Forest Policy and Economics 64 (2016) 46–55

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Socio-economic and ecological outcomes of community based forest management: A case study from Tobé-Kpobidon forest in Benin, Western Africa

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ARTICLE INFO

Article history:
Received 18 June 2015
Received in revised form 1 January 2016
Accepted 4 January 2016
Available online xxxx

Keywords:
Community forestry
Traditional institutions
Socio-economic and ecological outcomes
Benin

ABSTRACT

Community forestry, promoted as a "win–win" forest management strategy yielded a variety of results that includes both failure and relative success. The willingness of government to hold control over forest resources while transferring only part of property rights to local communities is one of the major constraints. Therefore, there is a need to explore alternative approaches, which enhance the position and accountability of local communities in community forest management. This study evaluated socio-economic and ecological outcomes of community forestry in a context of important property rights conceded to local communities. The study was conducted using focus groups discussions, forest income evaluation and assessment of forest resources and their dynamics. Findings showed that institutional design with important property rights conceded to local communities partially empowered local communities and reduced threats while improving the condition of forest resources. The approach also yielded positive economic outcomes that enabled bordering populations to make up to 25% of their global annual income from the forest. However, the sustainability of this scheme of forest management was mostly limited by the financial dependency on local non-governmental organization, by local institutions and discrepancy in forest benefits sharing among local forest users.

1. Introduction

West Africa has recently been tagged as a new hotspot of accelerating loss of forest resources (GFW, 2015). Apart from the key drivers identified to contribute to depletion of forest resources (oil palm expansion, small scale agriculture and illegal logging), the issue of forest governance in this region and its outcome/impact are of great concern. Forest governance in West Africa is complex with multiple forest tenure and coexistence of customary and statutory regulations (German et al., 2010; Marfo et al., 2012).

With regard to forest properties rights in Benin, two categories of forest have been distinguished by the law (n°93–009 of July 2nd, 1993). Forests within the State's domain ("Gazetted forest" and "Non gazetted but protected forest") and forests within the private domain. In gazetted forests, property rights are clear and exclusively held by the State. In the 1990s, important reforms in forest governance policies occurred. These new policies recognized some rights to local people over forest resources, advocated for more involvement of local communities in forest management and protection and consequently promoted the development of community forestry. After three decades of implementation in Benin, outcomes of these approaches in State forests range from relative success to failure (Djogbenou et al., 2011). Similar results were found in other countries (Nagendra et al., 2005; Blaikie, 2006). These inconclusive outcomes are partly associated with the control kept by States over forest resources and the transfer of portions of user rights regarding forest resources to local communities (Cronkleton et al., 2012). As a result, local communities feel less concerned with conservation of forest resources and unable to exert some control over them; this leads to persistent unsustainable forest use practices.

The outcomes of community forestry in situations where property rights are conferred to local people have not yet been investigated in West Africa. The Tobé-Kpobidon forest, located within the protected

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http://dx.doi.org/10.1016/j.forpol.2016.01.001
1389-9341/

(and not the gazetted) domain represents such a case. Such an investigation will provide insight into ongoing forest governance practices and to help in developing alternative strategies for sustainable management.

Community forestry approach is expected to '*alleviate poverty among forest users*, *empower them and improve the condition of the forests*' (Maryudi et al., 2012). We expected these outcomes to occur best in community forests where local communities exert their customary property rights on forest resources and have full rights to make decisions regarding access, use and management among others. In this study, we revisit the linkages between forest property rights and institutions at work on one hand, contributions to the livelihoods of local communities and forest conservation on the other hand (See Lambini and Nguyen, 2014) and intend to operationalize the concept of local community in the situation under study. The Tobé-Kpobidon community forest (TK) in Benin has been selected as a case study due to its location. It is in the protected domain (where the State exerts little over the forest and its resources) nearby large forests from the gazette domain. The TK forest is also known among other community forests in Benin to have an outstanding institutional design strengthening the ability of local stakeholders to design collective rules and restrictions in forest resource use and have them enforced. Local stakeholders have been supported by an external stakeholder — Foundation "Aide à l'Autonomie Tobé" (a Non-Governmental Organization) over the last thirty years. Activities alternative to logging and conversion such as ecotourism, beekeeping and a small-scale forest enterprise marketing beehive products sold countrywide under the label "Tobe" have been promoted. Because of its governance model, its exceptional floristic and wildlife richness, the TK forest attracts researchers from the national universities and the national herbarium as well as conservation practitioners.

This paper addresses the issue of the local communities' capacity to sustainably manage their own forest resources. It analyzes the institutional arrangements promoted and assesses the efficiency and the sustainability of an approach intending to empower local communities and protect forest resources while providing enough income to reduce the risk of forest conversion.

2. The issue of "community forestry"

Community forestry seen as a project or policy intervention emerged in the 1980s with changes in forest property and user rights (Sunderlin, 2011; Cronkleton et al., 2013). However, for a long time, this concept has been vague and diversely implemented (RRI, 2012) resulting in confusion. In 2010, researchers, policy-makers and practitioners reconsidered definitions and scopes of community forestry during the conference of Montpellier on "Taking Stock of Smallholder and Community Forestry: Where do we go from here?"(Cronkleton et al., 2013).

Accordingly, community forestry now encompasses situations where people manage forests either inside or outside of community forestry projects, through traditional or adopted institutions, on land they own and use, with or without formally recognized rights and with or without secure tenure. It may include the management of forests, but also of landscape mosaics of forests, trees and farms contributing to livelihoods through both on-farm and off-farm activities.

Community forestry has three interconnected objectives which include alleviation of poverty of direct forest users, their empowerment and the improvement of forest conditions (Maryudi et al., 2012). By involving people in the decision-making process, they are expected to acquire a sense of ownership and start using forest resources in more conservative ways (Agrawal, 2002), leading to various positive outcomes for forest resources and for themselves (Kellert et al., 2000; Shrestha, 2005; Blaikie, 2006). Different indicators have been elaborated and proposed to measure the efficacity of community forestry in delivering these outcomes (Maryudi et al., 2012; Schusser, 2013). To date, community forestry has resulted in both failure and relative success (Nagendra et al., 2005; Blaikie, 2006; Wollenberg et al., 2008; Devkota, 2010; Maryudi et al., 2012). A major determinant seems to be the lack of clear understanding of property rights in community forests where direct forest users may not have clear rights, may have their rights contested or when the official regulations exclude customary rights and practices (Cronkleton et al., 2013). While context dependent, studies converge to the conclusions that, provided community ownership is secured, the likelihood that communities would defer forest use for the future is increased (Lambini and Nguyen, 2014).

