

Understanding the *Coula edulis*, *Dacryodes buettneri* and *Irvingia gabonensis* non-timber forest product value chains from Makokou, North-East Gabon from a gender perspective

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HIGHLIGHTS

- Evidence is provided on the gendered aspects of NTFP value chains given Gabon's "Decade of women 2017–2027" policy.
- The value chains of *Coula edulis*, *Dacryodes buettneri*, and *Irvingia gabonensis*, non-timber forest products from Makokou have highly gender-differentiated participation where women dominate in all three chains.
- NTFPs provide a seasonal means of livelihood.
- The lack of income generation opportunity and employment were cited as key drivers to engage in the trade.
- Climate change, deforestation, and unsustainable forest resource management were reported as the main threats to the NTFPs and their value chains.

SUMMARY

Trade-in Non-Timber Forest Products (NTFPs) in the Congo Basin is a source of cash income for stakeholders in their value chains, from harvesters to traders. However, gender-disaggregated data on the benefits of such trade in Gabon remains poorly captured and used by policy-makers, despite a decree on women's empowerment enacted by the Republic of Gabon in 2017. This study assesses gender dynamics, reasons for entering the trade, economics, and perceived threats to *Coula edulis*, *Dacryodes buettneri*, and *Irvingia gabonensis* value chains originating in Makokou, Gabon. Data from field observations, key informants, and 79 semi-structured interviews with stakeholders in three markets showed that activities in the value chains of these three NTFPs were highly gender-differentiated. Women dominate in all three chains, particularly in the two lower-value products. This was driven by women's vulnerability and men's preference for higher-value timber and NTFPs. Both men and women enter the trade mostly because they lack other ways to generate income and employment. The men involved in the chains tended to harvest slightly larger volumes and sell at higher prices. The NTFPs and their value chains were all perceived as threatened by climate change, deforestation, and unsustainable forest resources management, with both men and women aware of these threats. The importance of the NTFP trade for women suggested that policies and gender focus interventions, for example on domestication, cultivation, value-adding to improve and sustain their income, could contribute to more sustainable value chains and livelihoods.

Keywords: Gabon, gender dynamics, household economics, NTFPs-value chains, threats

Comprendre la chaîne de valeur de *Coula edulis*, *Dacryodes buettneri* et *Irvingia gabonensis*, des produits forestiers non ligneux issus de Makokou, au nord-est du Gabon du point de vu genre

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Le commerce des produits forestiers non ligneux (PFNL) dans le bassin du Congo est une source de revenus en espèces pour les parties prenantes de leurs chaînes de valeur, des récolteurs aux négociants. Cependant, les données ventilées par sexe sur les avantages d'un tel commerce au Gabon restent mal saisies et utilisées par les décideurs, malgré un décret sur l'autonomisation des femmes promulgué par la République du Gabon en 2017. Cette étude a évalué la dynamique de genre, les raisons de l'entrée dans le commerce, l'économie et les menaces perçues pour les chaînes de valeur de *Coula edulis*, *Dacryodes buettneri* et *Irvingia gabonensis* originaires de Makokou, au Gabon. Les données des observations sur le terrain, des informateurs clés et de 79 entretiens semi-structurés avec les parties prenantes de trois marchés montraient que les activités dans les chaînes de valeur de ces trois PFNL étaient fortement différenciées selon le sexe. Les femmes dominaient dans les trois chaînes, en particulier dans les deux produits de moindre valeur. Cela était dû à la vulnérabilité des femmes et à la préférence des hommes pour le bois et les PFNL de plus grande valeur. Les hommes et les femmes entraient dans le commerce principalement en raison de

l'absence d'emploi. Les hommes impliqués dans les chaînes avaient tendance à récolter des volumes légèrement plus importants et à vendre à des prix plus élevés. Les PFNL et leurs chaînes étaient tous perçus comme menacés par le changement climatique, la déforestation et la gestion non durable des ressources forestières, les hommes comme les femmes étant conscients de ces menaces. L'importance du commerce des PFNL pour les femmes a suggéré que les politiques et les interventions axées sur le genre, par exemple sur la domestication, la culture, la valeur ajoutée pour améliorer et maintenir leurs revenus, pourraient contribuer à des chaînes de valeur et des moyens de subsistance plus durables.

Comprender la *Coula edulis*, *Dacryodes buettneri* y *Irvingia gabonensis* valor del producto forestal no maderable de cadenas de Makokou, noreste de Gabón de un género perspectiva

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El intercambio de productos forestales no maderables (PFNM) en la cuenca del Congo es una fuente de ingresos en efectivo para las partes interesadas en sus cadenas de valor, desde los recolectores hasta los comerciantes. Sin embargo, los datos desglosados por género sobre los beneficios de dicho comercio en Gabón siguen siendo mal capturados y utilizados por los encargados de formular políticas, a pesar de un decreto sobre el empoderamiento de las mujeres promulgado por la República de Gabón en 2017. Este estudio evaluó la dinámica de género, las razones para ingresar al comercio, la economía y las amenazas percibidas a las cadenas de valor de *Coula edulis*, *Dacryodes buettneri* e *Irvingia gabonensis* originarias de Makokou, Gabón. Los datos de observaciones de campo, informantes clave y 79 entrevistas semiestructuradas con partes interesadas en tres mercados muestran que las actividades en las cadenas de valor de estos tres PFNM estaban muy diferenciadas por género. Las mujeres dominan en las tres cadenas, particularmente en los dos productos de menor valor. Esto fue impulsado por la vulnerabilidad de las mujeres y la preferencia de los hombres por la madera de mayor valor y los PFNM. Tanto hombres como mujeres ingresan al comercio principalmente porque no tienen empleo. Los hombres involucrados en las cadenas tendían a cosechar volúmenes ligeramente mayores y vender a precios más altos. Los PFNM y sus cadenas fueron percibidos como amenazados por el cambio climático, la deforestación y el manejo insostenible de los recursos forestales, y tanto hombres como mujeres eran conscientes de estas amenazas. La importancia del comercio de PFNM para las mujeres sugirió que las políticas y las intervenciones centradas en el género, por ejemplo en la domesticación, el cultivo, la adición de valor para mejorar y mantener sus ingresos, podrían contribuir a cadenas de valor y medios de vida más sostenibles.

INTRODUCTION

The Congo Basin is the second-largest tropical forest after the Amazon, with a rich biodiversity of over 7,000 plant species (Sosef *et al.* 2006) and 1,200 floral species inventoried (Amalfi *et al.* 2010, Yombiyeni *et al.* 2011, Sonke *et al.* 2012). Thus, out of 58 botanical plant families identified, 41 are used for food, 29 for traditional healthcare, and 15 for building materials. Due to the social, cultural and economic values of such forest and derived products (including Non-Timber Forest Products (NTFPs)) used for food, fuel, medicine, building materials and to generate cash income, they may form a key component in the livelihoods of both rural and urban communities in Africa (Leakey *et al.* 2005, Akinnifesi *et al.* 2006).

