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ABSTRACT

Forest-linked institutions are rapidly changing in sub-Saharan Africa – suggesting the need for renewed evidence. While growing qualitative evidence suggests changes in forest-linked institutions, there is the dearth of quantitative evidence on the extent of change in institutions and how this shapes forest use practices. To stem this knowledge gap, we draw from a representative sample of 200 forest-dependent households around the Santchou forest landscape, complemented by key informant interviews (N = 17) and focus group discussions (N = 11). We quantitatively analyzed changes in forest-linked institutions and their effects on forest use practices using a two-stage least square (2SLS) approach with heteroscedasticity-based instruments. We corroborate the evidence with thematic analysis ad narratives. We first identified and characterized the structural and functional attributes of forest-linked institutions, and then estimate the effect of structural and functional changes on forest use practices. The results suggest the following: First, traditional council and secret society exhibit similar functional attributes and are dominant forest-linked institutions in the Santchou landscape. Second, endogenously-rooted institutional structures and processes have an exogenous origin. Institutions which were hitherto not designed to regulate forest use have installed themselves as influential regulators of forest use. Third, more than half of the customs and norms have changed over time; some are in a state of dormancy, others have witnessed numerical increase, and others have declined. Functional attributes negatively and significantly explain forest use practices; however, the effect varies between attributes. Finally, farm-based occupation significantly intensifies the level of forest dependency. Future studies are required to uncover the extent to which the different types of farm practices influence forest use practices. From a policy standpoint, emphasis should be placed on the promotion of cultivable NTFPs to complement and reverse the current positive association with farm-based occupation.

1. Introduction

The institutions-cum-natural resource management link continues to attract scholarly attention, in the face of growing pressure and rapid transformation of socio-ecological systems such as forests (Kimengsi and Balgah, 2021; Agrawal and Ostrom, 2001; Ostrom, 1990). Institutions are construed as "cognitive, normative, and regulatory structures that provide stability and meaning to social behaviour." (Scott, 1995: 33). They manifest through cultures, structures and routines in different contexts (Scott, 1995). The formality-informality dichotomy presents institutions as formal (e.g. written and codified laws) and informal - rules that are unwritten or un-codified and are communicated through customs and traditions over generations (Osei-Tutu et al., 2015; Yeboah-Assiamah et al., 2017). On the basis of exogeneity and endogeneity, endogenous institutions are construed as those which evolved within societies (e.g. informal rules), while exogenous institutions are externally induced. For instance, state rules introduced in communities assume an exogenous feature, when compared to endogenous, culturally-embedded and largely informal rules. In this paper, we define institutions using the structure - process analytical approach

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(Fleetwood, 2008a, 2008b). As structures, forest-linked institutions refer to the informal village-based structures (e.g. secret societies) and formal or state-oriented organizations (e.g. Delegation of Forestry) that enforce rules and sanctions related to the access, use and management of forest resources. The process dimension construes institutions as informal rules (e.g. norms, values, taboos) and formal ones (e.g. laws) which are provisioned to regulate the use of forest resources especially around protected areas. It is important to remark here that both structures and processes are inseparable. For instance, the customs, values and beliefs which are attuned to communities are agreed upon by the village traditional councils. Furthermore, sanctions, rules and customs determine membership into such traditional institutions. This makes it difficult to separate structures from processes in institutional literature. By and large, institutions are dynamic and evolutionary nature; thus attracting research attention especially in the field of forest resource management.

Scholars who theorize on institutional change argue that such processes could be gradual, imperceptible and/or quite rapid (Greif, 2006; Kingston and Caballero, 2009; Mahoney and Thelen, 2010; Ostrom, 2014). This applies in many parts of the global south – with more intricacies applicable to sub-Saharan Africa (SSA). For instance, the institutional change pathways of SSA countries have been sufficiently documented – spanning pre-colonial, colonial, early post-colonial, and the modern era. While the outcomes vary, there is seemingly a point of convergence: pre-colonial institutions (informal) which were fairly stable, have, over the years, been transformed, weakened and/or abandoned in certain instances. Such changes are linked to forces such as population growth, changes in the age structure of societies (towards a more youthful age bracket), market forces (e.g. price), leadership and religious influences, among others (Ensminger, 1992; Haller, 2001, 2007; Haller et al., 2013). Further complications are linked to the diversity of informal institutions – linked to the significant ethnic diversity of SSA. In fact, SSA has an ethnic fractionalization score of 0.71, surpassing the global average of 0.48 (Fearon, 2003). The debate on whether institutional change produces more of optimal or sub-optimal resource use and management outcomes remain inconclusive. This suggests the need for fresh evidence in culturally diverse contexts of SSA. In addition, the extent to which such institutions have assumed structural and functional changes – and the outcomes linked to such processes in terms of natural resource use practices (e.g. forests) – still beg for evidence in many parts of SSA. From a methodological standpoint, studies which employ robust analytical approaches (e.g. mixed-methods approaches) are scanty in SSA (Kimengsi et al., 2021a). This unaddressed knowledge gap stalls the formulation of efficient policies to regulate forest use in socio-culturally diverse settings of the Congo Basin, of which Cameroon forms part.

The most recent reforms in Cameroon's natural resource sector dates as far back as the 1994 Forestry and Wildlife Law (MINEF, 1994). The law did not make sufficient provisions for alternative forms of livelihoods for communities around protected areas (Lambi et al., 2012). This defect has precipitated the uncontrolled access and use of protected area resources, leading to conflicts amongst resources users. Furthermore, growing pressures linked to socio-demographic changes and market forces around protected areas have led to changes in protected area-linked institutions (Kimengsi and Balgah, 2021; Kimengsi et al., 2021b). However, the extent of institutional change (both structurally and functionally) and their outcomes in terms of forest use practices, still beg for evidence in many parts of Cameroon. The Santchou landscape, described as a 'cultural melting pot', presents a useful landscape to analyse these changes and their effects on forest use practices. This study is justified on the grounds that the Santchou Landscape harbours the Santchou Reserve, and communities in and around this reserve face threats of eviction from the state. In addition, they are grappling with external pressures from the forestland expansionist tendencies of neighbouring communities (Kimengsi et al., 2021b). These issues represent an unresolved conundrum, requiring fresh insights to inform

policy guidelines. To address these, this paper undertakes a structural and functional characterization of forest-linked institutions, and estimate the effects of structural and functional changes on forest use practices (NTFP harvesting in this case) in the Santchou Landscape of Cameroon. The evidence generated could further inform the on-going forest policy revision process in Cameroon, with emphasis on rapidly transforming landscapes (FAO, 2010).

2. Analytical framework

The analytical framework for this study centres on the exogenous and endogenous institutional analytical lens, in which institutions are typified as either externally enforced (exogenous), or endogenous,[1] i.e. self-enforcing (Greif, 2006). In this regard, elements of formality and informality could be identified in both exogenous and endogenous institutions (North 1990; Osei-Tutu et al., 2015; Yeboah-Assiamah et al., 2017; Kimengsi et al., 2021a). Both forms of institutions (i.e. exogenous and endogenous) constantly interact to shape the intentions and actions of forest users. This paper emphasizes on endogenous informal institutions – structures and processes. Rooted in the customs and traditions of communities, these institutions in the context of SSA date as far back as the pre-colonial era. Despite threats of institutional breakdown due to colonialism and socio-demographic forces, there are still last vestiges of endogenous institutions (Kimengsi et al., 2021b) (Fig. 1). Beliefs linked to sacred forests and the practices of members of secret societies have a long history in SSA. For instance, the rain-making traditional practice (*Mbona*) in Southern Africa, is an example of a traditional practice. Furthermore, natural resource users in Zimbabwe significantly depended on indigenous customs to make major decisions (Mapfumo et al., 2016).