3. Methodology

3.1. Study area

The study was conducted in the Tobé-Kpobidon (TK) community forest (Fig. 1) and its three bordering villages (Itchokobo, Issale and Akpaka). The TK forest is located in Mid-West Benin (8°18–8°20′ N and 1°50–1°52′ E), in the Sudano-Guinean phytochorological transition zone (White, 1983). The rainfall regime is bimodal with a trend to unimodal regime. Population size has been increasing considerably in the region (Table 1). However, the population density is one of the lowest in the country (Judex et al., 2009). TK forest covers about 550 ha. In this region, first settlers were hunters, who delimited large lands (including forest reserves) and considered these as under their control. These lands were bequeathed to their descendants, who in turn exerted customary ownership rights including use, management, allocation and intergenerational transmission. People from other lineages were granted user rights (with some restrictions) by landowners over these lands and forests. Such user rights are per se temporary and late migrants who were clearing forest patches into farmland in the seventies have been subsequently evicted by first settler lineage leaders.

Based on the forest law in Benin (n°93–009 of July 2nd, 1993), TK forest belongs to the private domains. Customary ownership including the use and management rights is recognized to communities bordering the forest. As such, TK forest has escaped from government control and has been administrated by local communities.

In the 1990s, a local NGO (*Foundation Aide à l'Autonomie Tobé*) working in natural resources protection built an alliance with some elders in the communities especially those from the first lineages. Later in 2004, after the decentralization reform, the alliance has been extended to local government. Sets of rules concerning uses and restrictions in use of forest resources and traffic flows were agreed upon jointly. Alternative sources of forest products were promoted (home gardens) and innovative sources of income encouraging forest conservation were developed actively (i.e., beekeeping and ecotourism).

3.2. Methods

3.2.1. Social outcomes (empowerment) of TK forest management

Involvement in decision-making is an important step for empowerment. To assess the involvement of local communities in decision-making process, a preliminary survey was carried out to identify different stakeholders involved in forest management using a snowball sampling technique. Stakeholders included organizations like NGOs, committees and individuals having traditional or religious authority to manage TK forest. For each group, 1 to 3 key informants (leaders, elder or referee person) were selected for in-depth interviews. They were asked about their role in the forest management and how decisions were made and implemented.

Using a Likert scale, informants were asked to score their position as well as those of participating actors in *decision-making and access to forest land and resources*. These are considered as the key elements of empowerment (See Maryudi et al., 2012). The SWOT (Strengths, Weaknesses, Opportunities and Threats) tool was used to assess internal and external drivers of the institutional design through a global focus group discussion.

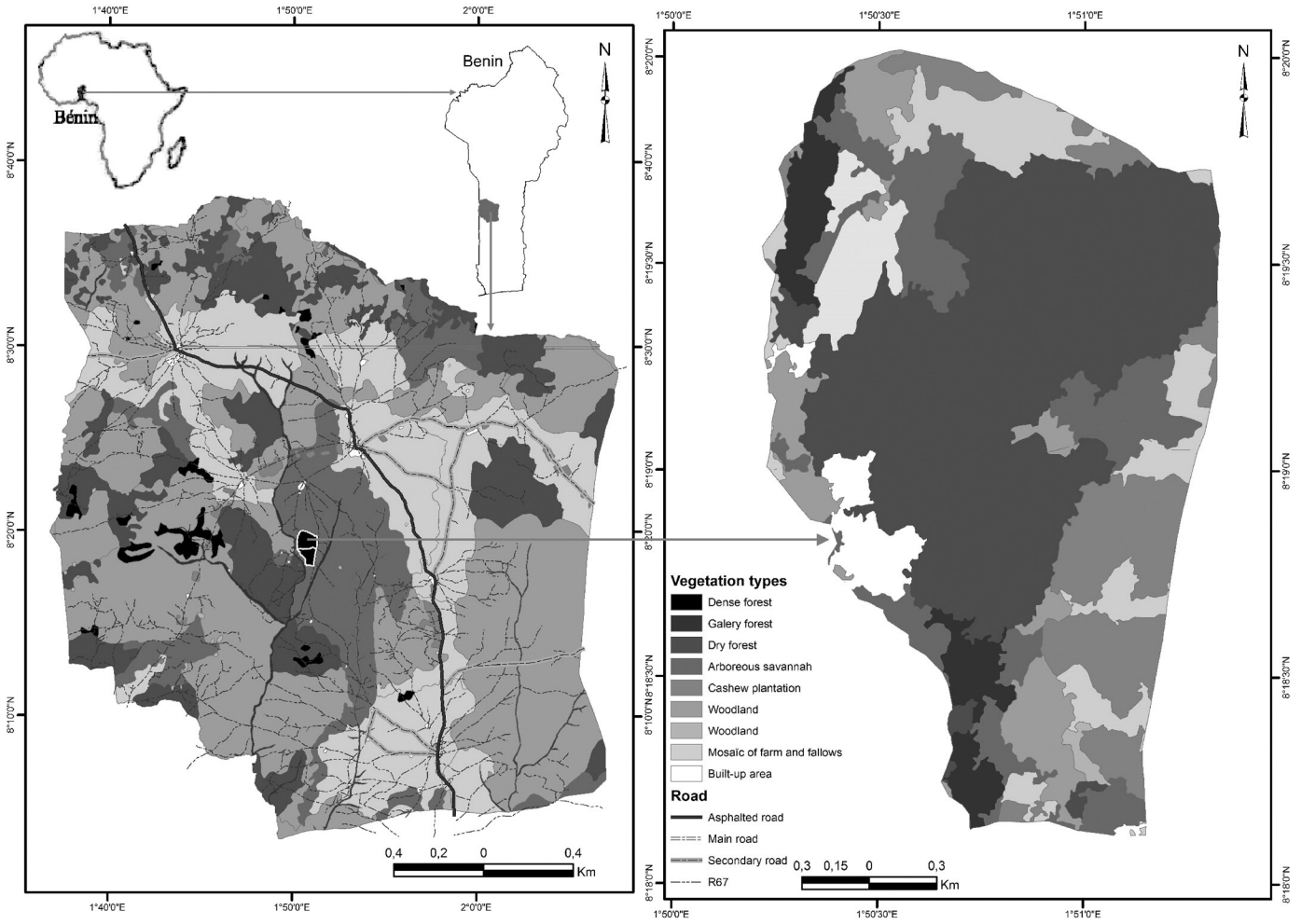

Fig. 1. Study area map.