In Cameroon for example, *Irvingia gabonensis* (bush mango or odika), is a multipurpose fruit tree and represents also a priority indigenous fruit tree in the central African region with its wood used for making utensils, and fruits are used for food, income generation and medicine (Ayuk *et al.* 1999, Mateus-Reguengo *et al.* 2019). Odika nut kernels are cracked and dried to make a sauce that is commonly used in Gabonese traditional cuisine (Lescuyer and Ntougou 2006, Sassen and Wan 2006, Iponga *et al.* 2018a). According to Ofundem *et al.* (2017) and Nfornkah *et al.* (2018), kernels of this species are acknowledged as one of the most important NTFP in Cameroon. Likely, up to five *Irvingia* species and three other species (*Klainedoxa* and *Desbordesia*) are sold under the term collective bush mango (Gallois *et al.* 2020). *Coula edulis* and *Dacryodes buettneri* (Ozigo or atanga

sauvage) are also known as nutritious fruit-producing trees (having edible fruits and seeds). Atanga sauvage fruits are eaten raw or lightly boiled, as a snack or with meals, or processed for oil and the noisettes are cracked and eaten raw or roasted as a popular snack. Both are sources of timber (Ozigo wood is sold in domestic and international markets) and NTFP (sources of food, income generation, and medicine) (Vivien and Faure 1988, Todou *et al.* 2014).

In Gabon, as in other Congo Basin countries, the consumption and use of NTFPs is a component of subsistence livelihoods for rural communities and a source of income, often part of diversified livelihood strategies (Leakey *et al.* 2005, Akinnifesi *et al.* 2006, Christian and Kasumi 2014, Yobo and Ito 2015, Iponga *et al.* 2018a). NTFPs are also socio-economically important, with products such as safou (the fruits of *Dacryodes edulis*), atanga sauvage (the fruits of *Dacryodes buettneri*), essok (*Garcinia lucida* Vesque bark), cola nuts (from *Cola nitida* and *Cola acuminata*), bitter kola (*Garcinia kola* Heckel), njangsang (seeds of *Ricinodendron heudelotii*), odika (nuts of *Irvingia gabonensis*), moabi (*Baillonella toxisperma* nuts) and noisette (*C. edulis* nuts) among the most popular NTFPs consumed and traded in Gabon (Iponga *et al.* 2018b).

Gender is defined as socially constructed, gendered norms and practices translating into different rights, opportunities, and constraints across cultures, families, and livelihoods. According to Agarwal (1997), it can influence a person's ability to access, use, own goods and resources, and overall affect their ability to exert agency over their livelihood strategies. Gender differences in how people use and benefit from timber

and NTFPs have been widely acknowledged (Ingram *et al.* 2014, Wiersum *et al.* 2014). Such gendered differences are particularly evident in the trade-in NTFPs as they move from the forest via harvesters to traders, and eventually to consumers (Haverhals *et al.* 2014). Gender roles refer to socially defined tasks and responsibilities considered appropriate for men and women (Manfre and Rubin 2012). As gender roles and responsibilities are dynamic and evolve in response to changing circumstances, needs, and interests of actors; gender-disaggregated data can clarify the challenges and benefits encountered by each group. It also contributes to better inform and implement policy decision-making and improve governance arrangements (Mai *et al.* 2011).

Conversely, the lack of gender-disaggregated data undermines gender mainstreaming in NTFP policy (Shackleton *et al.* 2011). More attention has been given to gendered roles and responsibilities in NTFP value chains, including highly commercialized NTFP, originating largely from natural or minimally managed forests and fallows (Iponga *et al.* 2018b), and ending in local, regional and international markets (Ingram *et al.* 2014). However, the paucity of current gendered studies of the NTFP trade in Central Africa (Ingram *et al.* 2014) and specifically in Gabon, highlights that this is a research and policy gap (Ngoye 2010).

The Gabonese Constitution n°047/2010 of 12 January 2011 and the Labor Code Act n°3/94 of 21 November 1994 modified by Act n°12/2000 of 12 October 2000 recognize that men and women are equal concerning employment opportunities (République Gabonaise 1994, 2011). The Gabonese government validated a national NTFP strategy and developed an action plan in 2011 regarding NTFPs with high economic potential (FAO 2011). To mainstream gender in policy and practice, the government declared 2017 to 2027 as the Decade for Women. However, in practice, the Gabonese national NTFP strategy has hardly been implemented. There is no gender-specific policy on NTFP governance or trade in Gabon and policymakers lack up-to-date data on men and women's reasons for entering NTFP value chains and their benefits, which are known to change over time, especially when product values change (Ingram 2014, Haverhals *et al.* 2014).

Differences in NTFP values in terms of use and trade are associated with gender, product characteristics, geographical area, ethnic group, the position of stakeholders in the value chain, and customary and statutory regulations (Ingram *et al.* 2014, 2012, Wiersum *et al.* 2014). Gender inequalities are also driven by social labor division, knowledge systems, individual physical capacity, availability of financial and human capital; decision-making ability, and social norms and institutional rules governing access, use, and management of natural resources (Ingram *et al.* 2014). Men in the Central African societies typically have diversified livelihood strategies and women have less room to maneuver due to family responsibilities (Brown and Lapuyade 2001), particularly in remote and rural areas where cash income generation is seen as a men domain (Gladwin *et al.* 2001).

African household gender relations also influence income distribution and expenditure (Njuki *et al.* 2011). The value of

unprocessed and processed forest products harvested by men often surpasses the value of those collected by women, with value differences lower for subsistence than for commercialized products. This suggests that women specialize in collecting and processing forest products used for subsistence, whereas men specialize in their trade, and female-headed households having a stronger reliance on processed and unprocessed forest products income than male-headed households (Sunderland *et al.* 2014). NTFPs consumed and income from their trade can affect food and nutritional security both positively and or negatively (Chiwona-Karltun *et al.* 2017).

Given this context regarding the gendered aspects of NTFP value chains, this paper aimed at clarifying the value chains of three popular NTFPs traded in Gabon, specifically: (i) describing the characteristics and dynamics in the value chains (ii) identifying the gender's reasons for entering into the NTFP value chains, (iii) determining income generated by men and women, (iv) evaluating men's and women's awareness of threats to NTFP species and value chains, and v) discussing opportunities to enhance gender equity and overcome the perceived threats.