At household levels, use practices are shaped by socio-economic characteristics such as age, sex, income level, and participation in trainings (Coulibaly-Lingani et al., 2009; Tesfaye et al., 2012; Wood et al., 2019). Studies have sufficiently explained that several interlinked forces such as socio-economic, demographic and political forces shaped natural resource institutions (North 1990; Haller, 2016). While endogenous institutions interact with exogenous ones, several interlinked socio-demographic and political forces interact to shape institutional structures and processes. These define forest use practices – mirrored through the use of different categories of NTFPs such as wood-based, vegetal-based, seed-based and other NTFPs (Awono et al., 2016) (Fig. 1). The focus on endogenous institutions is justified on the following grounds: (a) For the most part, exogenous institutions have dominated the regulation of natural resource use, with the virtual neglect of endogenous ones (Zenger et al., 2001; Kimengsi & Balgah, 2017); (b) despite the rapid transformation of endogenous institutions (North 1990; Ensminger, 1992; Wartmann et al., 2016), the role played by the 'last vestiges' of such institutions has hardly received enough attention (Leonard et al., 2013; Tyszczuk and Smith, 2018; Kimengsi et al., 2021b); (c) complementary evidence especially using mixed methods approaches in the study of forest-linked institutions and use practices are lacking (Leonard et al., 2013; Kimengsi et al., 2021a).

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[1] By endogenous cultural institutions, we refer to informal rules which are developed within communities and transferred from one generation to the other, through norms, values, beliefs and taboos (Colding et al., 2003). However, endogenous formal rules could equally be identified to include formal laws instituted by the state, vis-a-vis formal regulations which are emanating from international global and regional processes – exogenous in this case. Exogenous institutions here relate to the formal rules emanating from the state or international processes which are codified through law, policies and regulations. They are exogenous to communities.
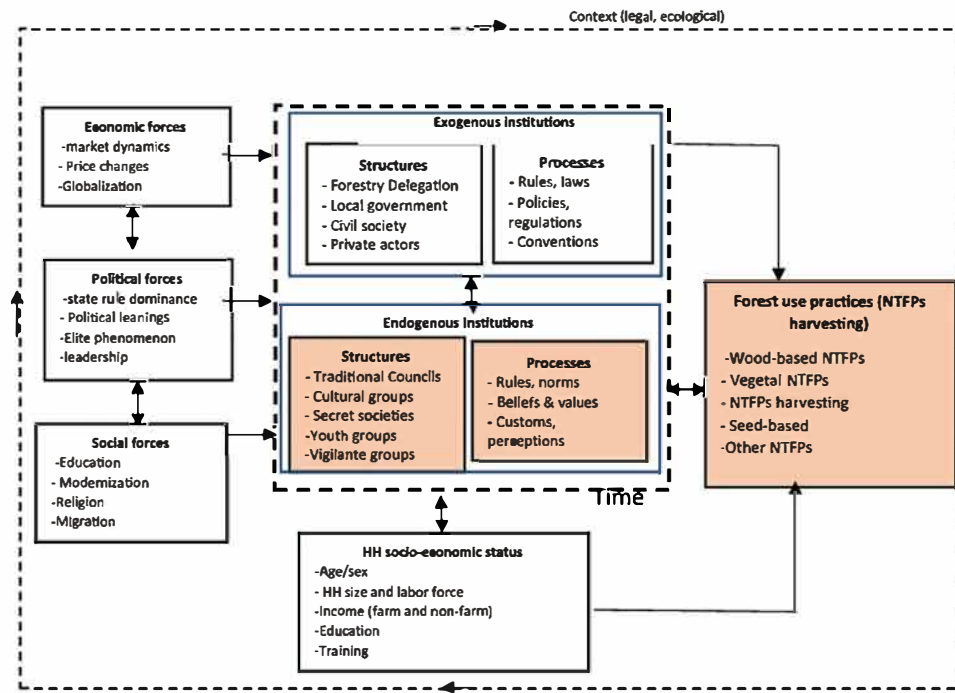
Fig. 1. Analytical framework on endogenous institutions and forest use practices. (Authors' conception). Note: Wood-based NTFPs =fuel wood & chewing stick; Vegetal NTFPs =medicinal plants, ngongo leaf & eru; Seed-based NTFPs =bush pepper, penja pepper, kolanuts, bitter cola & njangsang; Other NTFPs = honey, bush meat, snails, mushroom.

3. Materials and methods

3.1. Background of the study area

The Santchou Landscape home to the Santchou Reserve is one of Cameroon's over 30 protected areas. It is found in the Menoua Division of the West Region of Cameroon, between latitude 5°18'^{0}'' North and 9°54'^{0}'' East (Fig. 2). The reserve which is estimated at 7000 ha, is rich in species such as dwarf elephants (*Loxodontapumilio*), dwarf buffalo and endemic plants (Tchoungui et al., 1995; Birdlife International, 2015). The vegetation consists of a mixture of *Sterculiaceae and Ulmaceae*, dominated semi-deciduous forest, shrubby savanna, and sub-montane forest. The reserve also hosts periodically inundated swamp-forest, grassland and forest species such as *Lophira alata, Mitragyna ciliata, Khaya ivorensis, and Milicia (Chlorophora) excelsa*, among others. These vegetal characteristics, coupled with the fauna, make the Santchou Reserve an Important Birds and Biodiversity Area (IBA) in Cameroon (Birdlife International, 2015; Fokeng and Meli, 2015). The Santchou reserve owes its creation to French colonial rule in 1947, in which the French sought to encourage natural reforestation, and to undertake reforestation projects to protect biodiversity. This saw an implicit imposition of the French direct rule – largely centralized and formal, as opposed to the indigenous customs and traditions (informal). In 1986, the status changed to a Wildlife Reserve due to the reported animal species variety in the area, including rare species such as the dwarf elephant (*Loxodontapumilio*). The change was a virtual continuation of already established centralized formal systems of natural resource management – a colonial hangover (Kimengsi and Balgah, 2021). The Landscape is found in the predominantly French speaking region of Cameroon, and is originally home to the Mbo of the sawa tribes (Mbeng and Buba, 2017). However, due to its transitional location between the coastal areas and the humid montane region of Cameroon, this area today has become a cultural melting pot, hosting people from diverse cultures – especially from the North West and South West Regions. In terms of management, responsibility shifted from the Ministry of Agriculture to the most recent being the Ministry of Forestry and Wildlife

(MINFOF). This change in institutional structures, and the accompanying formal processes (laws) have, over the years, continued to interact with culturally-embedded institutions, forming essential ingredients in the institutional change processes. Key NTFPs exploited around these areas include *Piper guineensis* (bush pepper), *Cola nitida* (cola nut), *Rocinodendron heudolitti (*njansang*), Irvingia gabonensis (*bush mango*), Garcinia mannii (chewing stick), Garcinia cola* (bitter cola), *Piper nigrum* (Penja pepper) *and* fuel wood, *and Megaphrynium macrostachyum (*ngongo leaf*)*.