3.2.2. Evaluation of the economic outcomes of TK forest management

The contribution of forest income to the global annual income (GAI) of local forest users was used as proxy to assess the economic outcomes of TK forest management. The sample size n (number of respondents) was computed to guarantee a margin error of $d = 8\%$ for all the estimations using the binomial approximation law of Dagnelie (1998):

$$n = \frac{U_{1a/2}^2 \times p(1-p)}{d^2} \quad (1)$$

where $U_{1-\alpha/2}(\alpha = 0.05) = 1.96$; p is the proportion of forest users for any access and user rights among the bordering communities. These include transit on forest trails, harvest of Non-Timber Forest Products of which plant parts for traditional medicine, firewood, fish and gastropods and also all activities related to the forest (beekeeping, ecotourism, forest management, prevention of fire and other service provision).

In order to estimate p, a preliminary survey was carried out on seventy-five local people randomly chosen in forest bordering villages. The proportion p of persons having access to the forest was equal to 16.5% and the value of the sample size, n was then computed and rounded to 83. This preliminary survey showed heterogeneity in forest access and thus n was further stratified into 3 groups (Table 2). Group 1 (G1) (40) consisted of first settlers' lineages who traditionally have unlimited access to forest resources and

Table 1
Socio-economic and climatic conditions around TK Forest.

Variable	1961 to 1990	1990 to 2002	2002 to 2012
Governance system†	Community based	Community–NGO	Community–NGO–Local state
Main ethnic groups†	Tcha, Holli, Fon	Tcha, Fon	Tcha, Fon, Peulh
Main activities†	Agriculture, hunting, small livestock	Agriculture, small livestock, forest activities	Agriculture, cashew plantation, forest activities
Population size††	4317	5855	7243
Rainfall (mm)*	1000–1400	900–1300	900–1100
Temperature (°C)*	21–25	25–29	25–29
Relative humidity (%)*	80–95	31–98	15–95

Population sizes are for each of the three period specified in the Table 1. Values for climatic parameters are the arithmetic means.
† (Field data 2013).
†† (INSAE, 2013).
* (Sinsin et al., 2004; Judex et al., 2009).

Table 2
Description of the rights over forest resources granted to the three groups.

Stakeholders	Type of access	Description
Group 1 — first settlers' lineages	Unlimited, user and administration rights	Use of forest resources excluding self-imposed restrictions (logging, hunting and cultivation). Uses are self-consumption and market oriented.
Group 2 — first settlers' kin and allies	Under authorization	Identical uses as in group 1 but submitted to authorization from the first group lineage heads
Group 3 — recent and temporary settlers with social links with groups 1 and 2	Very restrictive	Restricted use of few forest resources (transit on trails, drinking water from the river, restricted fishing, fruits and medicinal plants) harvesting for self-consumption only

(Field data 2013).

are the ones granted the rights to enact new rules. As soon as G1 users decided to exclude logging, hunting, livestock keeping and cultivation in the forest from their initial user rights, the same applied to the other two groups. Group 2 (G2) (21), consisted of first settlers' kin and allies who may be granted similar access rights to forest resources but have to ask for authorisation. Group 3 (G3) (22) comprised of recent and temporary settlers who were only granted very restrictive access rights.

Based on this classification the computerized permanent electoral list of villages bordering TK forest was stratified with assistance of key informants and respondents were randomly selected. Individual interviews were conducted to record and evaluate all productive activities conducted between January 2012 and December 2012. Productive activities including crop production, livestock production, small-scale trade, forest activities (beekeeping, plant collection, fishery, hunting etc.) were recorded and their income assessed, including the value of domestic consumption. Annual incomes of all productive activities were aggregated to get the Global Annual Income of every respondent (Eq. (2)).

$$GAI_k = \sum_{i=1}^{m} AI_i \;\; with \;\; AI_i = GO_i - OC_i \tag{2}$$

GAI_k is the Global Annual Income of respondent k; AI_i is the Annual Income of activity i ($i = 1$ to m, m being the total number of activities of the respondents k); GO_i is the Gross Output of activity i and OC_i is the operating costs related to activity i.

Cash flow (CF) or monetary income was also determined for each activity and aggregated for each respondent (Eq. (3)). Cash flow appeared more relevant to respondents because it expresses the flow of money and the ability of each respondent to invest.

$$\mathrm{CF_k} = \sum_{\mathrm{i=1}}^{\mathrm{m}} \mathrm{CF_i} \quad \text{with} \quad \mathrm{CF_i} = \mathrm{SV_i} - \mathrm{MC_i} \tag{3}$$

CF_k is the Cash flow of respondent k; CF_i is the Cash flow of activity i ($i = 1$ to m, m being the total number of activities of the respondents k); SV_i is the Sales Value of activity i and MC_i the Monetary Costs of activity i.

It was then possible to calculate the contribution of the TK forest to the GAI, by aggregating the incomes of activities dependent on the forest resources.

$$\%RF_i = \frac{GAI_{forest_i}}{GAI_i} \times 100 \tag{4}$$

where $\%\, RF_i$ = *contribution of the TK forest to GAI of respondent* '*i*'; *GAI forest i = Global annual income related to the TK forest and* GAI_i = *income of all productive activities of respondent* '*i*'.

$$\%RF_i = \frac{CF_{forest_i}}{CF_i} \times 100 \tag{5}$$

where $\%RF_i$ = *contribution of the TK forest to GAI* (*monetary*) *of respondent* '*i*'; *CF forest i = Global annual income* (*monetary*) *related to the TK forest and* CF_i = *Monetary income of all productive activities of respondent* '*i*'.