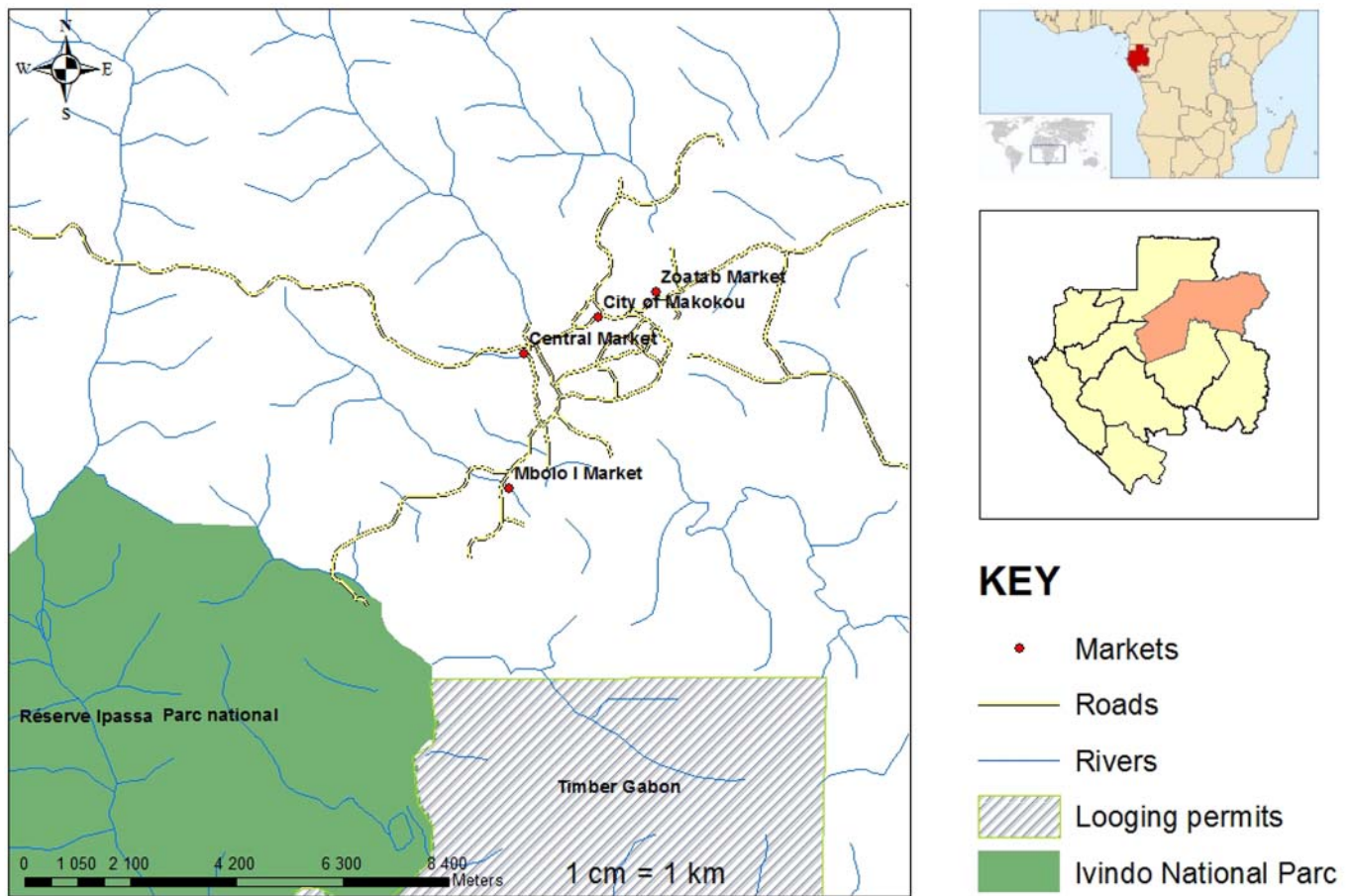
METHODOLOGY

Study area

The study was carried out in the three markets of Makokou, the capital city of Ogooué-Ivindo province, in the northeast of Gabon (Figure 1). The city is located at 632 km from Libreville, the capital city of Gabon. A key characteristic of this site is its proximity to the Ivindo National Park (INP), one of the 13 national parks in Gabon, created in 2002 and covering 300,000 hectares. The park is an extension of the Ipassa Biosphere Reserve of 10,000 hectares, established in 1979. Vegetation cover in the Park consists of dense, old moist forest typical of the Guinea-Congolese basin. The west and south areas of the Park have more of an Atlantic ecosystem, with a strong dominance of *Okoumé* (*Aucoumea klaineana*) while the north and eastern parts of the Park contain very old dense forest stands dominated by the *Caesalpinioideae* family.

Makokou is characterized by an equatorial climate, with an alternation of two dry (mid-December to mid-March and mid-June and mid-September) and two rainy seasons (mid-March to mid-June and mid-September to mid-December). The average annual rainfall is about 1600–1800 mm. The mean temperature is about 24 °C with a minimum of 21.7 °C in July and a maximum of 25 °C in April. The vegetation is composed of primary, secondary forests, and flood plain forests and the fauna is rich and diverse. The main livelihood activities of the inhabitants are fishing in the Ivindo and Dji Dji rivers which are braided with numerous parallel channels and islands dominated by *Raphia textilis*, *Newtonia spp.* and *Rubiaceae spp* (IRET/CENAREST 2003). Hunting and agriculture are also among the key livelihood activities carried out by people. The population is estimated at 15,000 people comprised of Bantu – in two main dominant ethnic groups- the Kota and Fang and the Baka ethnic group (Betti *et al.* 2013).

FIGURE 1 Surveyed markets in Makokou (0 23'-0 33'N, 0 42'-12 49E), Ogooué Ivindo, Gabon



Makokou was selected as an area that is known for the harvest and sale of NTFP (Sassen and Wan 2006, Betti *et al.* 2013, Iponga *et al.* 2018a). Three of the most popular indigenous multiple-use forest species in Gabon and Makokou were selected for this study due to their high market (timber and non-timber values) and consumptive, and nutritious values: Atanga sauvage fruits (*Dacryodes buettneri*), odika kernels (*Irvingia gabonensis*), and noisettes (*Coula edulis*) (Christian and Kasumi 2014, Yobo and Ito 2015, Iponga *et al.* 2018b). Atanga sauvage, noisettes, and odika nut kernels are all used either for their timber, economic (trade of processed into kernels or oil and unprocessed), consumptive (fruits and snack), medicinal (bark), and nutritious values (Lescuyer and Ntougou 2006, Sassen and Wan 2006, Iponga *et al.* 2018a). In the Rougier forest concession, located around 5 km from the park, NTFP harvesting is permitted, with customary rights granted for local communities by the 2001 Forest Code.

Data collection and analysis

Data were collected through field observations and semi-structured questionnaires. The stakeholders in the value chains in Makokou were interviewed during December to February 2011, the mid-dry season. Discussions with key informants (representatives from the Ministry of Water and Forestry, staff from the Institut de Recherche en Ecologie

Tropicale (IRET) and Centre National de la Recherche Scientifique et Technologique (CENAREST) at the Makokou research station and local chiefs) and a market reconnaissance survey were used to identify and categorize stakeholders in the value chain into harvester-traders, those who harvest and carry out preliminary processing and trading, and traders; those who only sell NTFPs.