3.2. Data collection

This research forms part of an on-going study on "Past customs, current law: Analyzing the Effects of Endogenous and Exogenous Institutions on Sustainable Forest Management in Cameroon" (for details, see: https://tu-dresden.de/forst/camforst). The first part of the research explored institutional bricolage manifestations around the Santchou Landscape (see Kimengsi and Balgah, 2021). Institutional bricolage denotes a situation where actors strategically adopt or modify old rules while inventing new ones, as they navigate through their daily access and use of natural resources (Cleaver, 2012). The preliminary evidence indicated the need for further studies on the effects of structural and functional institutional changes, and their determinants and implications on forest use practices. Data collection ran through the following phases. First, between July and August 2020, preliminary field visits were undertaken to the Santchou Landscape. The Santchou Landscape was chosen due to the fact that it hosts the Santchou Reserve – a key area of forest resource extraction. Furthermore, this are serves as a cultural melting pot – hosting forest users from diverse cultural backgrounds in Cameroon.

Within the Landscape, four villages were randomly selected as study communities to include Mokot, Mbokou and Mankang (in-reserve
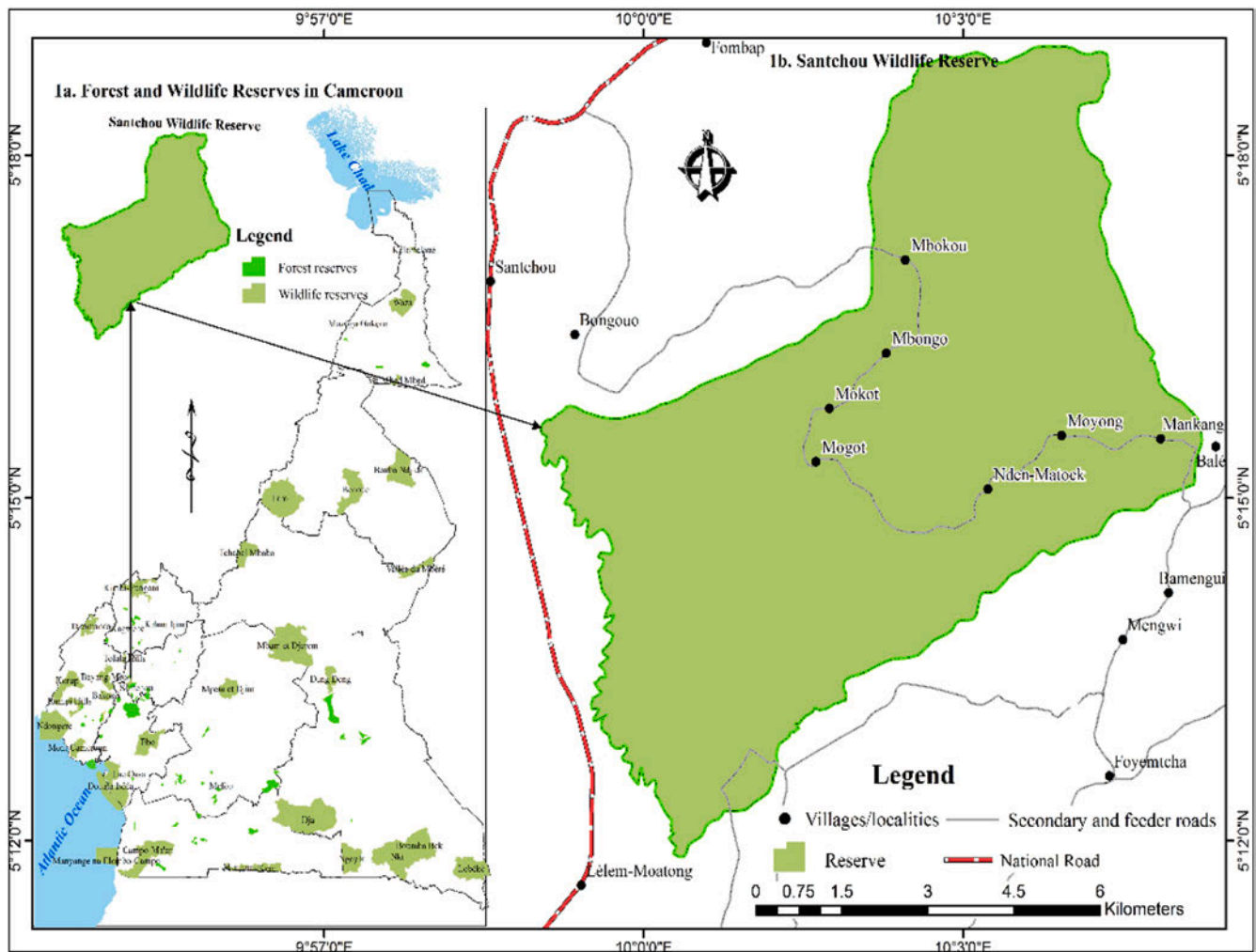
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Fig. 2. Map of the Santchou Landscape.

Table 1
Target villages and their HHs sizes in Santchou.

Targeted villages	Total number of HHs	Sampled HHs
Mokot	102	50
Mboukou	55	50
Mankang	105	50
Bale	150	50
Total	412	200

villages), and Bale (out-reserve).[2] Since these communities exhibit similarities in their socio-economic activities and forest use practices, a random selection was considered relevant to provide evidence which could inform the situation of the Santchou Landscape. Bale, as an out-reserve village, is under threat of incorporation into the reserve, with a possibility of the inhabitants being evicted. The four communities therefore had similar challenges in terms of forest use. Besides the selection of study sites, the first phase aided in the generation of some preliminary data on the key forest resources, and the functioning of institutions linked to these resources. This was achieved through key informant interviews (N 5) and focus group discussions (N 2). The

focus group discussions were carried out in Mankang and Mokot. Regarding key informant interviews, 2 each were performed in Mankang and Mokot, while 1 was performed in Bale.

The second phase of data collection was planned from March to April 2021. It began with the design of a structured questionnaire (60 main items) for household surveys. Apart from the section on socio-demographic characteristics of respondents, the questionnaire had sections which focused on forest resources in the Santchou Landscape and use practices. The next section contained aspects on the characterization of informal institutions, and their sources. The subsequent sections centred on the evolution and effectiveness of forest-based institutions. The earlier used interview guide was modified to capture two other aspects: the explanation of changes related to forest-linked institutions and their application in conflict resolution. The interview guide therefore contained 12 items. A focus group discussion guide containing 8 items was also prepared for the data collection exercise. We proceeded to pre-test the survey questionnaire with 10 households in the village of Ngang and Mogot.[3] From here, a random sample of households in each village was selected. These villages largely exhibited attributes of linear settlements, making it easy for an ad-hoc household numbering process to be performed. From the total number of households, raffle draws were repeatedly conducted to select household numbers randomly. These

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[2] While the intention was to explore forest use practices for in-reserve villages, we judged that it was imperative to equally consider an out-reserve village to enhance comprehension and triangulate our evidence on the dynamics of institutions and forest use practices in the landscape.

[3] It is recommended to pretest in study villages around the same area which are not included in the sample (Angelsen et al., 2011).

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numbers guided the data collection team to locate the exact house for the questionnaire to be administered.

Two research assistants who could communicate well in the French language were recruited and trained in the process to support the data collection. Prior to the start of data collection, the research team took time to explain the aim of the research and to seek the consent of the respondents before the instruments were administered. Equally, we explained to the respondents that they could withdraw at any point during the interviews, should they feel uncomfortable with the exercise. Due to the sensitive nature of the landscape, we assured respondents of confidentiality in the reporting of the results. In total, 200 households were randomly sampled from the 4 villages (Table 1). The quantitative data were recorded using tablets on the KOBO collect software, while field notes were used to record the data from KIIs and FGDs.

