

LOCAL COMMUNITY VALUES AND PERCEPTIONS OF NATURAL RESOURCE
MANAGEMENT IN NORTHEAST GABON

by

Nina Hamilton

Dr. Connie Clark, Adviser

April 28, 2017

Masters project submitted in partial fulfillment of the
requirements for the Master of Environmental Management degree in
the Nicholas School of the Environment of
Duke University

Executive summary

Conservation and development activities, intended to diversify national economies while protecting high conservation value landscapes, could positively or negatively affect communities dependent upon natural resources to sustain their livelihoods. The degree to which local communities are affected by national level decisions will depend on the level of access they are afforded to their most valued resources. Yet, community values and priorities are often not considered in landscape-level management decisions. The study of community values is particularly important in contexts where government, industry, and local priorities may conflict. This study pilots the use of value mapping as a means of documenting the importance of various forest resources for rural communities living in multi-use forests in the Ogooué-Ivindo province of northeastern Gabon. By identifying the most highly valued resources, perceived threats to those resources, and local perspectives regarding potential management solutions, this study also identifies key local priorities that could inform regional land use planning to balance local and national needs.

I conducted separate gender-specific focus groups in 10 villages, for a total of 20 focus groups consisting of 178 community members. Participants first drew maps of the natural resources use areas in their villages, and then engaged in a resource prioritization activity using the pebble distribution method (PDM), in which they distributed tokens across the map to score land types and resources by their importance to local livelihoods and well-being. Participants also mapped and scored perceived threats, and discussed potential solutions to those threats in response to open-ended questions. I converted PDM scores into percentages, representing the relative value or threat allocated to each resource out of the total number of tokens (represented as V , with $V > 0$ representing positive value and $V < 0$ representing negative value, or threats). To assess village perceptions towards forest access and resource availability, I conducted a survey across the 10 study villages ($n=50$) about current satisfaction with forest access, changes in forest access, forest coverage, and resource availability. Finally, to better understand community perceptions of community forestry as a means to secure local forest access, I conducted 7 key informant interviews with chiefs in villages within the study area that have established or are in the process of establishing a community forest as recognized by Gabonese law.

My results suggest that crops ($V = 20\%$) are the most highly valued resource by local communities, followed by firewood ($V=14\%$). The importance of wild game resources differed significantly by gender ($V_{\text{women}}=9\%$, $V_{\text{men}}=16\%$, $t=-3.23$, $df=15$, $p<0.01$). Crops are also perceived as the most threatened resource ($V=-62\%$), followed by forest products in general ($V=-23\%$). Community members identified forests elephants and logging operations as the greatest threats to resources, but put the onus of designing and implementing solutions on the State. Despite an overall positive perception of forest access, satisfaction with forest access increased with distance to the park ($F_{1,48} = 10.04$, $R^2 = 0.17$, $p = 0.002$). There was widespread awareness among village chiefs about the benefits of community forests for forest protection and community development. However, there remain significant barriers to the establishment of community forests, including the lack of village scale community organizing and technical assistance.

The participatory approach taken in this study highlighted local priorities that could inform national level decision-making, most notably the widespread local concerns that human-elephant conflict, extractive industries, and national parks threaten and restrict access to natural resources valued by rural communities. To integrate local communities into the decision-making process regarding access rights to natural resources, I recommend prioritizing: (1) mitigation of crop raiding with transition to intensified agriculture, (2) work with forestry operators and NGOs to improve local perceptions of industrial logging operations and promote community forestry, and (3) implement a decentralized approach for communities to access information on and participate in regional land-use decisions. These steps would likely mitigate tension that could derail national conservation and development goals, while promoting strategies that are compatible with both local and national interests.

Introduction

Forest products meet livelihood needs in about 80% of forest communities worldwide (Levang et al. 2015), and contribute on average 20% of rural household incomes in developing nations, and up to 59% in sites in Central Africa (Angelsen et al. 2014). Over two-thirds of the population in Africa depends on timber and non-timber forest products (NTFPs) to some degree (CIFOR 2005), and forest products meet subsistence needs of 60 million people living in or near the forests of Central Africa and feed another 40 million in urban areas (Nasi et al. 2011, CBFP 2015). For example, in the Congo Basin over 3 million tons of bushmeat are consumed annually, and bushmeat is particularly crucial for rural communities where few alternative sources of animal protein are available (Nasi et al. 2011). NTFPs are used for many purposes (Timko et al. 2010), generate up to 55% of income in forest communities in Central Africa (Endamana et al. 2016), have important cultural and spiritual value (Lescuyer et al. 2009, Mbete et al. 2011), and serve as important sources of household energy (Eba'a Atyi et al. 2016) and medication (Ntiama-Baidu 1997, FAO 2017). The dependency on forest resources increases with household poverty levels (Langat et al. 2016).

Within Central Africa, Gabon is unique with over 85% remaining forest cover (FAO 2014) due to its low population density and high economic reliance on oil extraction, making up over 50% of GDP (World Bank 2015). Although only 12% of Gabon's population resides in rural areas outside of regional population centers (FAO 2014), the lowest proportion in Africa, most of these communities lie in highly forested areas and remain dependent on the harvest of forest products and small scale agriculture. Approximately half (45%) of the rural population lives in poverty, compared to 30% in urban centers (Government of Gabon 2011). As the Government of Gabon works to develop and grow its economy, it is expanding its agricultural, mining, and forestry industries, already allocating over half (52%) of its land area to logging concessions (MEFEPA and WRI 2013). While these activities are expected to provide economic benefits at a national scale, their effect on rural livelihoods will likely depend on the degree to which they reduce access to or availability of forest resources.

Gabon's national park system, which covers 11% of Gabon's land area (MEFEPA and WRI 2013), and conserves the region's high biodiversity and natural heritage, could also detrimentally affect rural livelihoods if it restricts access to areas of valued natural resources. Furthermore, wide-ranging wildlife species that move out of protected areas into forests used by

rural communities often damage or destroy income-generating property, such as cropland and livestock, threatening rural livelihoods. National law that protects endangered species, such as the forest elephant, also limits the right of farmers to protect their property from damage (Décret no. 164/PR/MEF du 11 janvier 2011). Thus, forest dependent communities could be threatened locally by both the development and conservation decisions being made nationally.