We received verbal approval from respondents to use and reveal the above mentioned personal and confidential information data.

3.2.3. Ecological outcomes of TK forest management

3.2.3.1. Land use and land cover in TK forest landscape. First, we conducted focus group discussions with elderly persons to have their perceptions about the evolution of the forest landscape (degraded, stable, improved positively) during these last twenty years.

Second, we analyzed the dynamics of TK forest cover between 1995 and 2008 to detect and quantify change in TK forest landscape. Two serial times of land use/land cover maps were used based on Landsat images TM 1995 (acquired by the National Center of Remote Sensing within the framework of *Projet de Gestion des Ressources Naturelles*) and LANDSAT7 ETM + 2008 (acquired by DFS & MAPS Geosystems Co. within the framework of *Projet Bois de Feu Phase II*). Six land cover classes were identified: Gallery forest, Dry dense forest, Woodland savannah, Tree savannah, Mosaic of farms and fallows, Rocky and bare terrain. Based on the information of land cover classes from the two observed periods, cross-tabular comparison using the algorithm Intersect polygons available in ArcGIS 9.3 were used to assess the differences in extent of each class and the conversion that took place between the two periods. A transition matrix was elaborated for the periods 1995 to 2008 with respect to the subset areas; it represents either the persistence area of each land cover category during the period 1995 to 2006, or the area which was converted to another land-cover category during the same period.

3.2.3.2. Forest biodiversity and growth. Biodiversity and forest growth are the key indicators in ecological outcomes assessment (Maryudi et al., 2012; Schusser, 2013).

To assess the floristic diversity of the TK forest, fifty square plots of 50 m × 50 m were randomly set up in the forest. Within each plot, tree species and diameter at breast height (Dbh) were recorded for all individuals of Dbh ≥ 10 cm. A matrix $m \times n$ (m being the total number of species recorded over the n plots, $n = 50$) of species coefficient of abundance was drawn and submitted to a non-metric multidimensional scaling (NMDS) in the SPSS v16 software using ALSCAL procedure. This analysis allows individualizing vegetation types. For each identified vegetation type as well as for the overall forest, three floristic diversity parameters (species richness, Shannon diversity index and Pielou evenness) were calculated; (See Gillet, 2000) for details on these parameters. Diversity parameters were then compared among identified vegetation types.

The stem diameter size class distribution SCDs was established to analyze trends in forest growth. SCD is a useful tool in assessing trends in the population of woody species (Cunningham, 2001) in the absence of complete demographic data. The 3-parameters (a, b, c) Weibull theoretical distribution (Husch et al., 2002) was adjusted to the observed distributions and Log-linear analyses were performed in SAS 9.2 to test for goodness-of-fit.

Apart from biodiversity and forest growth assessment, our results were based on memories and perceptions of respondents and thus are subject to various biases. To reduce these biases, the period of recall used in this study was short for economic evaluation. In addition, authors were proficient and familiar with the study area and survey strategies based on recall. However, such bias cannot have been entirely eliminated. Conclusions from this study especially economic contributions of the forest should thus be taken as estimates.

4. Results

4.1. Institutional design of TK forest governance

The ongoing governance framework of the TK forest (Fig. 2) basically relies on: (*i*) *local communities*, (*ii*) *the NGO and* (*iii*) *the local government.*

Local communities are represented by three agencies: (1) family *committees* (*First settlers*), *representing* the two land-owning lineages, in charge of regulating access to the forest and enacting access and user rules as well as restrictions (Table 3), (2) *hunters' brotherhood* regrouping hunters bordering TK forest and taking charge of its monitoring and control against illegal hunting, grazing or logging and (3) divinity *priests*, representing different deities ("*Ogu*" = God of iron, "*Tchankponon*" = God of smallpox, "*Otchoumare*" = God of rainbow", "*Nonon*" = God of bees) installed at the entrance and inside the forest and which are expected to provide metaphysical and deterrent monitoring. Priests are called upon to conduct ritual ceremonies in case of an offence, using a goat to appease gods and divinities.

The NGO (Fondation Aide à l'Autonomie Tobé), a second pillar of the institution design, acted as a supportive external actor to local communities bordering TK forest and tried to reinforce the above mentioned three traditional agencies in order to support TK forest governance. For instance, family committees were restructured into a formal executive representation with regular meetings. The hunters' brotherhood also has been restructured and trained for monitoring instead of hunting purposes. The NGO realized pictorial warning signs for marking the boundaries of the forest and indicating restrictions, employed two permanent guards and conducted forest management activities (including cleaning for fire prevention, nursery and reforestation). The NGO also consented to pay a yearly amount of 500,000 FCFA (ca $1000 USD) to each of the two landowner families as a reward for their conservation efforts and a motivation for them to keep up rules, prohibitions, control and monitoring.

After decentralization in the early years of the new century, the local government has been integrated into the institutional design and is expected to provide legal framework to prosecute offenders. According to interviewees, this hardly happens because decentralization laws do not legitimate such interventions by a local government.

The SWOT analysis (Table 3) performed on TK forest governance environment reveals strong involvement of local forest users into institutional design as main strength. The low cohesion within landowner families was identified as an important weakness likely to lead to some attempts of TK forest conversion (Table 3). Similarly, the rewards consented to family landowners were considered as potential threat when the NGO will be unable to pay. However, opportunities arising from the growing interest in community based forest management, including payments of environmental services were considered as an asset.

4.2. Social and economic outcomes of TK forest management

4.2.1. Involvement of local forest users into decision-making process

According to respondents, family landowners (here seen as an agency in local communities) play prominent roles in decision-making concerning forest governance (Fig. 3). With regard to regulation (rules establishment), access to forest resources, monitoring/control and punishment of offenders, they have full privileges of making decisions and are also in charge for their enforcement. They are assisted by the NGO except for punishment (Fig. 3). However, family landowners are only occasionally consulted with decisions regarding management activities and have no say on decisions based on funds.