In total, 80 stakeholders were active in the markets both regularly and on an occasional basis. Table 1 shows the 79 harvester-traders and traders interviewed in the three markets, representing 98% of the total stakeholders, as one stakeholder refused to participate in the study. Interviews were adapted to each category of stakeholder, and both questionnaires included the respondent’s socioeconomic characteristics such as the market value of the three NTFPs; the value and type of

TABLE 1 Number of harvesters and traders interviewed in three Makokou markets, Gabon

| Market | Traders | Harvester-traders | Total |
|--------|---------|-------------------|-------|
| Zoatab | 0 | 31 | 31 |
| Affane | 3 | 28 | 31 |
| Mbolo | 0 | 17 | 17 |
| Total | 3 | 76 | 79 |

other income sources in 2011; perceptions of the threats to NTFP species and the value chains, and potential solutions to overcome such threats.

The calculation of the average gross income of stakeholders was based on the average amount of NTFPs sold per month in the whole year of 2011, multiplied by the average selling price, multiplied by the sales frequency per month for that period or season of the year (Shackleton 2005). Production costs were not obtained, as the respondents did not keep written financial accounts and could not recall labour, investments, and other operating costs, thus limiting the ability to calculate average net income. Market prices are given in African Financial Community Francs (CFAF), the currency used in Gabon (655 CFAF equivalent to one Euro at the time of the survey) and calculated per kg, after calibrating the volumes commonly sold in the markets (cups and heaps) into kilograms.

The Statistical Package for Social Sciences (SPSS 17.0) and Microsoft Excel 1997–2003 were used for descriptive statistics including averages and frequencies. Since the data are non-parametric, a Mann Whitney U test was used to assess any significant differences between the price of each of the three NTFP, all three NTFPs together and gender, although the number of men in the total sample was extremely small, illustrated in the tables and figures.

RESULTS

Stakeholder characteristics and dynamics in NTFP value chains

The activities and stages in all the NTFP value chains are similar. The first step was harvesting, the mature fruits were collected from the ground in the forest and fallows. All three NTFP species are seasonal in terms of harvesting, processing, and trading. Regarding the phenology and reproductive cycle, *I. gabonensis* flowers between July–August with the main period of fruiting from December–March. *C. edulis* and *D. buettneri* flower between May–June and fruit from January and April. According to interviewees, all these fruits are gathered during the rainy season. Once gathered from the forest, the products were transported home, usually carried as headload or on rattan back-baskets and occasionally in baskets by motorbike or vehicle. The second step was related to basic processing.

Odika (*I. gabonensis*) fruits were directly cracked using a machete or were left to rot for about a week and split by a stone to extract the kernels, that were then dried under the sun or over fires. *C. edulis* fruits were split using a machete to obtain the nuts, and then sun-dried. Atanga sauvage (*D. buettneri*) fruits were sold either raw or boiled. The third step was to transport, with distances ranging from less than 1 km up to 4 km from the harvest location to markets. Harvester-traders sold their produce in the daily and weekly markets, often alongside other forest and agricultural products. Some harvester-traders also sold to traders.

The interviews confirmed that stakeholders were active either as harvester-traders (harvesting the NTFPs and then engaging in preliminary processing and trading), and traders (who only retail). Table 2 shows how women dominated in the value chains. Women harvester-traders represented 95% of stakeholders in the value chains. Men were engaged as both harvester-traders and in sole trading.

Table 3 shows the extent to which men and women were involved in one or more of the NTFP value chains. The most popular NTFPs harvested and traded were *I. gabonensis* (95%), followed by *C. edulis* (94%) and *D. buettneri* (88%). The combinations of different products show *C. edulis* and *I. gabonensis* as the most traded (93%), *C. edulis*, and *D. buettneri*, and *D. buettneri* and *I. gabonensis* (87%). Men showed no preference for specific combinations of NTFPs while more women were engaged in *C. edulis* and *I. gabonensis* trade and harvest. Over ninety percent of women harvester-traders were involved in harvesting-trading of all the three NTFPs compared to 10% of men who harvested and traded (7%) or only (3%) traded one product.

Shown in Table 4, the commonest profile of stakeholders in the value chains in the study area was the Gabonese female harvester-trader with an elementary level of education (primary school). Although several ethnic groups were encountered in the study area, women from Kota ethnic groups were the most prevalent, accounting for 60% of interviewees and Mahongwe (19%) – part of the Fang ethnic group. Cohabiting men and women represented 75% and 43% of respondents respectively and were engaged seasonally in harvesting, with many engaged on a part-time basis: 75% of men and 59% of women. The women respondents had a mean age (42.5 years old) which was older than male respondents (40.5 years old). Women respondents had a larger family size of six than men respondents (four). Female respondents tended to have more experience (over 10 years) working in the activity compared to their male counterparts (8.8 years).

TABLE 2 Gender disaggregation of NTFP stakeholders per market in Makokou Gabon

| Market | Harvester-traders | | | | Traders | | | | Total (n=79) | | | |
|--------|-------------------|---|--------|-----|---------|---|--------|---|--------------|----|--------|-----|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| | Number | % | Number | % | Number | % | Number | % | Number | % | Number | % |
| Zoatab | 0 | 0 | 31 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 31 | 100 |
| Affane | 1 | 3 | 28 | 90 | 2 | 6 | 0 | 0 | 3 | 10 | 28 | 90 |
| Mbolo | 1 | 6 | 16 | 94 | 0 | 0 | 0 | 0 | 1 | 6 | 16 | 94 |
| Total | 2 | 2 | 75 | 95 | 2 | 3 | 0 | 0 | 4 | 5 | 75 | 95 |

TABLE 3 Men and women's involvement in three NTFP value chains in Makokou Gabon

| | Harvesters-traders | | | | Traders | | | | Total (n=79) | | | |
|------------------------------------------------------------------------|--------------------|---|--------|----|---------|---|--------|---|--------------|----|--------|----|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| | Number | % | Number | % | Number | % | Number | % | Number | % | Number | % |
| <i>C. edulis</i> (n=65) | 2 | 3 | 60 | 92 | 2 | 3 | 1 | 2 | 4 | 6 | 61 | 94 |
| <i>D. buettneri</i> (n=25) | 2 | 8 | 22 | 88 | 1 | 4 | 0 | 0 | 3 | 12 | 22 | 88 |
| <i>I. gabonensis</i> (n=58) | 2 | 3 | 55 | 95 | 1 | 2 | 0 | 0 | 3 | 5 | 55 | 95 |
| <i>C. edulis</i> and <i>D. buettneri</i> (n=23) | 2 | 9 | 20 | 87 | 1 | 4 | 0 | 0 | 3 | 13 | 20 | 87 |
| <i>C. edulis</i> and <i>I. gabonensis</i> (n=46) | 2 | 4 | 43 | 93 | 1 | 2 | 0 | 0 | 3 | 7 | 43 | 93 |
| <i>D. buettneri</i> and <i>I. gabonensis</i> (n=23) | 2 | 9 | 20 | 87 | 1 | 4 | 0 | 0 | 3 | 13 | 20 | 87 |
| <i>C. edulis</i> , <i>D. buettneri</i> and <i>I. gabonensis</i> (n=29) | 2 | 7 | 26 | 90 | 1 | 3 | 0 | 0 | 3 | 10 | 26 | 90 |