Regarding the generation of qualitative data, 9 FGDs and 12 KIIs were conducted. Therefore, in total, 11 FGDs and 17 KIIs were conducted (Annex I). The surveys for each household lasted between 60 and 90 min, while the interviews and focus group discussions lasted between 45 and 70 min. All interviewees were fluent in French and could express themselves very well. While we acknowledge the existence of threats such as the global pandemic on place-based socio-ecological research (Hermans et al., 2021), this did not deter the data collection process, as the research team effectively respected COVID-19 regulations including social distancing and made use of protective masks to avoid the risk of infection. This also applies to the respondents, some of whom were further educated on the necessity to stay safe from the virus.

3.3. Method of data analysis

Descriptive statistics were used to characterize the structural and functional attributes of forest-linked institutions in villages around the Santchou Landscape and heteroscedasticity-based instruments approach was employed to examine how structural and functional attributes of forest-linked institutions influence changes in forest use practices. The heteroscedasticity-based instruments address the potential endogeneity between forest use practices and institutions. Evidence suggest that the main source of endogeneity is the reverse causality between environmental resources use (forest use in this case) and institutions (Ostrom et al., 2007; Ntuli and Muchapondwa, 2018; Ntuli et al., 2019). That is, institutions are used to control forest use practices and ensure optimality in usage. However, changes in the behaviour of forest users suggest the need for the formulation of institutions. In addition, parameter estimates are likely to be biased due to the omission of unobservable explanatory variables that might be correlated with the institutional variables. In this regard, the IV estimation with heteroscedasticity-based instruments is superior to the standard IV approach (Baum et al., 2013). This approach has been used extensively in the literature (Ntuli et al., 2019; Ntuli and Muchapondwa, 2018; Mishra and Smyth, 2015; Banerjee et al., 2013; Emran et al., 2012).

The heteroscedasticity-based instruments variable approach is described in Lewbel (2012). According to the model, identification is achieved by assuming that regressors are uncorrelated with the product of heteroskedastic errors. This is a feature of many models where error correlations are due to an unobserved common factor and instruments are constructed as simple functions of the model's data (Baum et al., 2013). Considering the following specification:

$$y_1 \quad y_2\beta_1 + X\beta_2 + \varepsilon \tag{1}$$

Where X is a vector of exogenous variables; y_2 the endogenous variable - institutions in this case. With a two-stage least square (2SLS) approach, the first-stage equation is given by:

$$y_2 \quad Z\gamma_1 + X\gamma_2 + \mu \tag{2}$$

Where Z is the suppose exclusion restriction (exogenous instruments), which is unobserved in our case. Lewbel (2012), therefore suggest that the key identifying assumptions for the β_1 coefficient is that there exists some variables Z_2, which may be variables in X, such that:

$$E(W\varepsilon) \quad 0 \tag{3}$$

$$E(W\mu) \quad 0 \tag{4}$$

$$E((Z_2 \quad \mu_2)\mu\varepsilon) \quad 0 \tag{5}$$

$$E((Z_2 \quad \mu_2)\mu^2) \; / \; 0 \tag{6}$$

Where $W \quad (X, Z)$ are the available exogenous variables and Z_2 is a subset of W. Eqs. (3) and (4) are from the exogeneity assumptions of W. Eq. (5) requires zero expectation for the product of errors $\mu\varepsilon$ and demeaned Z_2. This condition requires that the covariance between μ and ε conditional on Z_2 does not depend on Z_2, since $E((Z_2 \quad \mu_2)\mu\varepsilon)$ $E((Z_2 \quad \mu_2)cov(\mu, \varepsilon|Z_2|))$ $E((Z_2 \quad \mu_2)\sigma_{\mu,\varepsilon}(Z_2))$, which is zero when $\sigma_{\mu,\varepsilon}(Z_2)$ is a constant. Equivalently, any heteroscedasticity related to Z_2 cannot enter through the correlated component. The condition in Eq. (6) requires that the first stage error μ is heteroscedastic in demeaned Z_2, implying that $(Z_2 \quad \mu_2)\mu$ can be used as an instrument for y_2.

The variables used in the empirical analysis are described in Table 2. The survey collected data on forest use practices, household socio-economic variables, structural and functional attributes of forest-linked institutional variables. The dependent variable is forest use

Table 2
Description of variables used in the empirical models.

Variables	Description
Gender	1: if household head is male and 0: otherwise
Age	Age of household head in years
Education	Education of household head categorized into no formal education; primary; secondary and tertiary education.
Main occupation	1: if household head's occupation is non-farming and 0: otherwise
Household size	Number people residing in the household
Migration	1: if household is a migrant and 0: otherwise
Household income	Household average monthly income (in CFA)
Index of structural institutions	Structural attributes of forest-linked institutions including traditional council, secret society, village forest management committee, cultural groups, youth groups and vigilante groups are used
Indices of functional institutions	**Functional attributes**
Index of traditional council functional attributes	Settlement of disputes, setting of traditional days, enthronement of rulers, enforcing sanctions and defining forest related rules.
Index of secret society functional attributes	Guard sacred forests, enforcement of sanctions, definition of forest taboos and performing rituals.
Index of village forest management committee functional attributes	Enforcing access rules, support forest officials, defining forest rules and monitoring forest encroachment.
Index of cultural group functional attributes	Organizing NTFP collection, enforcing sanctions, regulating farming activities, monitoring forest encroachment and others.
Index of youth group functional attributes	Organising NTFP collection, collaborate with forest officials, reporting poaching activities, monitor forest encroachment and others.
Index of vigilante group functions attributes	Enforcing sanctions, collaborate with forest officials, report poaching, monitor forest encroachment and others.
Dependent Variables	
Wood based NTFP index	This is made up of Fuel wood and chewing stick
Vegetal NTFP index	This is made up of medicinal plant, ngongo leaf and eru.
Seed based NTFP index	Include: bush pepper, penja pepper, kolanuts, bitter cola, and njangsang
Other NTFP index	Include: honey extraction, bush meat, snails, mushroom and others
NTFP index	Combination of wood based, vegetal, seed and other NTFPs

Table 3
Functions of forest-linked institutional structures.