The NGO has full privileges in decisions concerning management activities and funds (Fig. 3). It generally decides without the input of local users about the nursery and species to be used, the organization of reforestation and cleaning among others. The NGO also decides how benefits from eco-tourism and honey processing unit will be

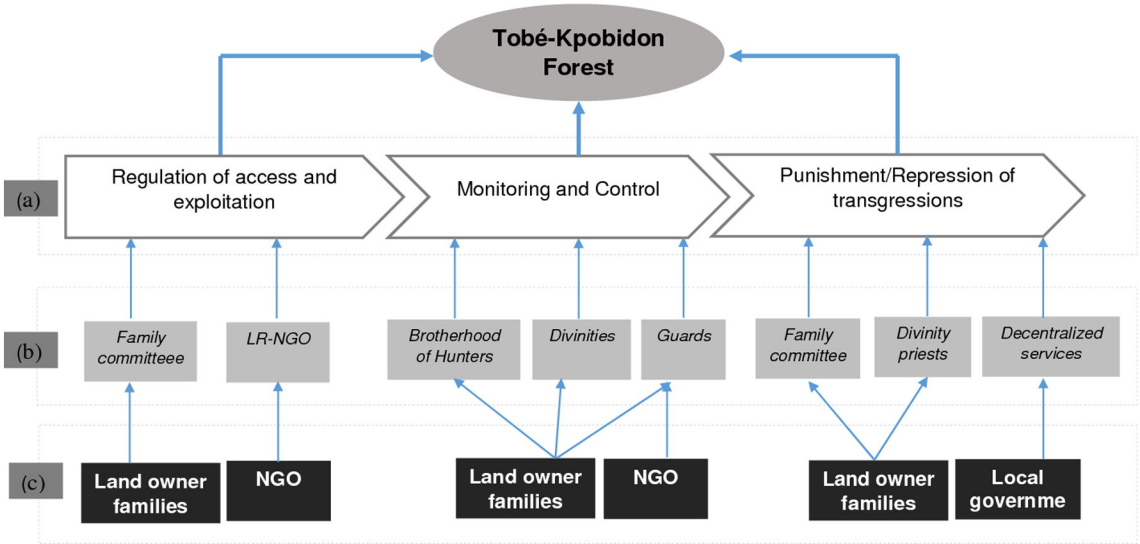

Fig. 2. Framework of Tobé-Kpobidon forest management.

Table 3
SWOT analysis of the ongoing management system in the TK forest.

Strengths[a]	Weaknesses[a]	Opportunities[b]	Threats[b]
– Active involvement of the community – Tradition (including religious ties) as framework of regulation and enforcement – Availability of technical and financial supports – Benefits from the forest	– Low cohesion among landowner families – Challenged the authority of the traditional leader by landowner families members – Progressive loss of tradition value – Complacency in the implementation of sanctions – Strong financial dependence towards the NGO – Decentralization without real authority and without resources	– Growing interest in community based forest management approach among State agencies and donors	– Discontinuity of the annual grant to landowner families

(Field data 2013).
[a] Internal drivers.
[b] External drivers.

used and reinvested and when to give the promised annual reward to each landowner family. The local government has not yet been involved in decision-making concerning forest governance.

4.2.2. Economic outcomes of TK forest management

As already stated above, user rights differ strongly between the three user groups (Table 4).

The annual income (mean ± coefficient of variation) was 797,440 ± 114.67% ($ 1595 USD) for users from G1, 1040,063 FCFA ±92.60 ($ 2080 USD) for users from G2 and 754,980 ± 94.16 ($ 1510 USD) for users from G3. There was no significant difference in the total annual income (p-*value* = 0.190) between the three local groups of forest users groups. However, there is a highly significant difference (p-value < 0.000) among these stakeholders regarding the contribution of the forest to their GAI. Indeed, TK forest contributed on average to 25.65%, 17.08% and 0.09% to the GAI of local forest users from G1, G2 and G3 respectively (Fig. 4a). Based on user rights discrimination around the forest, the contribution of TK forest to the GAI rose with an increase in access to forest resources. However, with regard to the monetary income (cash flow), local forest users from group 2 derived up to 16.47% of their income from forest, which was 5 times more than local users of G1 who use forest resources for their own consumption. Local forest users of G3 derived no cash from the TK forest (Fig. 4b).

Forest related activities were pooled in two categories: conventional activities (medicinal plant gathering, firewood collection, hunting, fishing) and innovative activities (beekeeping and service provision such as path cleaning, afforestation, plant nursery, honey processing, guidance for tourism, forest guard etc.). Unlike forest users from G2 whose important part of forest-based income came from innovative activities (63.45%), forest users from G1 were mainly involved in conventional activities (57.22%). Similarly, forest users from G3 were associated with conventional activities especially poaching. Restrictions concerning harvest seem to be observed and conventional activities provided almost no cash for local users (Fig. 5), while beekeeping and service supplies were main sources of cash regardless of access rights. They provided in average users form G1 with 80% of cash from forest and users from G2 with 85.46%.

4.3. Ecological outcomes of TK forest management

4.3.1. Change in TK forest

The focus group discussion revealed that before 1994–1995, being considered as the beginning of management activities, the TK forest had been conceded for farming purpose to Hollis, an agrarian socio-ethnic group in Benin with preferences for shifting cultivation who had cleared large parts of the forest. According to elder persons, farming activities have been regulated and the overall landscape of forest evolved greatly in 20 years of management. Their perception was confirmed by the dynamics of vegetation cover of TK forest between 1995 and 2008 (15 years of forest management). TK forest was mainly

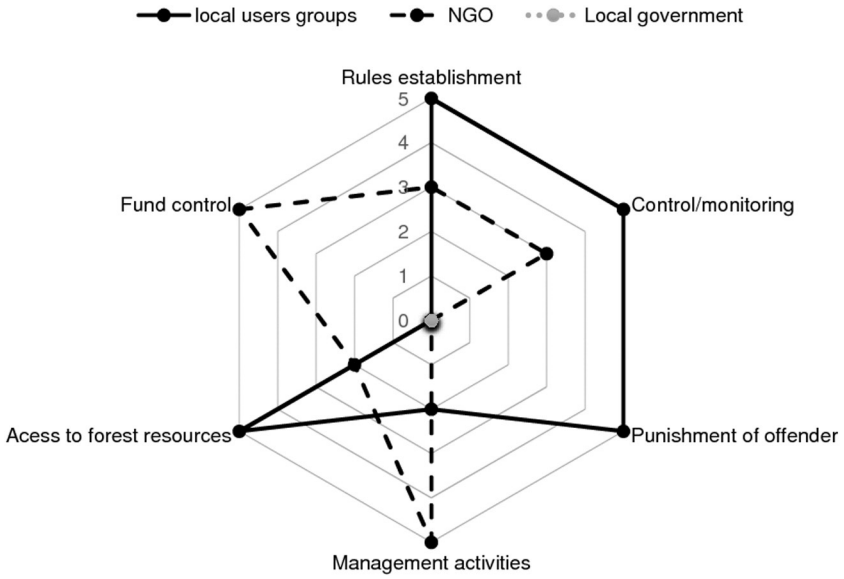

Fig. 3. Position of forest governance institution in decision making process.