NTFP value chain stakeholder's engagement in other value chains

The NTFP harvester-traders collected and sold other forest products including bushmeat, wrapping leaves (*Marantaceae* spp.), fuelwood and charcoal, crops and livestock, household items, fish products, alcohol, as well as clothing (Table 5). Women harvester-traders were engaged in trading in multiple and different agricultural and forest products, whereas male harvester-traders focused only on other forest products.

Motivations and incomes from the NTFP value chains

Table 6 shows that irrespective of gender, the reasons for stakeholders engaging in the value chains of the three NTFPs were motivated by a lack of formal employment. The engagement of women than men harvester-traders was motivated particularly by not having employment and the need to generate additional income for the household, given the different responsibilities of women and men in contributing to household expenses and different household tasks.

Table 7 presents the average gross income for men and women engaged in the NTFP value chains. The Mann Whitney U test showed no statistically significant differences between gender and selling prices of each of the three NTFP and all the three NTFP. However, men on average generated higher gross income from the sale of *I. gabonensis* and *D. buettneri* than women. Women harvester-traders of *C. edulis* tended to sell at a lower average price. In contrast, women traders tended to gain more average gross annual incomes (165.798 FCFA) for the three NTFPs compared to men (158.806 FCFA). No men traders sold *C. edulis* and *D. buettneri*. Men traders were engaged in the higher per-unit value odika value chain, while women were engaged in all three chains.

Perceptions of threats to NTFP species and value chains

Figure 2 shows that the majority (over 90%) of male and female stakeholders in the NTFP value chains perceived threats to the sustainability of all three NTFP species.

For all the NTFP species, climate change – as indicated by changes in rainfall variability, deforestation-driven by logging operations, and unsustainable use of forest resources were all identified as major threats, especially by female harvester-traders. Respondents indicated that they perceived that the volumes of the three species harvested from the forest had reduced over time.

DISCUSSION

Gendered dynamics in NTFP value chains

The value chains of the three NTFPs in Makokou show gender differences. This reflects studies of other NTFPs in Africa (Shackleton et al. 2011, Ingram et al. 2014, Sunderland et al. 2014, Wiersum et al. 2014, Tieguhong et al. 2015). The reasons for differences in the engagement of women and men in

TABLE 4 Socioeconomic profile of stakeholders in three NTFP value chains in Makokou Gabon

| Socio-economic indicators | | Male | | Female | | Total (n=79) | |
|---------------------------------|-------------------|------------|----|-------------|----|--------------|----|
| | | Number | % | Number | % | Number | % |
| Value chain activity | Harvester-traders | 2 | 50 | 74 | 99 | 76 | 96 |
| | Traders | 2 | 50 | 1 | 1 | 3 | 4 |
| Nationality | Gabonese | 2 | 50 | 74 | 99 | 76 | 96 |
| | Others | 2 | 50 | 1 | 1 | 3 | 4 |
| Education level | None | 0 | 0 | 6 | 8 | 6 | 8 |
| | Primary | 3 | 75 | 57 | 76 | 60 | 76 |
| | Secondary | 1 | 25 | 12 | 16 | 13 | 16 |
| Ethnicity | Kota | 0 | 0 | 46 | 61 | 46 | 58 |
| | Mahongwe | 1 | 25 | 14 | 19 | 15 | 19 |
| | Others | 3 | 75 | 15 | 20 | 18 | 23 |
| Marital status | Concubine | 3 | 75 | 32 | 43 | 35 | 44 |
| | Married | 1 | 25 | 15 | 20 | 16 | 20 |
| | Single | 0 | 0 | 13 | 17 | 13 | 16 |
| | Widow | 0 | 0 | 15 | 20 | 15 | 19 |
| Involvement in the chain | Full-time | 1 | 25 | 31 | 41 | 32 | 41 |
| | Part-time | 3 | 75 | 44 | 59 | 47 | 59 |
| Mean age (Years) | | 40.5 ± 1.7 | | 42.5 ± 11.9 | | 42.4 ± 11.7 | |
| Mean household size (Number) | | 4.2 ± 2.9 | | 6.1 ± 2.6 | | 6.0 ± 2.7 | |
| Mean working experience (Years) | | 8.8 ± 4.2 | | 9.7 ± 7.0 | | 9.6 ± 6.9 | |

TABLE 5 Men and women NTFP stakeholder's engagement in other value chains in Makokou, Gabon

| Engagement in other value chains | Harvester-traders | | | | Traders | | | | Total (n=79) | | | |
|----------------------------------|-------------------|-----|--------|-----|---------|-----|--------|---|--------------|-----|--------|-----|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| | Number | % | Number | % | Number | % | Number | % | Number | % | Number | % |
| Agricultural products | 0 | 0 | 25 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 42 |
| Fish products | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| Brewing | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| Other forest products | 1 | 100 | 33 | 55 | 2 | 100 | 0 | 0 | 3 | 100 | 33 | 55 |
| Total | 1 | 100 | 60 | 100 | 2 | 100 | 0 | 0 | 3 | 100 | 60 | 100 |

Table 6 Reasons for engaging in NTFP value chains in Makokou, Gabon

| Reasons for trading | Harvesters-traders | | | | Traders | | | | Total (N=79) | | | |
|-----------------------------|--------------------|-----|--------|-----|---------|-----|--------|---|--------------|-----|--------|-----|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| | Number | % | Number | % | Number | % | Number | % | Number | % | Number | % |
| Additional source of income | 1 | 50 | 21 | 28 | 0 | 0 | 0 | 0 | 1 | 25 | 21 | 28 |
| Lack of employment | 1 | 50 | 52 | 69 | 2 | 100 | 0 | 0 | 3 | 75 | 52 | 69 |
| Meet consumers needs | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 |
| Total | 2 | 100 | 75 | 100 | 2 | 100 | 0 | 0 | 4 | 100 | 75 | 100 |