Yet, much of the decision-making regarding national-scale land use planning occurs without the voice of local communities. As a result, the perception that extractive industries, national parks, and wildlife endanger locally valued natural resources could increase tension between local communities and the State. Recent efforts have been made to empower communities to manage and secure their forest resources. In 2001, Gabon enacted legislation allowing communities to obtain rights over forest under sustainable community-based management plans (Meunier et al. 2011). More recently, Development of Community Alternatives to Illegal Logging (DACEFI), an initiative by the World Wildlife Foundation (WWF), aimed to assist communities in the process of establishing community forests through capacity building; however, many barriers remain to participation and only one community forest has been legalized in Gabon (Meunier et al. 2011).

Local participation in conservation

Local participation in decision-making for conservation and development often improves joint environmental and socioeconomic outcomes in contexts where livelihoods depend on natural resources (Waylen et al. 2010, Persha et al. 2011, Mugisha and Infield 2012). Direct involvement of community members, using participatory approaches, situates management strategies in the local context and encourages buy-in from the community, which is essential for long-term, sustainable outcomes. A lack of consideration of social processes in which conservation and development initiatives are embedded can even reduce an initiative's effectiveness (Brechin et al. 2002). The importance of community involvement is particularly salient in rural communities that are highly dependent on natural forests, where poverty and environmental degradation are often inextricably linked (Sunderlin et al. 2005). Community involvement, and particularly a context-specific understanding of local values of natural resources, can inform integrated conservation and development decisions that protect biodiversity while also safeguarding local livelihoods.

Local values and conservation/development priorities

An integral part of local community participation is the consideration of local values and priorities, which can be identified when local values are considered in relation to local threats to natural resources (Smith and Meredith 1999, Raymond et al. 2009, Klain and Chan 2012). By identifying and clarifying local conservation priorities, participatory tools can “strengthen the position of local groups in protecting their culturally defined resources”(Smith and Meredith 1999). Asking why people value their resources, identifying local concerns, and discussing options to address them brings diverse stakeholders to a shared understanding, preventing conflict and facilitating dialogue (Sheil et al. 2006). For example, village consultations in Tanzania revealed significant gaps between natural resource management goals at the local and national level within the Reducing Emissions from Deforestation and Forest Degradation (REDD) framework (Mustalahti et al. 2012). Community participation can also increase public trust, prevent the marginalization of peripheral groups, build a local sense of ownership over decisions, and may even reduce implementation costs if rules are more acceptable to the local communities (Reed 2008). As Sheil et al. (2006) state, “conservation can be built around what people find important”, as could initiatives that balance both conservation and development.

However, the challenges of conducting participatory processes in low-resource settings, with limited time and funding, continue to restrict their widespread adoption for national resource management. Furthermore, the “inaccessibility, language barriers, economic marginality, and prejudices against [indigenous communities]” make it difficult for decision-makers to consult with them (Sheil et al. 2006). Assessment techniques, therefore, need to be rapid, yet intensive so they can contribute to conservation planning before it is too late while still accurately representing the diverse viewpoints within and among rural communities. Mascia et al. (2003) advocate for “rapid social assessment programs, which would provide decision-makers with a rough sketch of critical social information at potential conservation sites through short-term, but intensive inquiry.” Similarly, rapid rural appraisal techniques have gained traction in the rural and international development fields since the 1980s as a method of “learn[ing] about rural conditions in a cost-effective way” (Chambers 1981).

Community mapping is a participatory method that engages local communities in mapping current and past land uses, identifying trends in resource quality, and developing context-specific management plans. Community mapping can be combined with other

participatory tools to spatially map the relative values and perceived threats that a community places on its natural resources (Raymond et al. 2009). The resulting maps provide communities with a valuable tool for incorporating their values into community-based management plans. This method allows for greater community input in both the data collection process and the design of management plans, while considering multiple factors simultaneously (land use, community values, and ecological data) to develop place-based solutions. Furthermore, where land tenure creates legal barriers for community-based management, this mapping technique can provide national decision makers with critical information to prevent the marginalization of rural populations in the land use decision-making process.

Purpose

This study pilots the use of a rapid assessment community mapping tool to identify the natural resources most valued by rural communities in northeast Gabon so that they can be incorporated in regional land use planning to balance local and national interests. Specifically, I determine the resources of highest local priority and identify locally perceived constraints or threats to those resources. I also investigate community perceptions of forest access, situating their current level of access in the context of past and future resource availability, and determine how perceptions of forest access differ across villages, depending on their proximity to different land uses, such as logging concessions and national parks. To assess the potential for community-based natural resource management (CBNRM) in this region, I characterize local attitudes towards mitigating the identified threats, as well as local perceptions of community forestry as a formalized approach to CBNRM. Finally, I discuss recommendations for integrating local priorities into national level decision-making so that conservation and development strategies are compatible with both the national targets and rural livelihoods.

Methods

Study area

This study was conducted in the Ogooué-Ivindo Province of northeast Gabon, a primarily forested region intermixed with agrarian communities, logging and mining operations, and the Ivindo National Park (Figure 1). From May-August 2016, I conducted fieldwork for 10 weeks in 10 villages within 50km of the regional city, Makokou. The villages represent a range of

population sizes, ethnic groups, and distances to potentially restrictive land management categories, such as national parks (4-50km) and logging concessions (all within 6km) (Table 1).