Variable	(1)	Settle disputes /guard sacred forest	Enforcement of sanctions	define rules/ taboos	Set traditional days	Enthrone rulers	perform rituals	Enforce access rules	monitor forest encroachment	Support forest officials	Regulate farming/ poaching	Organise NTFP collection	Others
Traditional council	0.98 (0.14)	0.88 (0.32)	0.72 (0.45)	0.73 (0.44)	0.65 (0.48)	0.56 (0.50)							
Secret society	0.98 (0.16)	0.94 (0.23)	0.42 (0.49)	0.57 (0.50)			0.86 (0.35)						
Forest management	0.32 (0.47)			0.01 (0.11)				0.22 (0.42)	0.88 (0.32)	0.73 (0.45)			
Cultural groups	0.06 (0.23)		0.15 (0.36)						0.21 (0.41)		0.27 (0.45)	0.04 (0.20)	0.40 (0.49)
Youth groups	0.13 (0.33)								0.63 (0.49)	0.14 (0.35)	0.02 (0.13)	0.02 (0.13)	0.30 (0.46)
Vigilante groups	0.82 (0.39)		0.01 (0.11)						0.99 (0.11)	0.75 (0.44)	0.14 (0.35)		0.03 (0.17)

Note: Standard deviation in parentheses and descriptive statistics for structural institutions in Column 1.

practices measured in terms of the different non-timber forest products (NTFPs) harvested. The institutional variable is made up of structural and functional attributes. Structures refer to traditional councils, secret society, village forest management committees (VFMCs), cultural groups, youth and vigilante groups (see Fig. 1). Qualitative data were transcribed and analyzed through narratives and thematic analysis. Here we discussed on the structural and functional characteristics of forest-linked institutions, and their sources and evolution over time. Descriptive statistics from the data suggest that 92% of the respondents came from male headed households, while 20% of the household heads are migrants. The mean age of the household head is 51 years with a standard deviation of 9.84. As expected, most household heads had completed only primary education (62%) compared to 28% with at least secondary education. Quite a significant proportion of the household heads (89%) are involved in farming as their main occupation. The mean household size is 7 and the average monthly household income is CFA34,561.

3.4. Measurement of forest use practices and institutions

As presented in Table 2, indicators of forest use practices (NTFPs) are summarized into indices. The indices are constructed using the Min-Max rescaling transformation. The Min-Max rescaling transformation is a method in which each variable is decomposed into an identical range between zero and one, with a score of 0 being the worst rank for a specific indicator and a score of 1 being the best. In this paper, the score is zero if a respondent did not harvest a particular NTFP in the past 12 months and positive if the respondent harvested that particular NTFP. All other values are then scaled between the minimum and maximum values. According to Yoon (2012) the scaling procedure ultimately subtracts the minimum value (X_{min}) and divides by the observed difference between the maximum value (X_{max}) and the minimum value (X_{min}), as illustrated as follows:

$$C_i = \frac{X_i - X_{min}}{X_{max} - X_{min}} \tag{7}$$

With this approach, differentially-scaled indicators can be standardized into indices. The indicators used in computing forest use practices of the different NTFPs are presented in Table 2. This approach has been used by several scholars to aggregate variables and create composite scores (Bernardi, 2007; Cutter et al., 2010; UNDP, 2014). To free the indicators from assuming their initial measurement units, the indices generated were standardized to between 0 and 1. Since there are more than one indicators for each of the different NTFPs, the standardization was obtained by calculating the average values of the different indicators as follows:

$$FP_i = \frac{\sum_{i=1}^{n} IndexA_i}{n} \tag{8}$$

Where $IndexA_i$ is the indicator(s) that make up a given index, n is the number of indicators in each type of NTFP and FP is the index for forest use practices. The range for the composite indices were between 0 and 1 with high values denoting higher level of NTFPs harvest. A similar approach is used to construct the indices for the functional attributes of institutions. The forest use practice variables are therefore continuous and are estimated using the heteroscedasticity-based instrumental approach.

4. Results

4.1. Characterization of structural and functional attributes of forest-linked institutions

Table 3 presents the distribution of structural and functional

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Table 4
Sources of forest-linked institutional processes (rules).

Variable	Observations	Migrants	Community/traditional rulers	Government/ state	Civil society
Traditional council	199	0.01 (0.10)	0.99 (0.10)		
Secret society	199		1.00 (0.00)		
Village forest management	135		0.237 (0.427)	0.741 (0.44)	0.022 (0.148)
Cultural groups	190	0.011 (0.102)	0.989 (0.102)		
Youth groups	192	0.01 (0.102)	0.99 (0.102)		
Vigilante groups	196	0.077 (0.267)	0.485 (0.501)	0.434 (0.497)	0.005 (0.071)
Norms	183		0.995 (0.074)		0.005 (0.074)
Customs	197		0.995 (0.071)	0.005 (0.071)	
Beliefs	198		0.995 (0.071)		0.005 (0.071)
Taboos	195		0.995 (0.072)		0.005 (0.072)
Values	180		1.00 (0.000)		
Others	137	0.007 (0.085)	0.985 (0.120)	0.007 (0.085)	

Note: Standard deviation in Parentheses and number of observations in Column1.

attributes of forest-linked institutions in the Santchou Landscape. About 98% of the respondents reported traditional council and secret society as key structures of forest-linked institutions. According to 82% of the respondents, vigilante groups exist as forest-linked structures, but only about 6%, 13% and 32% respectively reported cultural groups, youth groups and VFMCs as part of forest-linked institutional structures.

The results further suggest that functional attributes of traditional councils include the settlement of disputes (88%), the definition of forest related rules (73%), the enforcement of sanctions (72%), the setting of traditional days (65%) and the enthronement of rulers (56%). For the secret society, the main functional attributes include the guarding of sacred forests (94%), the performance of rituals (86%), the definition of forest related rules (57%) and the enforcement of sanctions (42%). As a traditional institution, secret societies indirectly regulate forest use as they protect certain portions of the forest and enforce spiritual sanctions to defaulters. In the case of threats to forestland expansion around Mankang village by neighbouring Bamileke communities, this society was very active in the process of spiritually chasing expansionists. A notable (male) in the community recounted thus:

"Our ancestors lived on the hillsides. However, we relocated to this low lying area, while we preserved the hilly forested parts as sacred areas. We visit our ancestors and perform rituals regularly. When the neighbouring Bamileke community attempted to convert the forestland into plantations, the sacred society simply invoked the gods who chased them away with bees"

The functional attributes of the VFMCs are the monitoring of forest encroachment (88%), the provision of support to forest officials (73%), the enforcement of access rules (22%) and the definition of forest related rules (1%). Over 27% of the respondents reported the regulation of farming/poaching activities, 4% reported the organization of NTFP collection and 40% reported other functional attributes. The functional attributes of youth groups were identified to include the monitoring of forest encroachment (63%), support provision to forest officials (14%), the regulation of poaching activities, the organization of NTFP

Table 5
The role of village structures in enforcing traditional rules.

Variable	Norms	Customs	Beliefs	Taboos	Values	Rules
Traditional council	0.995 (0.071)	0.985 (0.122)	0.899 (0.301)	0.769 (0.423)	0.97 (0.172)	0.933 (0.251)
Secret society	0.136 (0.343)	0.125 (0.332)	0.342 (0.475)	0.402 (0.492)	0.106 (0.309)	0.112 (0.316)
Village forest management	0.005 (0.071)	0.01 (0.10)	0.01 (0.10)	0.000 (0.000)	0.01 (0.10)	0.037 (0.19)
Cultural groups	0.000 (0.000)	0.015 (0.122)	0.005 (0.071)	0.000 (0.000)	0.071 (0.257)	0.037 (0.19)
Youth groups	0.000 (0.000)	0.015 (0.122)	0.005 (0.071)	0.000 (0.000)	0.03 (0.172)	0.022 (0.148)
Vigilante groups	0.01 (0.10)	0.005 (0.071)	0.005 (0.071)	0.005 (0.071)	0.015 (0.122)	0.03 (0.171)
Others					0.025 (0.157)	0.075 (0.264)

Note: Standard deviation in parentheses

Table 6
The evolution of traditional rules and structures.