TABLE 7 Men and women's average gross income in NTFP value chains in 2011, Makokou, Gabon

| Chain activity | Gender | C. edulis | | | | | D. buettneri | | | | | I. gabonensis | | | | | All 3 NTFPs | | | | |
|--------------------|--------------------|------------------|--------------|---------------------------------|---------------|------------------|-------------------------|---------------------------------|---------------|-------------------------|--------------|---------------------------------|---------------|------------------------|------------------------|---------------------------------|------------------------------|--|--|--|--|
| | | Amount sold (Kg) | Price (FCFA) | Mann-Whitney U Test (Mdn, U, p) | Income (FCFA) | Amount sold (Kg) | Price (FCFA) | Mann-Whitney U Test (Mdn, U, p) | Income (FCFA) | Amount sold (Kg) | Price (FCFA) | Mann-Whitney U Test (Mdn, U, p) | Income (FCFA) | Total amount sold (Kg) | Average price (FCFA) | Mann-Whitney U Test (Mdn, U, p) | Average annual income (FCFA) | | | | |
| Harvester-trader | Female | 62 | | Mdn= (F=32.87, M=35.00) | 22 | 53 | Mdn= (F=12.18, M=19.00) | 22 | 53 | Mdn= (F=29.57, M=28.17) | 53 | 74 | 74 | 74 | Mdn= (F=14.44, M=1.83) | 74 | | | | | |
| | Average per person | 133 | 510 | | 67 | 323 | | 21 641 | 235 | 660 | | 155 100 | 299 | 549 | | 164 151 | | | | | |
| | Std. Dev | 57 | 90 | | 23 | 25 | | 6 905 | 72 | 60 | | 48 014 | 162 | 85 | | 96 157 | | | | | |
| | Male | 2 | | | 2 | 2 | | 2 | 2 | | | 2 | 2 | | | 2 | | | | | |
| Average per person | 120 | 450 | | 70 | 350 | | 24 500 | 240 | 700 | | 168 000 | 430 | 484 | | 208 120 | | | | | | |
| Std. Dev | 0 | 71 | U=114,000 | 8 485 | 14 | 0 | U=15,000 | 4 950 | 0 | 141 | U=78,500 | 33 941 | 14 | 23 | U=24,500 | 37 477 | | | | | |
| Female | 1 | | | 1 | 1 | | 1 | 1 | | 1 | | 1 | 1 | | 1 | | | | | | |
| Average per person | 180 | 400 | | 80 | 350 | | 28 000 | 220 | 700 | | 154 000 | 480 | 550 | | 264 000 | | | | | | |
| Std. Dev | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | | | | | | |
| Male | 0 | | p=.814 | 0 | 0 | | 0 | 2 | 2 | | p=.875 | 2 | 2 | | p=.292 | 2 | | | | | |
| Average per person | 0 | 0 | | 0 | 0 | | 0 | 155 | 600 | | 93 000 | 155 | 600 | | 93 000 | | | | | | |
| Std. Dev | 0 | 0 | | 0 | 0 | | 0 | 35 | 0 | | 21 213 | 35 | 0 | | 21 213 | | | | | | |
| Female | 134 | 508 | | 67 | 324 | | 21 708 | 234 | 661 | | 154 674 | 302 | 549 | | 165 798 | | | | | | |
| Average per person | 120 | 450 | | 70 | 350 | | 24 500 | 198 | 650 | | 128 700 | 293 | 542 | | 158 806 | | | | | | |
| Male | 450 | | | 70 | 350 | | 24 500 | 198 | 650 | | 128 700 | 293 | 542 | | 158 806 | | | | | | |

FIGURE 2 Men and women’s perceptions of threats to NTFP species and value chains (N=79)

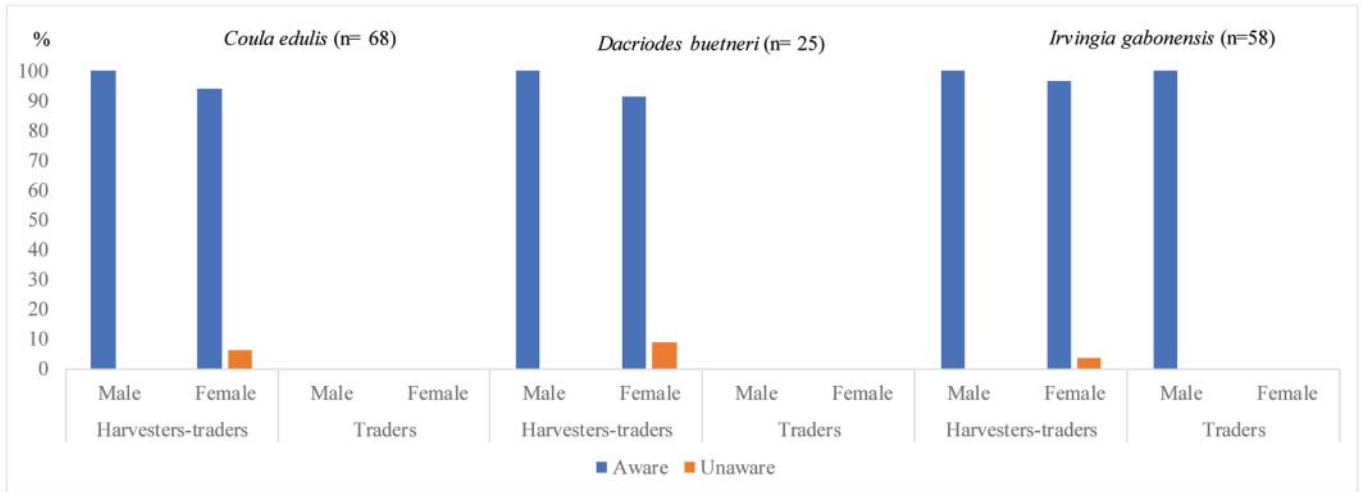
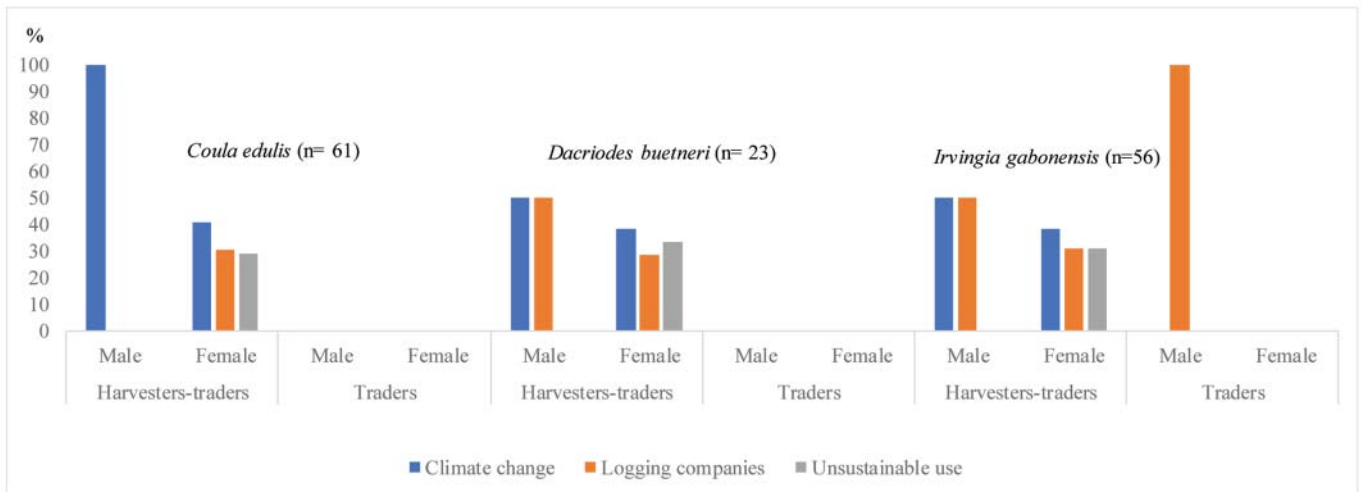