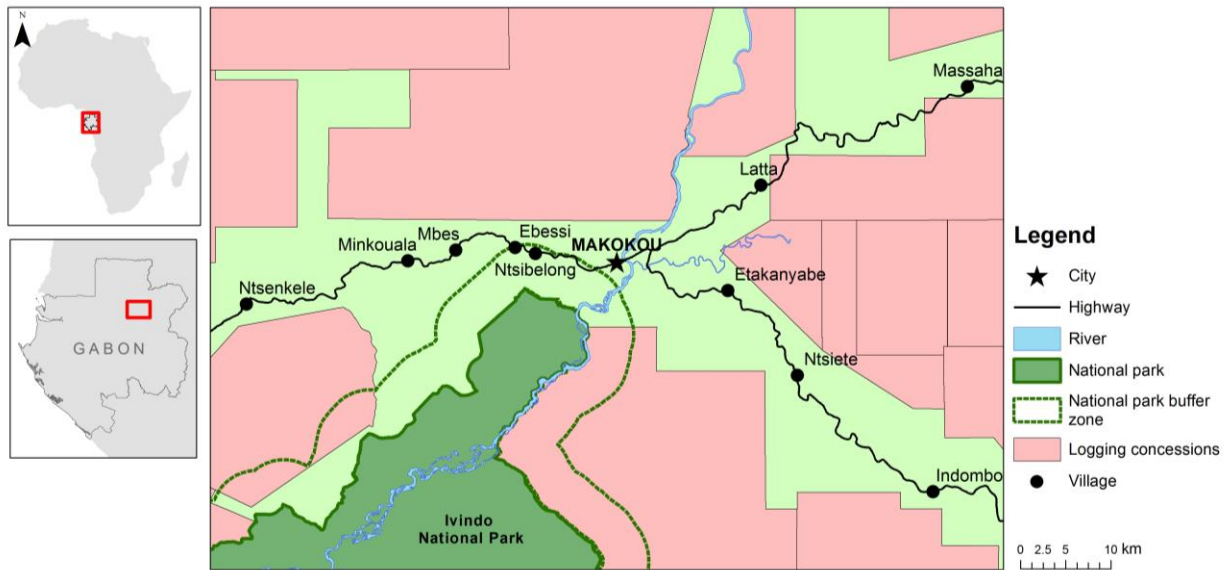


Figure 1. Map of study area.

Table 1. Characteristics of villages included in the study.

Village	Ethnic group	Number of households	Distance to city (km)	Minimum distance to national park (km)	Minimum distance to logging operation (km)
Ntsibelong	Fang	50	11	4	4
Ebessi	Fang	24	15	5	3
Etakanyabe	Kota	46	15	16	3
Latta	Kota	19	20	25	1
Mbes	Fang	54	20	9	3
Minkwala	Fang	37	26	11	6
Ntsiete	Kota	73	28	24	4
Ntsenkelle	Fang	62	50	20	2
Indombo	Kota	46	56	38	2
Massaha	Kota	69	56	50	1

Local natural resource use

Although all forested land in Gabon is federally owned, villages have customary tenure systems that vary by village, including individual, lineal, familial, associative, and mixed natural resource governance systems (Pierre et al. 2000). Government regulations place limits on wood harvesting and hunting for bushmeat, with clauses that permit hunting and forest product use for traditional subsistence purposes (Décret n°692/PR/MEFEPEPN du 24 août 2004, Décret

n°161/PR/MEF du 19 janvier 2011, Loi n°16-01 du 31 décembre 2001). Communities in the Makokou region are primarily agrarian, with bushmeat and fish as the primary sources of protein (Vande weghe 2006). They also use a great number of plant and tree species within the forest and fallow (from slash and burn agriculture) for food, medicine, wood, and energy. For example, *Gnetum* spp. is a genus of liana whose leaves are highly nutritious and commonly used in cooking (FAO 2017). Many other species have multiple uses, such as the moabi (*Baillonella toxisperma*) which is traditionally used for its fruit, bark (medicine), and wood (personal communication, focus group discussion).

Focus groups

To adapt the focus group and mapping exercises to the local social and environmental context, I first conducted a brief key informant interview with the chief in each village to ascertain community involvement with natural resource management, and to collect preliminary information on their most valued resources and the degree by which those resources are perceived to be threatened (Appendix A). I also conducted a mapping activity in one pilot village (Massaha) to identify the appropriate range of natural resources to be included in community mapping. I then modified the community mapping protocol and questionnaires to reflect lessons learned during the interviews and pilot mapping activity. Because Massaha served as a pilot study, I excluded it from data analysis (n=9 villages).

With the assistance of two community members in each village, I facilitated separate gender-specific focus groups for men and women (20 total). Participants were selected opportunistically along the entire length of the village to ensure that participants represented all sectors of the village. A total of 178 community members participated in the focus groups (78 men, 100 women; average 9 per group). Each session consisted of: 1) a community mapping exercise; 2) scoring of land uses and natural resources; and, 3) a discussion of the mapping results (Appendix B). All sessions were conducted in French, or the local language (Kota or Fang) when French was not spoken by all participants.

Community mapping exercise

At the opening of each community mapping exercise, I first explained the purpose and expected outcomes of the mapping exercise to ensure a shared understanding among the group. I then provided focus groups with large poster paper on which infrastructure landmarks, such as

the main road, school and churches, were represented. I provided multiple markers and asked participants to cluster around the map to encourage participation by all (Figure 2). I then asked participants to draw a specified set of 4 land types (forest, cropland, rivers, and water springs) and 8 resources (crops, drinking water, fish, bushmeat, firewood, construction wood, medicinal plants, and other NTFPs) in their community, with opportunities to include additional resources. Participants also estimated, for each mapped resource, the distance to the main road and the frequency of use to provide geographic and social context around natural resource use. Seasonal differences in resource use were also noted where relevant (e.g. fishing). After drawing the designated land types and resources, I asked participants to draw any additional resources or assets (e.g. sacred areas) of importance to their community. To conclude, I asked participants to confirm their collective agreement on the drawn map; once collective agreement was achieved, I considered the base mapping exercise complete.



Figure 2. A men’s group participates in community mapping.

Scoring for value

To determine the relative value of mapped resources to village participants’ livelihoods and community well-being, I next employed the pebble distribution method (PDM) using the community-created maps and small pieces of paper, or “tokens”. Participants scored the relative

value of natural resources by placing tokens on each land type and resource. A total of 20 tokens could be allocated to land types and 40 tokens could be allocated to natural resources (Figure 3). I then asked participants to specify the reasons each resource was valued, by coloring the tokens to match designated value categories (subsistence, income, health, culture; Figure 4). For example, if a resource was valued equally for subsistence and economic reasons, half the tokens would be colored for each category. This process was repeated to map threats, allocating 10 tokens to resources under threat. This standardized method allowed for direct comparison of values across communities, while still capturing the heterogeneity of values within and among communities. To conclude, I asked participants to confirm their collective agreement on the allocation of tokens. All groups received copies of their maps to use and display in their village.

