. 2004. Including walnuts in a low-fat/modified-fat diet improves HDL cholesterol-to-total cholesterol ratios in patients with type 2. Diabetes Care 27(12): 2777-83.
38. Nwaoguikpe R.N., Ujowundu C.O., & Wesley B. 2012. Phytochemical and Biochemical compositions of African walnut [*Tetracarpidium conophorum*]. *Int. J. Pharm. Sci.* 20(09): 1-5.
39. Akomolafe S.F., Oboh G., Akindahunsi A.A. & Afolayan A.J. 2015. *Tetracarpidium conophorum* Mull. Arg. Hutch and Daziel inibits FeSO4- induced lipid peroxydation in rats genitals. *BMC Complement Altern Med. 15:57.*
40. Sarr O., Ngom D., Bakoum A., & Akpo L. 2013. Dynamique du peuplement ligneux dans un parcours agrosylvopastoral du Sénégal. *VertigO - La revue Electronique en Sciences de l'Environnement* 13 (2).
41. PND (Plan National de Développement) 2016. Rapport de réalisation des objectifs de développement durable. République du Tchad. 25 P.
42. Mbakop N.C., Kanmegne G. & Fonkou T. 2019. Perceptions paysannes sur les services écosystémiques d'approvisionnement, la vulnérabilité et les strategies de conservation de *Diospyros mespiliformis* Hochst en zone soudannienne du Tchad. *Cameroon J Exp Biol* 14(2): 35-42.
43. Mezajoug K. 2010. Propriétés nutritionnelles et fonctionnelles des protéines de tourteaux, de concentrats et d'isolats de *Ricinodendron heudelotii* (Bail.) Pierre ex Pax et de *Tetracarpidium cconophorum* (Müll.Arg), Thèse de Doctorat, Université de Ngaoundéré, 226 P.
44. Jiofack T.B.R. 2014. Gestion des populations d'un produit forestier non ligneux à usage multiple: *Tetracarpidium conophorum* (Mull. Arg) Hutch. &Dalz. (Euphorbiaceae) dans les systèmes d'aménagement forestier au Cameroun. Thèse de Doctorat, Université de Kinshasa, 286 P.
45. Baskin J. M. & Baskin C.C. 2004. A classification system for seed dormancy. *Seed Sci. Res.* 14: 1-16.
46. Njoukam R. & Peltier R. 2002. L'aiélé (*Canarium Schweinfurthii* Engl.) : premier essai de plantation dans l'Ouest du Cameroun. *Fruits* 57 : 239-248.