	Increased	Redefined	Reduced	Constant
Norms	0.005 (0.072)	0.371 (0.484)	0.149 (0.357)	0.474 (0.501)
Customs	0.209 (0.408)	0.184 (0.388)	0.393 (0.49)	0.214 (0.411)
Beliefs		0.031 (0.174)	0.052 (0.222)	0.918 (0.276)
Taboos	0.005 (0.072)	0.067 (0.251)	0.108 (0.311)	0.82 (0.478)
Values	0.165 (0.372)	0.237 (0.426)	0.196 (0.398)	0.402 (0.492)
Traditional council	0.005 (0.073)	0.005 (0.073)	0.005 (0.073)	0.985 (0.125)
Secret society		0.01 (0.102)	0.016 (0.124)	0.974 (0.159)
Village forest management	0.14 (0.348)	0.006 (0.075)	0.67 (0.471)	0.184 (0.389)
Cultural groups	0.259 (0.439)	0.104 (0.306)	0.228 (0.421)	0.409 (0.493)
Youth groups	0.268 (0.444)	0.076 (0.265)	0.464 (0.436)	0.192 (0.395)
Vigilante groups	0.01 (0.101)	0.203 (0.403)	0.503 (0.501)	0.284 (0.452)

Note: Standard deviation in parentheses

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Table 7
The effect of structural and functional institutions on wood and vegetal based NTFP.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Wood based NTFP						
Index of structural institution	-0.23**	-0.27**	0.14	-0.35**	-0.38**	0.22
	(0.11)	(0.11)	(0.18)	(0.17)	(0.18)	(0.13)
Main occupation is non-farming	-0.11*	-0.09***	-0.07	-0.08	-0.05	-0.10*
	(0.05)	(0.02)	(0.08)	(0.09)	(0.10)	(0.05)
Index of traditional council functional attributes	0.07					
	(0.08)					
Index of secret society functional		-0.15*				
		(0.09)				
Index village forest management functional attributes			-0.24*			
			(0.13)			
Index of cultural group functional attributes				-0.85***		
				(0.25)		
Index of youth group functional attributes					-0.63***	
					(0.21)	
Index of vigilante group functional attributes						-0.28*
						(0.15)
Constant	0.48***	0.61***	0.48***	0.61***	0.55***	0.64***
	(0.07)	(0.09)	(0.11)	(0.17)	(0.19)	(0.11)
Observations	198	195	85	46	56	172
R-squared	0.05	0.06	0.07	0.13	0.14	0.06
Panel B: Vegetal based NTFP						
Index of structural institutions	-0.06***	0.07	-0.14*	-0.13**	0.03	-0.08***
	(0.02)	(0.07)	(0.08)	(0.06)	(0.12)	(0.03)
Main occupation is farming	-0.07**	-0.07**	-0.04	-0.02	-0.03	-0.07**
	(0.03)	(0.03)	(0.05)	(0.07)	(0.07)	(0.03)
Index of traditional council functional attributes	-0.09***					
	(0.03)					
Index of secret society functional attributes		0.01				
		(0.05)				
Index village forest management functional attributes			-0.13*			
			(0.07)			
Index of cultural group functional attributes				0.12		
				(0.88)		
Index of youth group functional attributes					-0.12***	
					(0.033)	
Index of vigilante group functional attributes						-0.13**
						(0.06)
Constant	0.56***	0.60***	0.62***	0.58***	0.65***	0.68***
	(0.04)	(0.05)	(0.06)	(0.13)	(0.13)	(0.06)
Observations	198	195	85	46	56	172
R-squared	0.05	0.03	0.06	0.01	0.01	0.04

Note: In each regression we control for age, sex and education of household head, household size, household monthly income and migration status. The wood based NTFP (panel A) includes fuel wood and chewing stick and vegetal NTFP (Panel B) includes medicinal plants, ngongo leaf & eru. Standard errors in parentheses ***$p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

collection (2%) and others (30%). Concerning vigilante groups, monitoring of forest encroachment (99%), support to forest officials (75%), the organization of NTFP collection (14%) and others (3%) make up their functional attributes.

Table 4 illustrates the different sources of structural institutions and traditional rules linked to the Santchou forest landscape. According to the entire sample, traditional rules such as norms, customs, beliefs, taboos, and values come from within the community. Overall, the results suggest that communities around the Santchou Landscape are responsible in setting-up structures and rules as forest-linked institutions, with the state playing a minor rule. About 99% of the sample think that traditional councils, youth and cultural groups are endogenously rooted. All respondents perceived secret society to be endogenous in nature. Over 74% of the samples perceive that VFMCs are introduced by the government/state, while 24% think it comes from within the community and 2% think it originates from the civil society. Vigilante groups emanate from within the community (49%), the government/state (43%), migrants (8%) and civil society (1%).

Table 5 presents results on the role of institutional structures in enforcing traditional rules around the Santchou landscape. The results suggest that relative to traditional councils and secret societies, VFMCs, cultural groups, youth groups and the vigilante groups are not significantly relevant in enforcing traditional rules. Specifically, the study

reveals that traditional councils are key in enforcing traditional rules. For example, about 100%, 99%, 97% 93% 90% and 77% of the respondents are of the view that traditional council is important in enforcing norms, customs, values, rules, beliefs and taboos respectively. This is followed by secret society where only 40%, 34%, 14%, 13%, 11% and 11% of the respondents respectively reported that it is important in enforcing taboos, beliefs, norms, customs, rules and values. The number of respondents reporting VFMCs as important in enforcing rules ranges from 00% for taboos to 4% for rules. For cultural groups, this ranges from 00% for norms and taboos to 4% for rules; while for youth groups it ranges from 00% to 2% for rules.

4.2. Evolution of forest-based institutions

Overall, the results show that while values, customs and norms are key traditional rules that have experienced changes over the years, VFMCs, youth groups, vigilante groups and cultural groups are key structural attributes that have experienced changes over the years. In Table 6, we report the direction of change in traditional rules and institutional structures. From the analysis, majority of the sample, that is, 92% and 82% respectively think that traditional rules such as beliefs and taboos have been constant over the last 10 years before the survey. Less than 25% of the respondents highlighted that institutions

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Table 8
The effect of structural and functional institutions on seed and other forms of NTFP.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Seed based NTFP						
Index of structural institutions	-0.086***	-0.084***	0.105	-0.136*	0.038	-0.114***
	(0.004)	(0.011)	(0.128)	(0. 065)	(0.137)	(0.036)
Main occupation is farming	-0.033	-0.020	-0.023	-0.004	-0.034	-0.035
	(0.041)	(0.042)	(0.059)	(0.071)	(0.075)	(0.042)
Index of traditional council functional attributes	-0.066***					
	(0.024)					
Index of secret society functional attributes		-0.165**				
		(0.069)				
Index village forest management functional attributes			-0.094***			
			(0.028)			
Index of cultural group functional attributes				-0. 517***		
				(0.189)		
Index of youth group functional attributes					-0. 381**	
					(0.137)	
Index of vigilante group functional attributes						-0.407***
						(0.109)
Constant	0.731***	0.802***	0.619***	0.759***	0.681***	0.904***
	(0.057)	(0.066)	(0.078)	(0.138)	(0.141)	(0.078)
Observations	198	195	85	46	56	172
R-squared	0.010	0.033	0.011	0.014	0.011	0.081
Panel B: Other types of NTFP						
Index of structural institutions	-0.111***	0.011	-0.419**	-0.310*	-0.454**	0.126
	(0. 034)	(0.105)	(0.187)	(0.182)	(0.173)	(0.129)
Main occupation is farming	-0.065	-0.029	-0.041	-0.113	-0.122	-0.072
	(0.054)	(0.051)	(0.083)	(0.092)	(0.095)	(0.056)
Index of traditional council functional attributes	0.088***					
	(0.024)					
Index of secret society functional attributes		-0.402***				
		(0.085)				
Index village forest management functional attributes			-0. 134**			
			(0.053)			
Index of cultural group functional attributes				-0. 672***		
				(0.252)		
Index of youth group functional attributes					0.339	
					(0.484)	
Index of vigilante group functional attributes						-0.436***
						(0.145)
Constant	0.685***	0.953***	0.397***	0.534***	0.299	0.758***
	(0.075)	(0.081)	(0.114)	(0.183)	(0.179)	(0.104)
Observations	197	194	84	45	56	171
R-squared	0.008	0.111	0.070	0.099	0.154	0.076