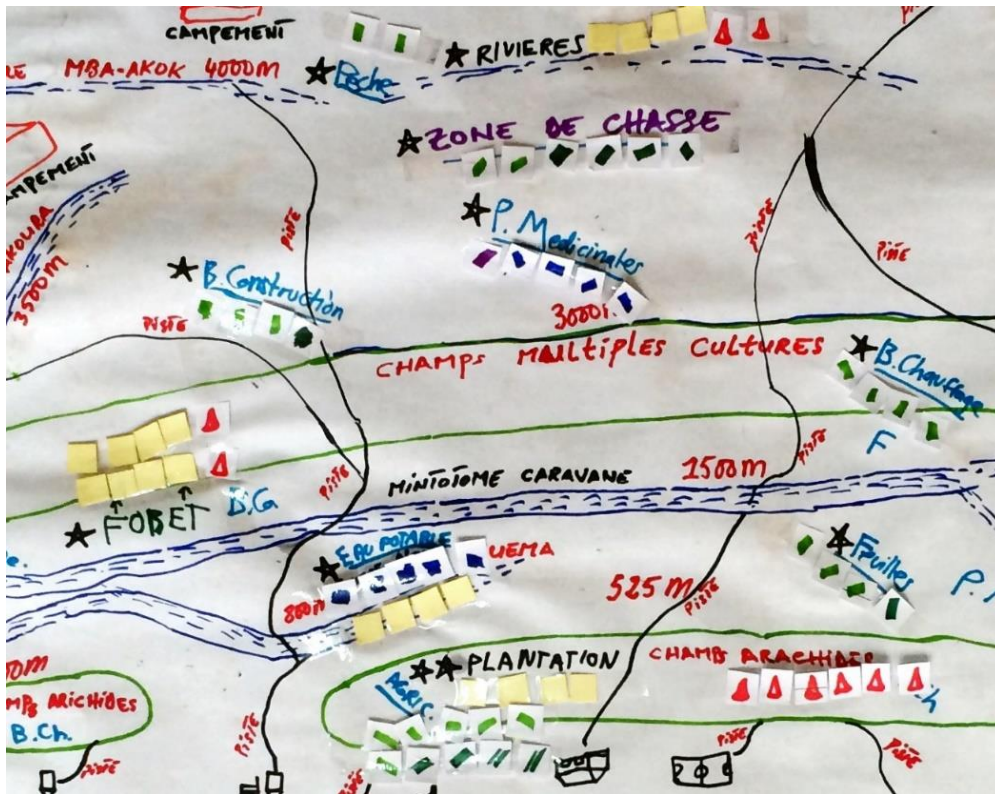


Figure 3. Example of PDM for this study. Yellow papers designate value for land types, red triangles for threats, and the rest for resources, colored based on reasons valued.

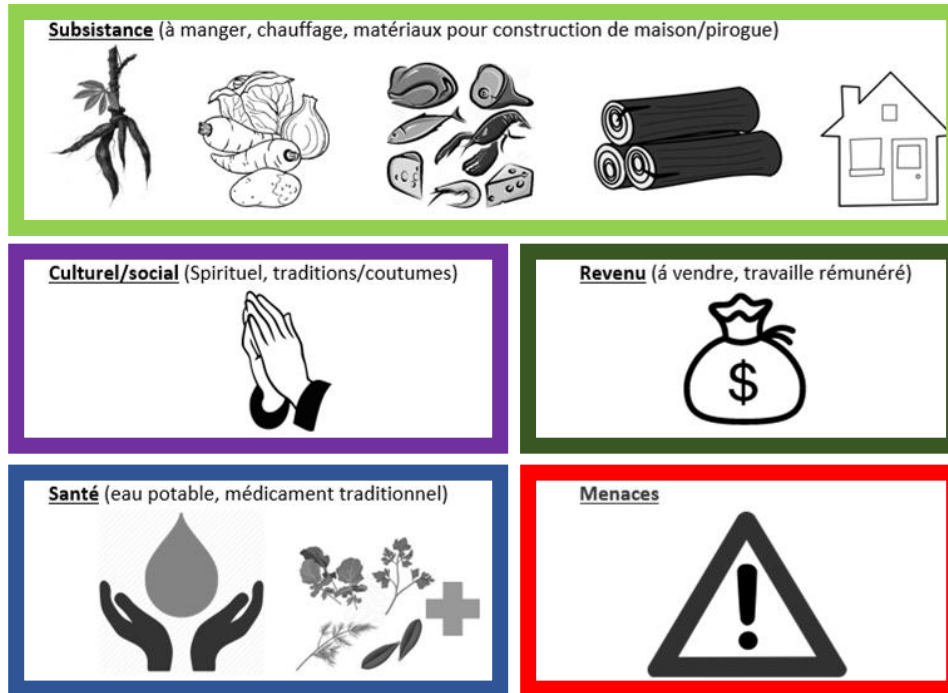


Figure 4. Color-coded key used with PDM for specifying reasons resources are valued.

To compare the relative value placed on each land type, resource, or threat, I converted the PDM results to percentages by dividing the number of tokens given to a category by the total number of value tokens (20 (land types), 40 (resources), or 10 (threats) possible points). The relative value is reported here as the variable V , with $V > 0$ representing positive value attributed to resources and $V < 0$ representing negative value, or threats. I then performed t-tests on arcsine square root transformed percentages to compare the relative value of land types and resources between genders.

Sources of threats and potential solutions

Following the mapping exercises, I asked a series of open-ended questions regarding sources of threats, potential solutions, local management strategies and historical changes in land uses to the group of participants. I recorded all discussions using a voice recorder and later transcribed responses from French to English. Using NVivo, I coded focus group discussions for the main threats, perceptions of connections among threats, suggested solutions, and attitudes towards responsibility (e.g. community or state) for addressing threatened resources using a nested coding structure (Table 2).