Table 4
Dynamic of land cover in TK forest between 1995 and 2008.

Land cover unit	Forest state 1995	Forest state 2008	GLOBAL EVOLUTION	
	ha	ha	Δha	% of the forest
Gallery forest	66.34	30.49	−35.85	−6.64
Dry dense forest	23.23	152.20	128.97	23.89
Woodland savannah	221.10	146.10	−75.00	−13.89
Tree savannah	114.57	60.57	−54.00	−10.00
Mosaic of farms and fallows	86.27	113.73	27.46	5.09
Rocky and bare terrain	28.30	36.72	8.42	1.56

(Landsat images TM 1995); (Landsat7 ETM + 2008); (Field data 2013).

composed of savannah in 1995 (62.18% of the forest, see Table 4). Even though the global evolution of gallery forest, woodland and tree savannah was slightly regressive in 2008, there was important progressive evolution of the dry dense forest. Additionally, human influenced vegetation (farm and plantation of cashew) progressed very slowly with an annual rate of 0.4%.

4.3.2. TK forest biodiversity and growth

Ninety-one (91) woody species belonging to seventy-four (74) genus and twenty-seven (27) families were recorded in the TK forest for a sampling effort of 2.5%. The most represented taxonomical families were Leguminosae–Caesalpinioidae (11.49%) whereas the less encountered were Rutaceae (1.15%) and Oleaceae (1.15%). The NMDS resulted into three vegetation types (Fig. 6).

Vegetation type 1 (VT1, tree savannah) was composed of 28 plots with 75 tree species and the most occurring species were *Vitellaria paradoxa* (9.8%), *Pterocarpus erinaceus* (9.7%) and *Burkea africana* (7.7%). Vegetation type 2 (VT2, wooded savannah) was composed of only 6 plots with 52 species and the most occurring species were *Anogeissus leiocarpa* (22.5%), *Khaya senegalensis* (10.3%) and *Terminalia macroptera* (6.90%). As for the vegetation type 3 (VT3, dry dense forest), it was composed of 16 plots counting 63 tree species with *Spondias mombin* (13.5%), *Gmelina arborea* (11.0%) and *Anogeissus leocarpa* (9.4%), as the most occurring species. Shannon diversity index ($H > 4$; Table 5) and Pielou evenness ($Eq > 0.8$; Table 5) were high, indicating diversified vegetation with approximately evenly represented species.

The diameter size class distribution (SCD) of trees within the TK forest (Fig. 7) indicated an inverse "*J* "shape distribution with the c-value of the Weibull distribution smaller than or close to 1. This would be indicative of multi-specific or uneven-aged stands. Log-linear analyses indicated a good fit (p-value > 0.05) of the Weibull distribution to the observed distributions. The results from the Weibull distribution were congruent with the ones of skewness values (>0; left dissymmetry). The most frequent (>75%) individuals had diameters ranging from 10 to 30 cm (Fig. 7). Trees having 50 cm DBH were scarce, 2.47%, 7.93% and 4.76% respectively in tree savannah, woodland savannah and dry dense forest.

5. Discussion

This study analyzed institutional arrangements and evaluated the socio-economic and ecological outcomes of a community based forest management with low State intervention.

The observed institutional arrangements link both local and external stakeholders (local forest users, NGO, and local government).

The originality of this scheme of forest governance is the reinforcement of the customary (religious based) institutions combined with the promotion of modern income-generating activities out of the non-timber forest products (NTFPs). It could maintain a group of local agencies who are in position of maintaining their authority to regulate, monitor and enforce the rules. These are key functions for successful forest management (Andersson et al., 2013). However, as perceptions and needs of forest users evolve and consequently also the pressure they put on forest resources (Levang et al., 2007), cultural and religious authority as observed in TK forest might not be sufficient to counter threats, especially external ones (i.e. large livestock herds on the move for pastures, powerful logging companies).

It seems inappropriate to sum up into "Community forestry" a reality where forests are actually under the control of a few lineages of first settlers (two lineages in the case of TK). Some lineages from the community do make the most important decisions concerning the forest, but this rarely involves a democratic and equally shared decision-making process, as most of the families in the villages are not represented.

With community forestry in general, local communities are expected to receive benefits from forests that alleviate poverty (Bray et al., 2004). Our findings showed that local stakeholders bordering the TK forest derive important benefits from the forest. This positive economic outcome is to be associated with two important elements: safe user rights preventing a "tragedy of the Commons" and innovative economic activities successfully introduced. None of the local stakeholders feel threatened that his rights over the forest resources might be questioned or conditioned by the State Authorities. Unlike case studies from Indonesia, where the economic outcomes of community forests are questionable (Maryudi et al., 2012), there are no management and utilization licenses imposed in TK forest management. However, a discrepancy was observed in benefits derived from the forest resources among local forest users groups. First settlers' lineages harvest many products from the forest they have rights upon, but mostly for consumption. The second group compensated their initially lower rights by seizing new economic opportunities and engaged in beekeeping.