Note: In each regression we control for age, sex and education of household head, household size, household monthly income and migration status. The seed based NTFP are made up of bush pepper, penja pepper, kolanuts, bitter cola, and njangsang while other NTFPs are made up of honey extraction, bush meat, snails, mushroom, and others. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

(processes) witnessed an increase, and less than 40% reported an observed decline in the number of traditional rules in the last 10 years (Table 6). Regarding structural attributes of forest-linked institutions, up to 99% of the respondents are of the view that some structures (e.g. traditional councils) have remained constant in the last 10 years, while less than 30% report an increase in the number of structures. The findings therefore report that traditional rules and structural attributes of forest-linked institutions were relatively constant in the last 10 years.

4.3. Effect of structural and functional attributes in forest-use practices

While forest use practices include timber harvesting, farming and NTFP harvesting, the latter is predominant. Different institutional structures and functions affect the extraction of different types of NTFPs differently and thus disaggregating the analysis provides useful insights. In Table 7, we report the effects of structural and functional attributes of forest-linked institutions on forest-use practices (wood-based and vegetal-based NTFPs). The results show that functional attributes negatively and significantly explain the harvest of both wood and vegetal NTFPs. The effect varies depending on the functional attributes of forest-linked institutions. For wood-based NTFP estimation, the effects are insignificant with the functional attributes of VFMCs and vigilante groups, and insignificant for vegetal NTFPs with the functional

attributes of secret society and youth groups. However, a unit increase in the structural institution index causes between 0.23 and 0.38, and between 0.06 and 0.14 decline in wood and vegetal NTFP harvesting respectively. The results also suggest that when the main occupation of the household head is non-farming, the level of wood and vegetal NTFP harvesting decreases. An increase in the functional attributes of secret societies, VFMCs, cultural groups, youth groups and vigilante groups significantly reduces the level of wood based NTFP harvesting by 0.15, 0.24, 0.85, 0.63 and 0.28 respectively. A unit increase in the functional attributes of traditional councils, VFMCs, cultural and vigilante groups significantly reduces the harvesting of vegetal NTFPs by 0.09, 0.13, 0.12 and 0.13 respectively. In the case of ngongo leaf, a vegetal NTFP, systematic pressure of over harvesting is reported – perpetrated mainly by in-migrants. This further questions the rigour of the institutions and their functional attributes. A female FGD participant recounted:

> "We harvest ngongo leaf here and use mainly for household consumption. But the majority of the ngongo leaf is harvested by 'strangers' (some of them do not even reside in our community) and it is transported and sold in the nearby markets. The harvest rate has increased with the influx of Anglophones who have been displaced by the crisis in the North West and South West Regions"

In Table 8, we report the effects of structural and functional

attributes of forest-linked institutions on seed-based and other types of NTFPs. The results show that the functional attributes of structural institutions negatively and significantly explain the harvest of both seed and other types of NTFPs. The effect varies depending on the functional attributes of forest-linked institutions. The effects of VFMCs and youth group functional attributes on seed based NTFP, as well as the effects of secret society and vigilante group functional attributes on other types of NTFP is insignificant. However, a unit increase in the functional attributes index causes between 0.08 and 0.14 and between 0.11 and 0.45 decline in seed and other types of NTFP harvesting respectively. The results also suggest that when the main occupation of the household head is non-farming, the level of seed based and other types of NTFP harvesting decreases. Furthermore, increasing the functional attributes of traditional councils, secret societies, village forest management committees, cultural groups, youth groups and vigilante groups significantly reduce the level of seed-based NTFP harvesting by 0.07, 0.17, 0.09, 0.52, 0.38 and 0.41 respectively. A unit increase in the functional attributes of traditional councils, secret societies, village forest management committees, cultural and vigilante groups significantly reduces the level of harvesting other types of NTFP by 0.09, 0.40, 0.13, 0.67 and 0.44 respectively.

Overall, the results suggest that structural and functional attributes of forest-linked institutions are important in limiting or reducing the level of dependency on the forest for livelihood by villages around the Santchou Landscape. Hence, any policy options that enhances the implementation of the different structural and functional attributes of forest-linked institutions are essential in improving forest conservation practices in the Santchou Landscape.

5. Discussion

This section discusses the implications of the following results in relation to existing literature: (i) characteristics of structural and functional dynamics of forest-linked institutions, and (ii) estimation of the effect of changes in the structural and functional attributes of forest-linked institutions on forest use practices.

5.1. Characterization of structural and functional attributes of forest-linked institutions

In the Santchou Landscape, traditional council and secret society are the key forest-linked institutions with youth groups being insignificantly represented. Generally, the formation of cultural groups in the landscape is not rooted in the objective of defining and regulating forest use practices. These cultural and youth groups are simply formed with the intention of promoting social cohesion and for the advancement of culture. The extent to which these cultural practices, and the potential role of youth groups in sustaining traditional rules in the community is yet to be established. Besides settling forest-linked disputes, traditional councils play an overarching role in regulating people's actions (forest or non-forest-linked) in the community. Closely linked to this structure are secret societies which equally play an indirect role in regulating forest use as they protect certain portions of the forest and enforce spiritual sanctions to defaulters. Sacred forests are usually linked to an array of beliefs, traditions and taboos which transcend generations. In parts of Asia, the importance of sacred sites was highlighted for conservation, economic and medicinal plants provision (Wadley and Colfer, 2004; Kandari et al., 2014). In Ghana, Aniah and Yelfaanibe (2016) examined the contribution of eight sacred natural sites to sustainable environmental management practices in the Bongo District. They observed that the activities of indigenous people to safeguard the environment hinges on the global views of an intricate relationship between humans and nature.

As structures, VFMCs and vigilante groups monitor forest encroachment and report to forest officials. In several resource landscapes in Cameroon, VFMCs, though having an endogenous composition, are largely explained by more exogenous state-driven interventions. For instance, the original constitution of VFMCs is a construct of the state, through forestry officials (Kimengsi et al., 2019). This potentially explains why their activities are more protection-oriented – and why 74% reported that it originated from the state. The vigilante groups, though community-based, are further shaped by state and municipal actors. Vigilante groups do not only work towards forest protection – they equally provide security support.

5.2. Sources of institutional structures and processes

On the sources of institutional structures and processes (rules), key endogenously-rooted institutions include traditional councils, youth and cultural groups. However, this endogenous origin does not entirely denote an informal setting. For instance, some cultural and youth groups are duly registered and recognized by administrative authorities. This explains why they are allowed to perform during national festivals. However, with growing migration, some of the cultural groups (especially from the Bamilekes the North West and South West regions) are exogenous to the Santchou cultural landscape. Such structures are, however, less dominant. Although secret society is reported as endogenous by all, some societies, while assuming endogenous attributes, have an exogenous origin. A case in point is *Abashi* – a very influential society which was introduced over three decades ago in the Santchou Landscape. From key informant interviews with patriarchs, it was revealed that the *Abashi* was 'imported' from Manyu Division in the South West Region of Cameroon. Although *Abashi* was not transplanted to regulate forest use, it has installed itself as a highly feared institution around the Santchou Protected area (Kimengsi et al., 2021b).