Table 2. Coding structure for focus group discussion on threats and solutions.

THREATS
Themes (Specific threats, e.g. elephants) Connections (Links between threats, e.g. logging and crop raiding)
SOLUTIONS
Themes (Specific solutions, e.g. electric fence) Attitudes (Responsibility, e.g. state, community)

Survey on forest access

To understand village perceptions towards forest access and resource availability, I conducted a survey of a random sample of 50 respondents across the 10 study villages, aiming for 5 respondents per village. The short survey instrument consisted of a series of Likert-like response questions on current satisfaction with forest access, changes in forest access, forest coverage, and resource availability (Appendix C). I re-coded Likert responses to a range of -2 (strongly negative perception) to +2 (strongly positive perception). To determine the degree by which proximity to the national park influences perceptions of forest access, I conducted a correlation between distance from park and survey response.

Community forest perceptions

To better understand community perceptions of community forestry as a means to secure local forest access, I conducted 7 key informant interviews with chiefs in villages within the study area that have established or are in the process of establishing a community forest as recognized by Gabonese law (Appendix D). I asked chiefs to describe their motivations for establishing a community forest, their level of advancement in the legal process, their institutional partners, and the challenges they have faced. I coded this information using NVivo for analysis.

Results

Scoring for value

The PDM activity identified cropland as the most valuable land type, with an average relative value, V , of 40% (SD=12%), followed by forest ($V=23.9%$, SD=11%), rivers ($V=19.7%$, SD=7%), and streams/water springs ($V=16.4%$, SD=8%). Women valued cropland significantly

more ($V_{\text{women}}=47\%$, $V_{\text{men}}=33\%$, $t=2.76$, $df=15$, $p=0.014$) and forest significantly less than men ($V_{\text{women}}=17\%$, $V_{\text{men}}=31\%$, $t=-3.02$, $df=14$, $p<0.01$).

When categorized by resource type, communities valued crops ($V=20\%$, $SD=6\%$) more than other resources, yet values were more equally distributed across resources than land types. The top four valued resources were crops, firewood, bushmeat, and medicinal plants (Figure 5). Men and women valued resources similarly, except that women valued bushmeat significantly less than men ($V_{\text{women}}=9\%$, $V_{\text{men}}=16\%$, $t=-3.23$, $df=15$, $p<0.01$), and in one village the men valued a sacred area that was not valued by women (Figure 6).

Crops were also identified as the most threatened resource, by all 18 groups, with an average V of -62% ($SD=11\%$) (Figure 10), suggesting that crops are a high priority resource for these communities. NTFPs were scored as the next most threatened resource ($V=-23\%$, $SD=13\%$), with 61% of groups listing them as threatened.

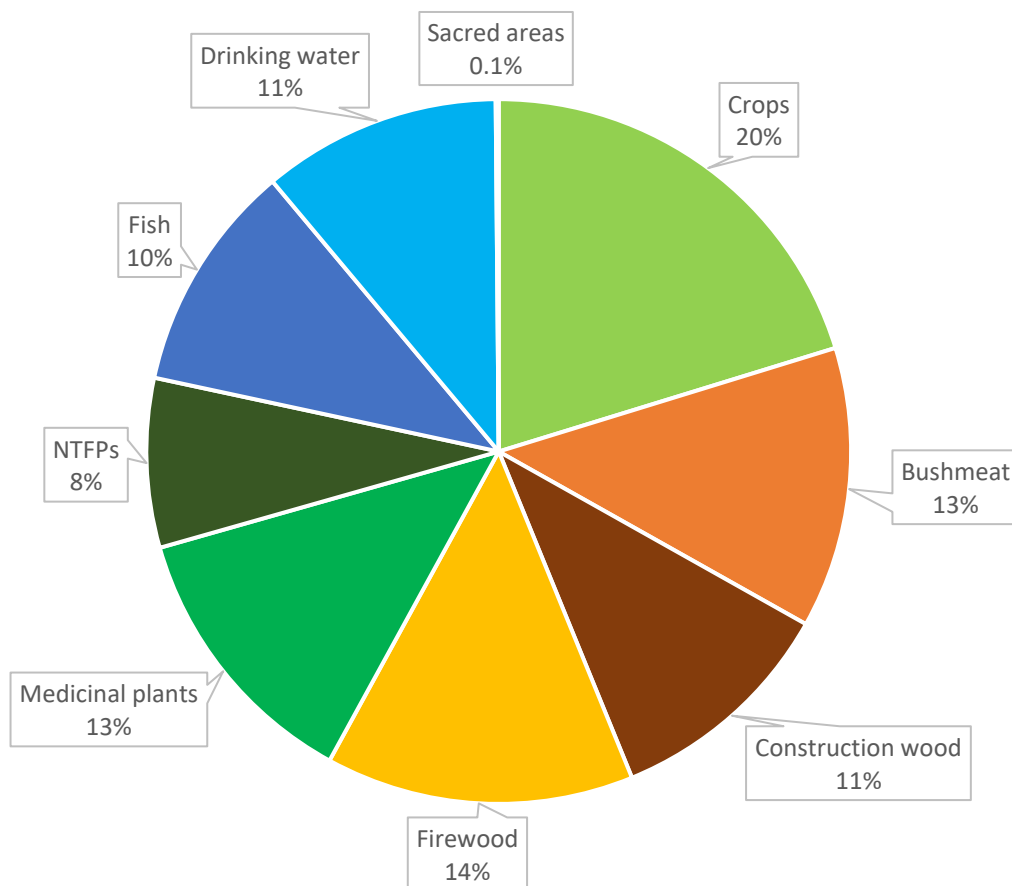


Figure 5. Average relative value (V) attributed to each natural resource for 9 villages. Crops are the most highly valued, but many resources were valued at similar levels.