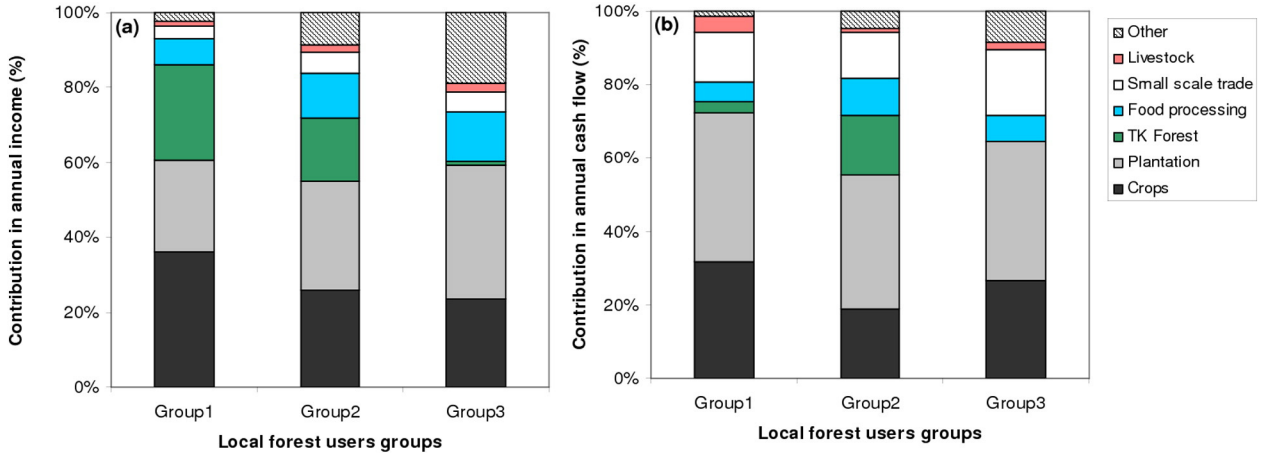

Fig. 4. Contribution of all activities to (a) Global annual income and (b) Annual cash flow of local stakeholders.

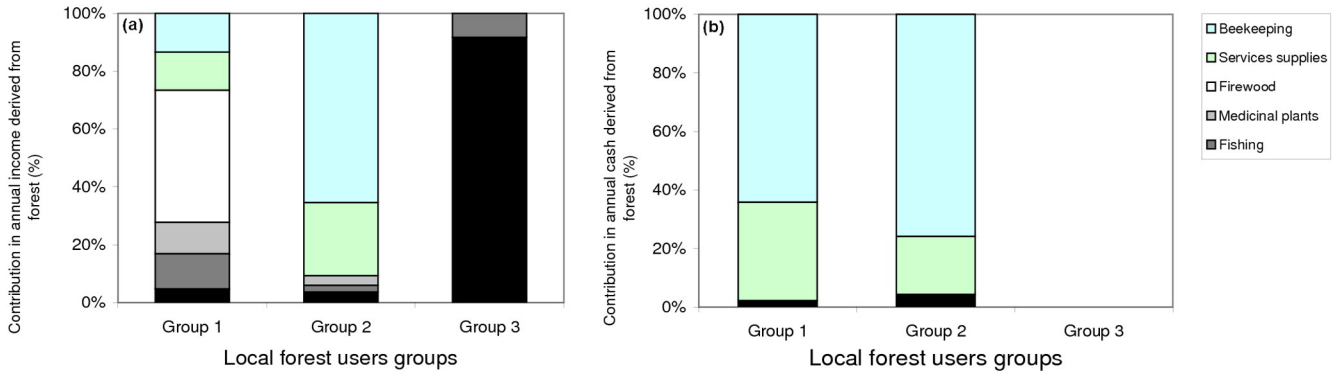

Fig. 5. Contribution of innovative activities versus conventional activities in income (a) and cash (b) derived from TK forest.

Recent and temporary settlers from the G3 have been excluded from both benefits.

By giving opportunities to local stakeholders to benefit from forest resources, they are presumably expected to counter threats affecting them (Salafsky and Wollenberg, 2000). Findings suggest that the ongoing management strategy has a positive effect on TK forest resources. Indeed TK forest hosts more than 3% of the diversity of the national flora estimated to 2600 plant species (Akoègninou et al., 2006). The structure of class diameter (SCD) of the whole forest indicates a very high coefficient of asymmetry suggesting very low progressive trend of forest population (Feeley et al., 2007; Fandohan et al., 2011). The TK forest conservation does not seem to be compromised given the importance of individuals in the class 10 to 30 cm. Our finding is consistent with conclusions from recent research (Charnley and Poe, 2007; Singh, 2008; Devkota, 2010; Vodouhê et al., 2010; Maryudi et al., 2012) which also reported the positive ecological outcome of community based forest approaches. All these observations support the theory that assumes local communities retain indigenous knowledge that makes them the most efficient defenders of a forest.

The observed positive ecological outcome is to be related to the economic factors and also to the power and the legitimacy of the institutional design put in place, which successfully mixed tradition and modern views. However, the observed discrepancy in the distribution of benefits reveals a paradox in the participatory approach of forest management: those who are the most dependent and involved in forest conservation may not be the ones who profit the most, at least from an economic point of view. There is a risk that those who strongly depend but derive little cash money from the forest (i.e. local forest users from G1) might find it more rational to convert forest to other uses more profitable for them than its conservation (Feintrenie et al., 2010), especially those who do not obtain a higher sociopolitical status from the authority conferred to rule makers and priests.

Local stakeholders would not have reshaped rules and rights over their forest nor seized economic opportunities without long-term external support. Here a local Non-Governmental Organization (Foundation Aide à l'Autonomie Tobé) with good connections in the North (Europe) played a major facilitation role. This has been a good opportunity but can also threaten the overall sustainability of the TK community forest management. First, first settlers' lineages as a major forest governance institution are financed for their environmental conservation services but this payment is not embedded in a larger institutionalized system. It relies on a few private donors and is channeled through the NGO. Would one of these fail, the local institution might well be in danger of collapsing. Second, the NGO has more than a supportive role and is involved in making decisions concerning forest governance. Our findings showed that the NGO is using its assisting role as a power element (See also Krott et al., 2013; Schusser, 2013) to influence forest management and control attempts of unsustainable but more profitable utilization of the forest. This raises the question of what would happen if the NGO exits. Community-based enforcements are necessary but are they sufficient? The NGO intervention is a proof that local agencies cannot countervail all attacks. Once again, the need for an external party to