FIGURE 3 Men and women’s perceptions of the causes of the threats to NTFP species



NTFP chains in Africa are influenced by the business size, product specialization, market strategies, product characteristics, the segment of the chain, and customary norms (Shackleton *et al.* 2011, Ingram *et al.* 2014). In this study of three NTFP chains in Gabon, women dominated in all three chains and worked mostly on a part-time basis, as it allowed time for other livelihood activities besides harvesting and trading the NTFPs, such as farming and household work. Men engaged as traders only in the highest value *I. gabonensis* chain, is a common tendency with men’s engagement in this chain in other areas of Gabon (Iponga *et al.* 2018b) and Cameroon (Awono *et al.* 2010, Ingram *et al.* 2017, Awono et Levang 2018). The reasons underlying men’s engagement in this chain can be explained by the fact that the trade-in high-value timber and NTFPs is as a men livelihood activity, particularly when customary rules governing forest resources grant men tenure and access rights (Ingram *et al.* 2014, 2015), and when men engage in larger-scale businesses and specialize in wholesale trade (Awono *et al.* 2002, Pérez *et al.* 2002).

Women dominate in the lower *C. edulis* and *D. buetneri* value chains in Makokou, also reflecting the findings of other

studies. Ndoye *et al.* (1997) found that 94% of market traders in the humid forest zone of Cameroon in low-value NTFPs were women. Pérez *et al.* (2002) pointed out that women dominate in lower value NTFPs chains is due to the less physically demanding nature of the activity and as harvest, processing and trade can be combined with household responsibilities (Brown and Lapuyade 2001, Tieguhong *et al.* 2015). Awono *et al.* (2010) found that a lack of employment, poverty, and economic crisis drove women’s involvement in NTFP value chains in rural and urban areas of Cameroon. Similarly, in the case of this study, the lack of formal employment opportunities has driven more women than men into the trade of the three NTFPs.

In Makokou, women were engaged in both harvesting and trading NTFPs, other forest products, and agricultural products, whereas both men harvester-trader and traders were engaged only in forest products. Such multitasking and diversified sources of incomes are common in Central Africa and forested low and middle-income countries, where women are often responsible for supplying household food needs and selling any surplus, with men concentrating on cash crops and

products (Chiwona-Karlton *et al.* 2017, Haverhals *et al.* 2014, Ingram *et al.* 2014). This can be explained by income inequality being relatively high in Gabon, despite the country being rated as an upper-middle income country (AFDBG 2011). About 32% of the population live in poverty and about 30% classed as economically vulnerable, with monthly incomes below the minimum wage of 150,000 FCFA (approximately € 229) (DGS 2015). In 2016, Gabon ranked 109 out of 188 countries on the United Nations Human Development Index, well below countries with similar per capita GDP. Unemployment is high, at an average of 30% for a population with age under 30-year olds, with an unemployment rate for women under 30-year olds estimated at 27%, compared to 14% for men. Large households with low levels of education and weak labour market skills are among the poorest component of the society (DGS 2015). Thus, women are among the economically vulnerable social groups, and accessing NTFPs in fallow lands and forests as a seasonal livelihood activity represented an important diversified source of income generation.

Gendered income disparities in the three NTFP value chains

In Makokou, the few men involved in the chains are mostly engaged in the higher value and volume of *I. gabonensis* value chain. There were no statistically significant differences between gender and selling prices of each of the three NTFP and all the three NTFP. Although men harvest slightly larger volumes at higher prices, they tend to gain slightly lower average gross annual income from the sale of the three NTFPs per year (158,806 FCFA) compared to women (165,798 FCFA). Given that, the activity and income generation are seasonal with a peak in the approximately three months harvest season, income generation from these NTFPs can be seen as a partial contribution towards the minimum income during the four-month harvest and trade period. The average monthly minimum wage in Gabon is 150,000 FCFA (corresponding to 450,000 FCFA over three months) (DGS 2015). Women harvester-traders tended to engage more in the three NTFP chains than men and earn a higher average gross annual income than men.

This analysis of the three NTFP value chains suggests that the gender differences in income and activity in Makokou are similar to other NTFP value chains in the Congo Basin and elsewhere, with men and women benefitting differently from the same forest products (Voudouhe 2009). Haverhals *et al.* (2014) in a global review and Ingram *et al.* (2014) in a Central African study, found that men tend to gain higher returns from their involvement in NTFP value chains compared to women and that men often dominate high-value NTFPs chains, with specialization allowing them to generate higher incomes and profits, compared to women. However, Ingram *et al.* (2012) found that in Cameroon women engaged in NTFP collection, processing and trade were able to increase selling prices through collective actions and information sharing, raising awareness of environmental issues and practices in forest

resource management which in return enabled greater access to resources and decision-making power on land use.

The slightly lower income gained by women in the sale of fruits (*I. gabonensis*) in Makokou does not mean that women are lesser entrepreneurs compared to men. Men's physical ability to harvest larger amounts of forest products and their better bargaining power might explain why men tend to be more successful in controlling high-value NTFP chains (Shackleton *et al.* 2011). However, when NTFP value chains are informal and invisible to policymakers, and characterized by low opportunity costs, of a seasonal and part-time nature, this also enables women to combine NTFP value chain activities with household duties and family responsibilities (Ingram *et al.* 2014). Informal value chains (i.e. not regulated by state regulations) are known to enable large numbers of harvesters and traders to resources or markets (Schure *et al.* 2013).

The main drivers for both men and women to engage in the value chains were to provide income and the lack of other employment. The National General Census on Population and Habitats of 2013 (DGS 2015) found that in the Makokou area there were more unemployed urban women (36.3%) than rural women (28.0%) and that urban men tend to have higher employment rates than rural men. This supports the finding that engaging in harvesting, processing, and trading of NTFPs provides a way for men and women to generate income but is particularly important for women who have less access to employment than men.