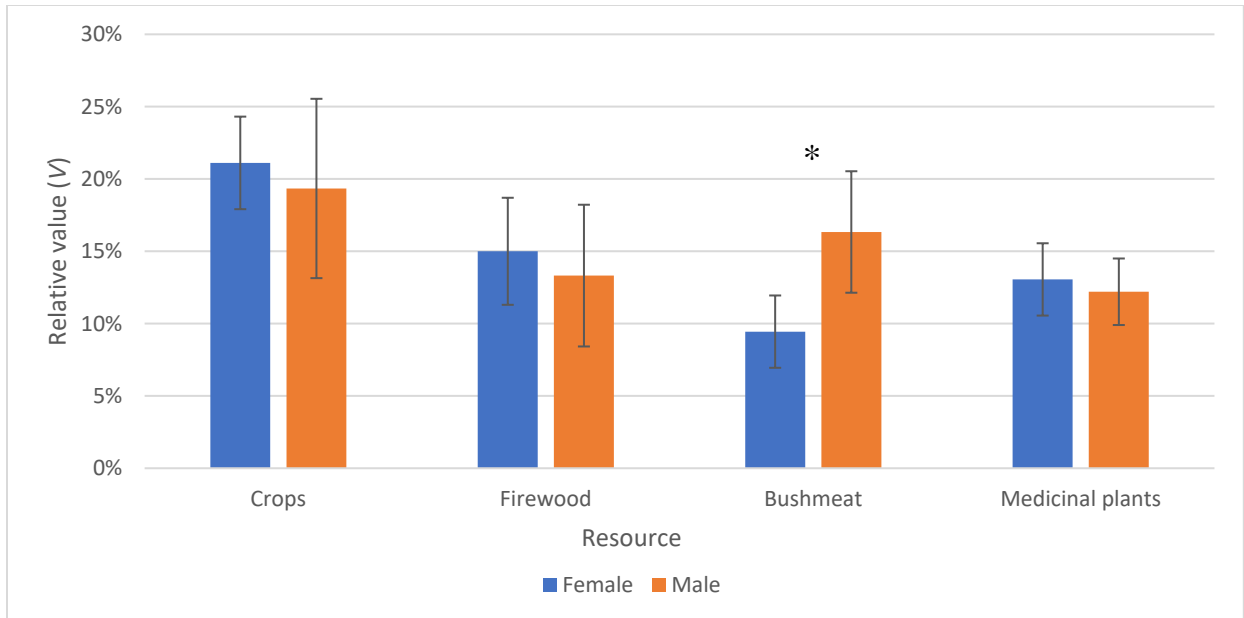


Figure 6. Average relative value (V) by gender for the four highest valued resources. Men and women valued resources similarly, except for bushmeat which men valued more. Error bars represent bootstrapped 95% confidence intervals. Asterisks denote significant differences between the values men and women attributed to a resource ($p < 0.05$).

Value rankings

Although cropland was, on average, the most valued land type, it was not consistently the highest-ranking land type in every group, indicating the high importance of multiple land types. All nine women's groups ranked cropland first among land types, whereas only 56% of the men's groups ranked cropland as (or tied as) the most valued land type (Figure 7). The most valued land type varied among villages, with all land types ranked the highest by at least one group: three of the nine men's focus groups ranked forest as the most valued land type, followed by rivers and water springs.

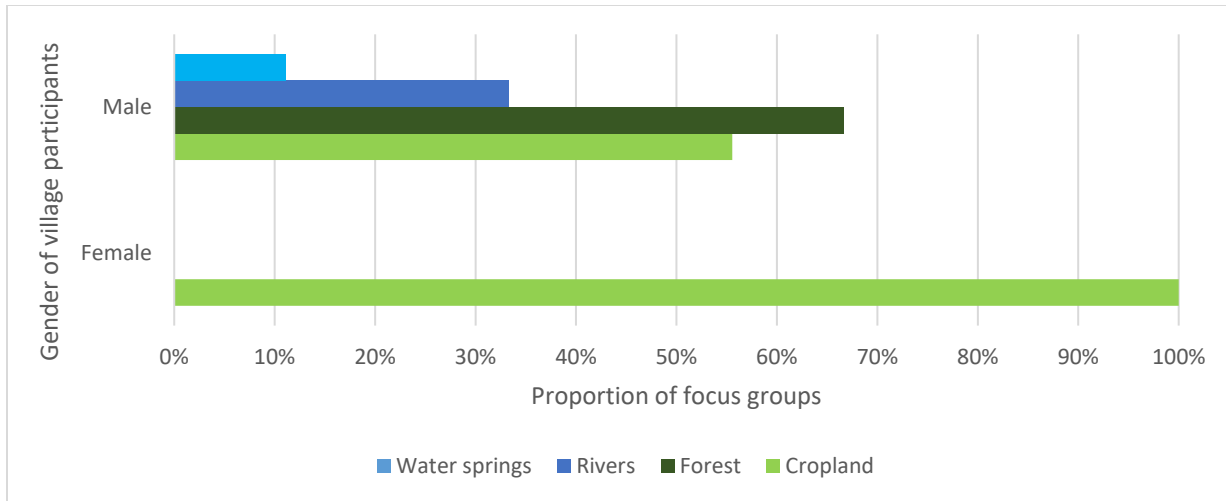


Figure 7. Proportion of focus groups ranking given land type as (or tied as) the most valued land type. All women’s groups ranked cropland as the most important land type, whereas men ranked multiple land types as the most important.

Similarly, crops were most frequently ranked as the most highly valued resource (67% of focus groups), but more than half (55%) of the focus groups listed other resources as having equal or more value than crops. Firewood was the second most frequently top-ranked resource (22% of focus groups). The rankings also revealed differences among gender groups. Women valued crops as the most important resource more than twice as often as men (89% and 44% of focus groups, respectively), and only men ranked bushmeat as the most valuable resource (33% of focus groups). Although the most valued resource varied by village, crops were ranked as the most threatened resource in every village (Figure 8).