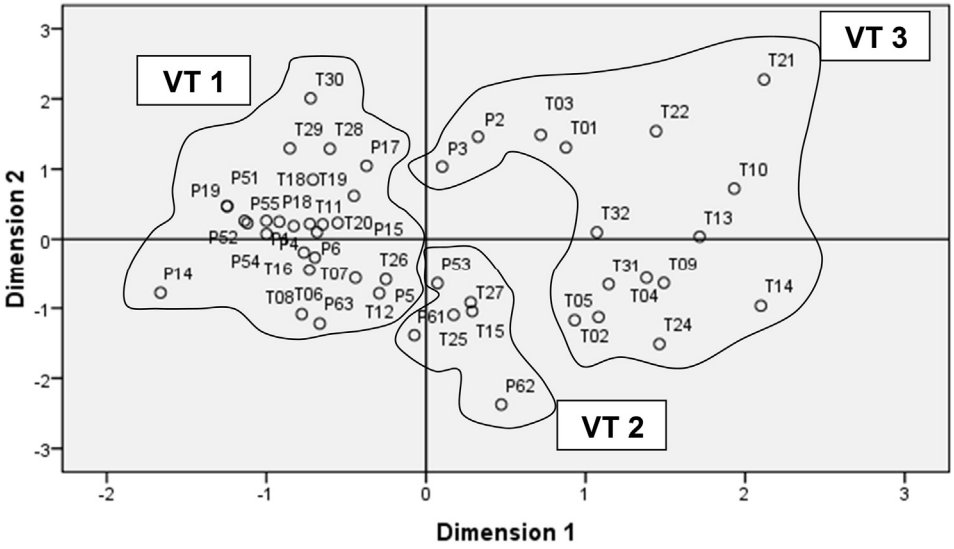

Fig. 6. Projection of the 50 plots of 50 m × 50 m in the system axes 1 and 2, Pi = ith plot installed in Kpobidon side of the forest and Ti = ith plot installed in Tobé side of the forest; VT1 = Arboreous savannah, VT2 = Enriched dry dense forest and VG3 = Wooded savannah. Stress-value = 0.130 and R-squared = 89.87%.

Table 5
Floristic diversity and dendrometric characteristics of identified vegetation types and the whole TK forest: mean values (m), coefficient of variation (Cv, %) and number of plots (n).

Floristic diversity and dendrometric parameters	VT1		VT2		VT3		*p*-Value	Whole TK forest	
	m	Cv (%)	m	Cv (%)	m	Cv (%)		m	Cv(%)
Floristic diversity									
Species richness (S, species)	75.00	–	52.00		63.00	–	–	91.00	–
Shannon diversity (H, bits)	5.09	–	4.60		4.77	–	–	5.40	–
Pieloueveness (Eq)	0.82	–	0.81		0.80	–	–	0.83	–
Dendrometric parameters									
Trees density (N, stems·ha^{-1})	207.86	45.93	252.00	55.77	298.75	30.35	0.021	242.24	44.21
Mean diameter (D, cm)	23.13	18.06	31.08	42.85	27.60	24.34	0.002	25.51	27.81
Basal area (G, m^2·ha^{-1})	9.03	57.21	18.68	66.59	18.49	50.02	0.030	13.21	67.68

(Field data 2013).

resort in case of transgression remains open. This is another paradox of this case study that begins on the premise of the advantage of lower State intervention and concludes with the need of an external party in case of transgression and conflicts.

6. Conclusions

This case study contributes to ongoing debates on the linkages between forest property rights, livelihoods of forest dependent communities and forest protection. Clearly, lower intervention of State and strong involvement of local stakeholders in forest management is a promising way for sustainable forest management and improvement of livelihood of local communities. In Benin, there is lack of legal framework for the protection of community forests. Communities are not yet considered as valuable forest managers and the role of local (indigenous) institutions in forest governance is still neglected. There is a need to make the best out of these traditional regulation systems, which helped to maintain forest resources up to date. However, local communities lack technical skills, financial capacities and knowledge about new economic opportunities. Local institutions may also be challenged. Then the success of this case study should be related to its exceptional context: external support of the NGO, successful development of innovative and profitable activities and the small size of TK forest (550 ha) which facilitates agreements, monitoring and control of threats among stakeholders. Thus, its replication in large forest reserves may not lead to the same outcomes. However important lessons and principles regarding the forest governance, the distribution of benefits and the need for a supportive external back stopper can be drawn from this study to improve the approach elsewhere. The study also questions the very meaning of "community" forestry. Behind this concept there are many discrepancies in status, local rights, capabilities that may constitute a threat upon forest resources if they are not adequately handled.

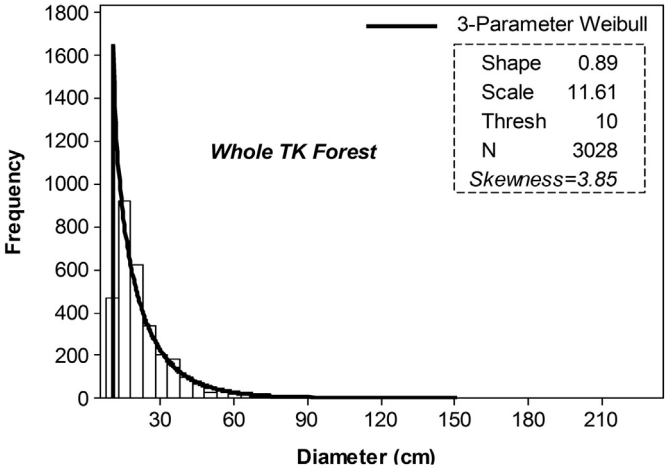

Fig. 7. The diameter size class distribution (SCD) of trees within the TK forest.

Acknowledgements

This work has been supported by The Foundation "Aide à l'Autonomie Tobé" (Grant FT/028-2013). We are grateful to the informants, who particularly welcomed the survey. Fandohan A.B. was supported by the Georg Forster Hermes Research Fellowship program of the Alexander von Humboldt Foundation (fellowship no 3.4-BEN/1155509 STP).We are also grateful to Malavika Hosahally Narayana, Noreen Mukhwana Mutoro, reviewers and the handling editor for constructive comments that helped to improve the manuscript.

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