All respondents agree that the norms, customs, beliefs, taboos, and values come from within the community. This is in stark contrast with the institution of structures such as Abashi which bring with them, rules that should be followed. On the role of the respective structures in enforcing traditional rules, traditional councils play key roles, followed by secret society. Cases were communities draw from ancestral norms, beliefs and traditional knowledge to shape natural resource-based livelihoods have been reported in East Kalimantan (Nugroho, 2020). It should however be noted that even the availability of these rules, including their reminders may not effectively shape forest use practices (Eisenbarth, 2020). Considering the non-traditional nature of VFMCs, and the limited forest-linked interest of cultural and youth groups, it is plausible to indicate that relative to traditional council and secret society, these structures are not significantly relevant in enforcing traditional rules. Despite this position, the complementary roles they play or could potentially play, should be considered in future analysis.

5.3. Evolution of forest-based institutions

On the evolution of forest based institutions, more than half of the forest-based institutions (e.g. customs and norms), have witnessed changes in the last 10 years. Surprisingly a significant proportion indicated that these processes have remained constant. The logic is that while the rules still exist, most of them are hardly applied or evoked – leaving them in a state of dormancy. Concerning structural changes, VFMCs and youth groups have witnessed changes in the last 10 years. This is logical, as the mandate of VFMC members are renewable every three years. It is therefore plausible that while the structure stays in place, its composition and the key activities might fluctuate. This also applies to vigilante groups and cultural groups. However, traditional councils and secret societies did not significantly change in terms of size – this affirms their stability as structures that preserve the cultural institutions of the Santchou Landscape. This is opposed to vigilante groups, youth groups and VFMCs. Institutional change in natural resource systems (forest in this case) has been reported in several parts of the globe. These changes could include the reformulation of traditional rules, the tacit undermining of these rules or their abandonment.

However, such changes do not lose sight of the institutional structures that enforce them. The changes are attributed to demographic, social economic and political factors. For instance, in the Sundarbans of Bangladesh, Titumir et al. (2020) reported that the neglect of traditional institutions – largely advanced by indigenous peoples - contributed to the losses of biological diversity. Furthermore, informal institutional change is rooted in state-based interventions; this has implications for forest use practices, and on the function of informal institutions (Rah-man, 2014). Such is reported for Latin America (Faggin and Behagel, 2018; Gebara, 2019), and Africa (Buchenrieder and Balgah, 2013; Hal-ler, 2016; Kimengsi and Balgah, 2021).

5.4. Effect of structural and functional attributes on forest-use practices

While the functional attributes negatively and significantly explain the harvest of all NTFP categories, the effect varies depending on the functional attributes of forest-linked institutions. In the case of wood-based NTFPs, a unit increase in the structural index negatively affects forest use practices – mirrored through a decline in wood and vegetal based NTFP harvesting respectively. When the household head's occupation is farming, the harvesting of wood and vegetal based NTFP harvesting increases. When the functional attributes of structures increase, it leads to a significant reduction in the level of wood-based NTFPs. For instance, this reduces by 0.85, 0.63, and 0.24, for cultural groups, youth groups, and VFMCs respectively. These results resonate with Steele et al. (2015) who insist that although several factors may explain the extent to which households harvest forest resources, particularly NTFPs, the nature and robustness of institutions at local levels should not be swept under the carpet. Although the results report this potential for changes in the respective structures and functions, it should be noted that further field evidence derived through key informant interviews and focus group discussions indicate a situation in which the multiplication of institutional structures and the division of institutional labour does not guarantee efficiency (Kimengsi et al., 2021c).

Regarding seed based and other types of NTFPs, the analysis reveals that the functional attributes of structural institutions negatively and significantly explain the harvest of both categories of NTFPs. An increase in the functional attribute index leads to a decline in seed and other types of NTFP harvesting respectively. When the household head is not a farmer, the level of seed based and other types of NTFP harvesting decreases. As the functional attributes of institutional structures increase, there is a corresponding reduction in the level of seed based and other categories of NTFP harvesting. From the analysis, it is plausible to deduce that the structural and functional attributes of forest-linked institutions are important in shaping forest use practices – in this case, they potentially, and at varying degrees, limit the harvesting of NTFPs around the Santchou Landscape. In the wake of the growing need to diversify as reserves are dwindling in Central Africa, Iponga et al. (2018) reported the surprisingly insignificant contribution of NTFPs, relative to the household and economic contributions of other sectors in Gabon. This occurs against the backdrop of a reportedly 1.5 billion global dependence on NTFPs (Shanley et al., 2016). Furthermore, farm-based occupation tends to increase NTFP exploitation. The extent to which the different types of farm practices may influence specific types of NTFPs represent another issue for further investigation. Cultivable NTFPs could complement farming activities, in a bid to reduce the extent of NTFPs harvesting; this represents an avenue for sustainable forest management. This result does not agree with recent findings in West Africa, where farm-based occupation significantly increased the likelihood of regulating forest use practices through controlled harvesting, fire breaks and enrichment planting (Chukwuone et al., 2020). Furthermore, in Southern Africa (Namibia), Kamwi et al. (2020) reported a significant association between the reliance on different categories of NTFPs and the occupation of households.

6. Conclusion

This paper explored the structural and functional dynamics of institutions in relation to forest use practices in the Santchou Landscape of Cameroon, using a 2SLS estimation with heteroscedasticity-based instruments. Based on the analysis, the following conclusions could be derived: Firstly, traditional council and secret society are the key forest-linked institutions in the Santchou Landscape; both exhibit functional attributes such as dispute resolution, the framing of forest-related rules and the enforcement of sanctions to defaulters. Secondly, most institutional structures and processes in the Santchou Landscape have an endogenous origin; although secret society is reported as endogenous, some have an exogenous origin. Thirdly, despite the non-traditional nature of VFMCs, and the limited forest-linked interest of cultural and youth groups, they play complementary roles in shaping forest use practices. The extent of these complementarity needs to be given careful scientific and policy attention. Fourthly, more than 50% of customs and norms have witnessed changes in the last decade; some of the existing institutions are in a state of dormancy, others have increased while some have declined. Possibilities to activate the dormant ones should be explored. Fifthly, while the functional attributes negatively and significantly explain the harvest of all NTFP categories (tree-based, vegetal-based, seed-based and others), the effect varies depending on the functional attributes of forest-linked institutions. Finally, farm-based occupation leads to the intensification of forest use practices – mirrored in this case as the intensification of NTFP exploitation. Future studies are required to uncover the extent to which the different types of farm practices influence specific types of NTFPs. From a policy stand point, emphasis should be placed on the promotion of cultivable NTFPs to complement farm-based occupation. This could reverse the current positive association.

CRediT authorship contribution statement

Conceptualization, (J.N.K), data collection (J.N.K.), data analysis and reporting (J.N.K. and M.A.K.), writing—original draft preparation (J.N.K), writing—review and editing (J.N.K., M.A.K., L.G. and J.P).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2021.11.010.

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