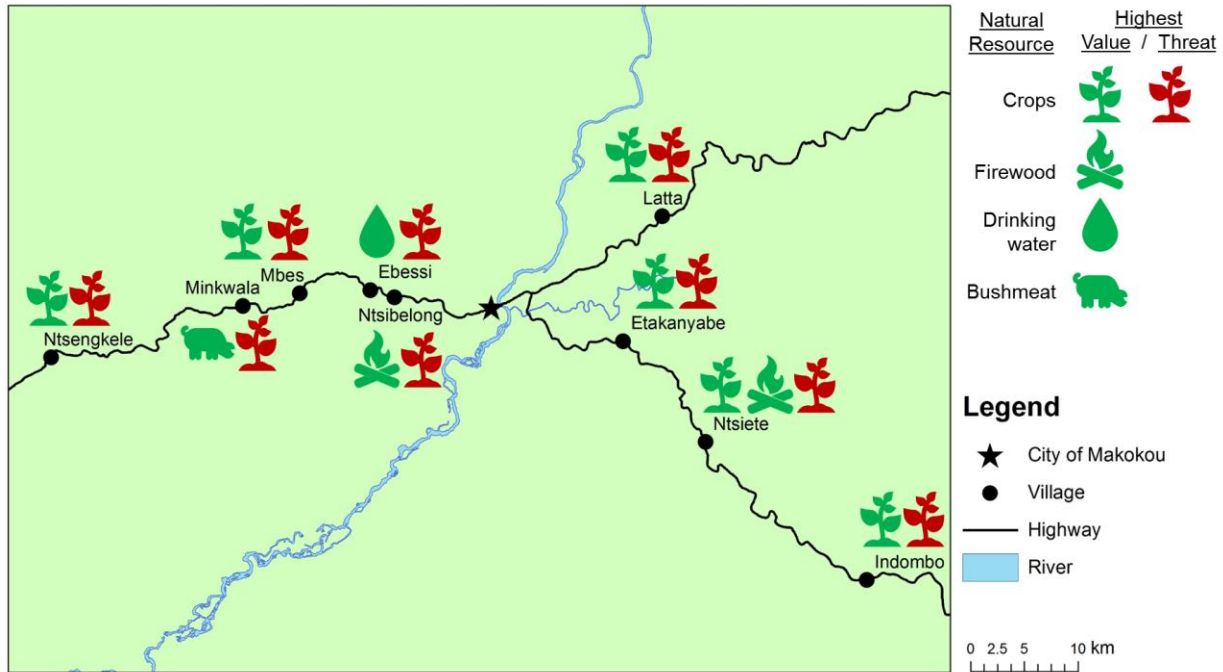


Figure 8. Regional map of most valued and most threatened resources. Most communities ranked crops as the most valuable resource, but all communities ranked crops as the most threatened.

Categories of value

When considering the reasons resources are valued, the PDM activity identified four categories of resources: 1) subsistence and income; 2) subsistence and health; 3) cultural reasons only; and 4) a combination of all four value types (subsistence, economic, health, and culture) (Figure 9a). Medicinal plants were the only resource valued for a combination of all possible value categories. Among the four value types, subsistence was the most prominent, with 53% of all value being attributed for subsistence reasons, followed by income (31%), health (16%), and cultural (0.3%) (Figure 9b). The high subsistence value suggests very strong livelihood dependence on the availability of these resources.