Gender ideology also influences the benefits gained from commercializing NTFPs. Culturally accepted and legally established norms and behaviour contribute to determining benefits, such as the lack of support for women to improve entrepreneurial skills contributing to the lower benefits than women gain from NTFP value chain activities (Carr and Hartl 2008, Ingram *et al.* 2014).

No gender-differentiated awareness of threats to NTFP species and value chains

This study showed that the three NTFP species are all perceived as threatened by climate change, deforestation and unsustainable use of forest resources; and that both men and women were aware of threats to NTFP species and their value chains. Lescuyer and Ntougou (2006) and Sassen and Wan (2006) reported that logging operations around Makokou had negatively affected the availability of timber and NTFPs for local communities. Unsustainable management of natural resources is also known to affect NTFP species availability in many areas of Africa (Ticktin and Shackleton 2011, Stanley *et al.* 2012). Tchatchou *et al.* (2015) and Gillet *et al.* (2016) showed how deforestation in the Congo Basin and subsequent infrastructure, agricultural expansion, industrial (e.g. mining) operations, uncontrolled population, and economic growth had negatively affected NTFP species availability and the value chains as a whole.

The difference in men's and women's perceptions of pressures to the NTFP species and trade was attributed to differences in their affinity with the forest and fallow lands where

the products are harvested and how it is managed, as all the stakeholders live and harvest from the Makokou area. Specifically for *I. gabonensis*, unsustainable harvest practices, such as felling the species for timber or harvesting all the fruits are known to affect natural regeneration and can lead to forest resource depletion (Vermeulen 2011). The species appears to be increasingly rare due to the degradation of the forest ecosystem in which it naturally occurred (Ainge and Brown 2004). *I. gabonensis* is among the high-value prioritized NTFPs in Central Africa because of its multiple subsistence and high commercial values (FAO 2011, Awono *et al.* 2016). The *I. gabonensis* trade appeared to have increased in Gabon (Iponga *et al.* 2018b) and regionally (Ingram *et al.* 2017), representing another driver for increased trade-in and from Makokou (Betti *et al.* 2013, Yobo and Ito 2015, Iponga *et al.* 2018b).

These threats were reiterated by the perceptions of stakeholders in the value chains. Another driver was the informal nature of the trade-in NTFPs, which was largely based upon local customary rules, which had a potential to substantial unsustainable and unofficial production, corrupt practices as well as a loss of tax revenues for the state (Schure *et al.* 2013).

Opportunities to improve gender equity and overcome threats to NTFP species and value chains

As both men and women in Makokou benefit from NTFPs, any decline in resource availability challenges the livelihoods of all those engaged in the value chains, particularly women who were more dependent on the value chains and by their socio-economic and cultural status more susceptible to vulnerability. For women to mitigate and adapt to these threats, improved governance arrangements that emphasize both access to NTFPs and access to markets were suggested as beneficial (Wiersum *et al.* 2014) in enabling gender equity in benefits along the value chains (Mai *et al.* 2011). The process of rule and decision-making associated with the harvest and marketing of NTFPs represented a complex and dynamic process that included the broader social processes that drive social practices, values, and principles (Ingram *et al.* 2014, Wiersum *et al.* 2014).

According to Ros-Tonen *et al.* (2015), any changes in governance arrangements should be part of a multifaceted and holistic social-ecological landscape if they are to improve gender equity and benefits along the value chain. This means changing rules and norms of access to species, production and marketing and determining the satisfaction levels of both men and women in value chains including vulnerable groups, with the benefits and costs, and equity of distribution (Pérez *et al.* 2002, Kanmegne *et al.* 2007).

Since women depend more on these NTFP value chains, enhancing gender equity in the value chains could also be achieved by empowering women to increase and secure control over the tree species, marketing and income generation from the trade of NTFPs (Carr and Hartl 2008, Awono *et al.* 2013). Other approaches include providing women with appropriate, sustainable harvesting and processing techniques and skills, and upgrading processing which can also add value

(Carr and Hartl 2008, Awono *et al.* 2013, Haverhals *et al.* 2014). Ambassadors or champions with power to promote and drive the implementation of the Gabonese gender mainstreaming policy and 2011 NTFP action plan may also help to shift these neglected policies towards implementation.

CONCLUSION AND RECOMMENDATIONS

This study showed the gender dynamics in NTFP value chains ending in Makokou in north-east Gabon and how these generate economic benefits for men and women. Women dominate all stages of the chains, like many other NTFPs in the Congo Basin. In all the chains, men and women conduct similar harvesting, low levels of primary processing, and trading activities. Men engage more in odika (*I. gabonensis*) and tend to earn slightly higher income compared to women. Women dominate in all the stages of harvesting and trading noisette (*C. edulis*) and atanga sauvage (*D. buettneri*). The lack of employment represents the main driver of stakeholders' involvement in the NTFP value chain. The difference observed in gender involvement might also be driven by multiple factors, including physical strength and cultural roles favouring men to harvest larger volumes and sell at slightly higher prices. Gender ideologies and customary governance arrangements may also influence how men and women access and benefit – such as through better price negotiation. As a result, women dominate in all three NTFP chains, the small percentage of men involved focus on odika as the higher value and income product.

As both men and women are aware of the types of threats (climate change – expressed as the unpredictability of rainfall, deforestation) to species and ecosystems from which these products are sourced, it is logical to involve both in policy decision-making and interventions. Such interventions could focus on forest management and governance – including a long-term understanding of the ecological impacts of the trade – to reduce resource decline and increase value chain benefits. This could be achieved by the more targeted implementation of the national gender and NTFP policies by: i) acknowledging women's role in these chains, ii) upgrading NTFP value chains through training, sustainable harvesting methods, and group sales to increase bargaining power and trade benefits, especially for women, and iii) enhance gender equity favouring women for the most part.

Further research is recommended to assess if other aspects of social differentiation (such as nationality, ethnicity, etc.) affect benefits and roles, and if different formal and customary forest and value chain governance arrangements can positively impact the benefits from NTFP value chains and maintain forest ecosystems, and lead to equitable and improved livelihoods for forest product dependent people in Gabon.

CONFLICT OF INTEREST STATEMENT

There is no conflict of interest declared.

AUTHOR CONTRIBUTIONS STATEMENT

CMY conceptualized the work, design, interpret the data, and wrote the manuscript. VI and AA contributed to data analysis, writing, and reviewing the manuscript.

ETHICS APPROVAL AND INFORMED CONSENT

The study was approved by the Commission Scientifique des Autorisations de Recherche (CSAR) and the Ethics Committee of Institute of Research in Tropical Ecology (IRET) of Gabon. Since the study did not involve medical research therefore the World Medical Association (WMA) Declaration of Helsinki is not applicable.

Given the context of low literacy levels in Gabon, verbal rather than written consent was obtained for each interview for all participants before starting the interview process, and the purpose of the study was explained. All data has been anonymized.

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