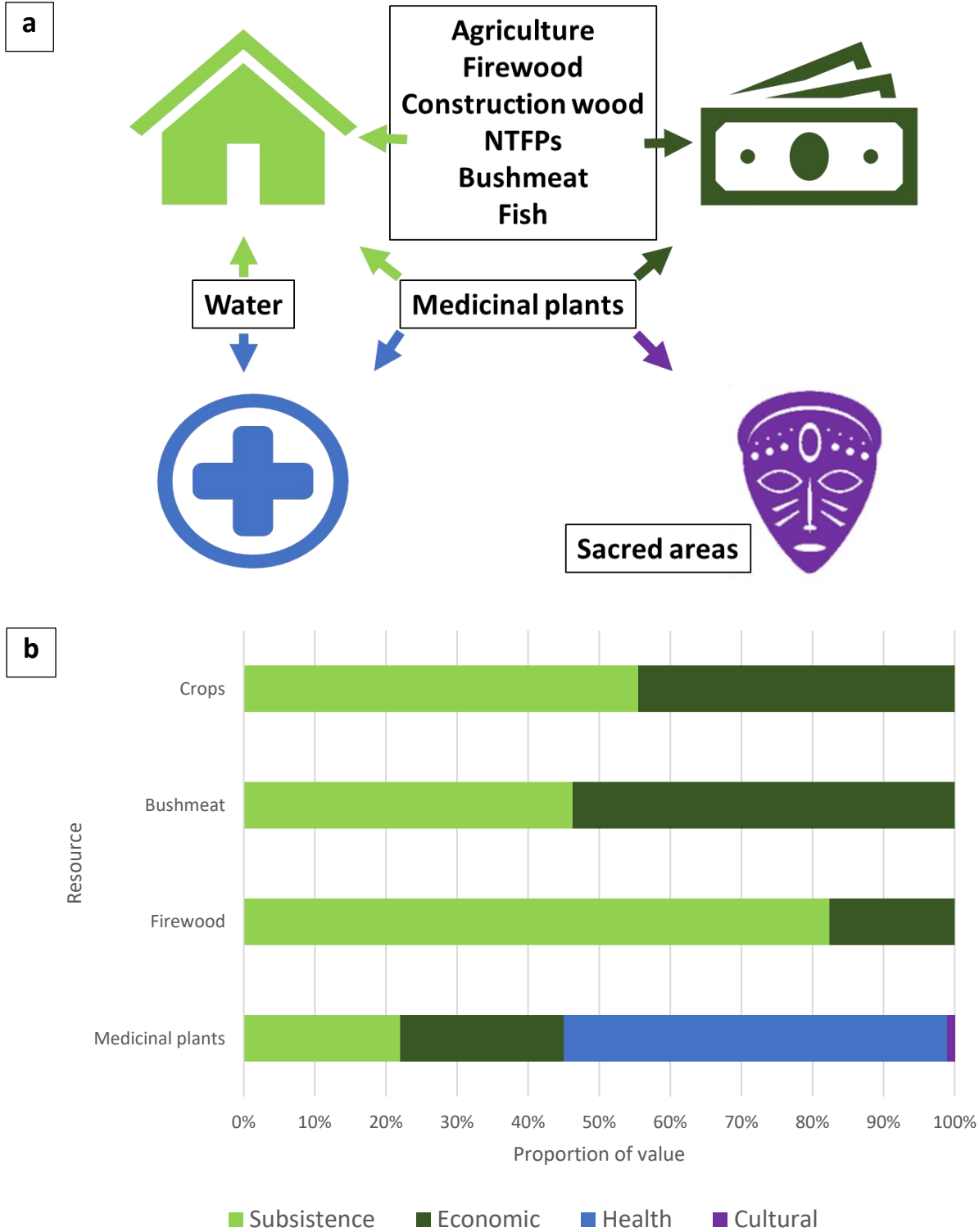


Figure 9. Diagram of resources as they align with value types in the Makokou region (a), and the relative breakdown of value types for the top four resources (b). Medicinal plants were the only resource valued for all four value types, and subsistence was the most prominent value overall.

Sources of threats

Focus group participants identified elephants and logging operations as the most common threats to resources, with each threatening multiple resources (Figure 10). All groups perceived elephants as a threat to plantations, 45% of the groups perceived elephants as a threat to forest products through the consumption of fruits and leaves that people harvest, and 30% perceived elephants as an overall danger to village life and hunters in the forest. Comparatively, only 55% of the groups noted other wildlife (including porcupines, monkeys, red river hog, and buffalo) as threats to valued natural resources.

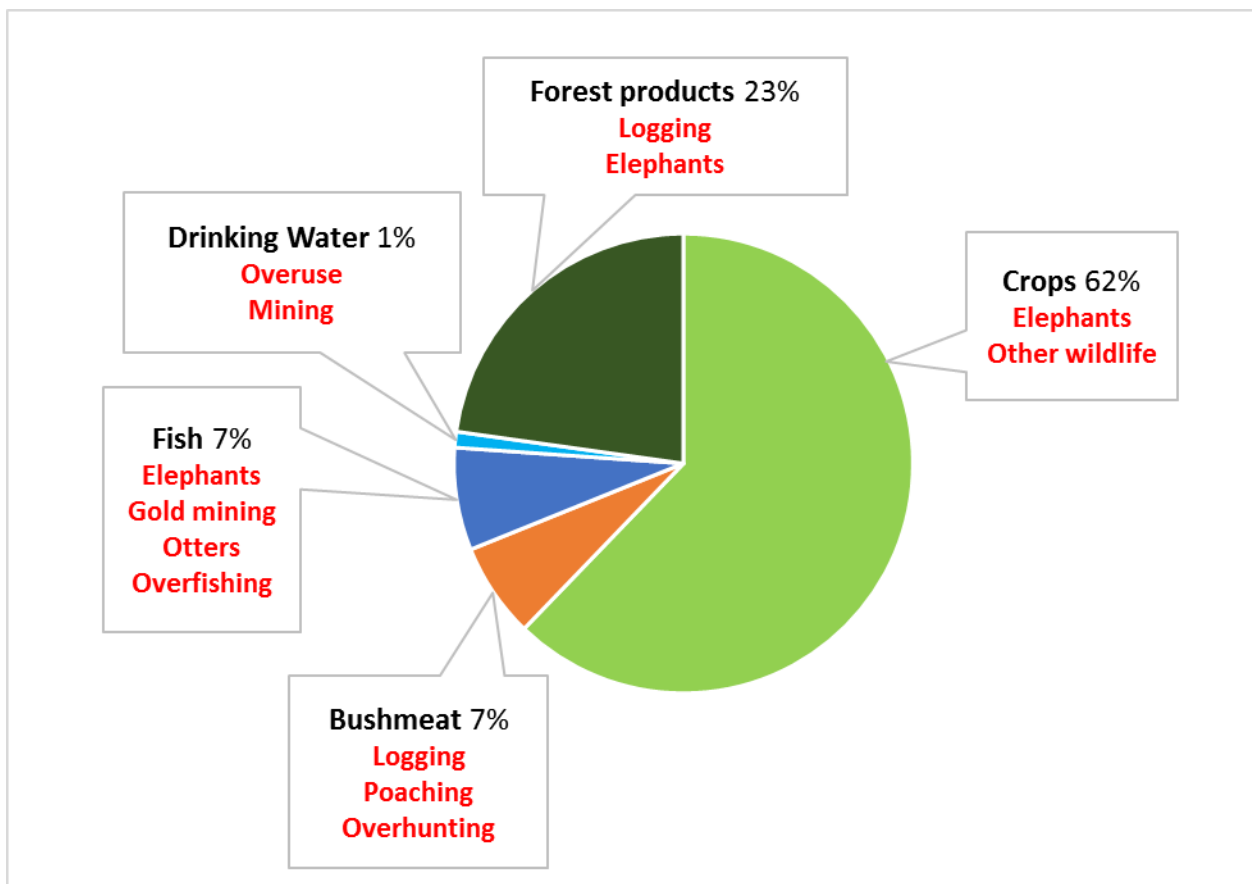


Figure 10. Percentage represents average relative threat (V) to each resource and primary sources of threats listed in red. Crops were perceived as the most threatened resource, and elephant crop raiding was perceived as the greatest threat. Elephants were perceived as a threat to multiple resources, and logging was the second most prominent threat, also impacting multiple resources.

More than half (60%) of the groups identified logging as a threat, including 30% of groups that perceived logging as a threat to forest products (fruit, wood, and medicinal plants),

and 15% that perceived it as a threat to animals for bushmeat (through habitat destruction, noise pollution, and logging roads that have improved poachers' access to the forest). Only one village noted a connection between poaching activity and increased crop raiding by elephants, while 20% of groups thought that logging activity (exploiting fruiting trees) was associated with increased crop raiding.

Only 20% of groups perceived overexploitation by members of their own community as a threat to natural resources, and even fewer (20%) identified exploitation by outsiders (poachers and neighboring villages) as a threat. One group, in the village nearest the national park, also noted excessive enforcement of government regulations on wood harvesting and hunting as a threat.

Proposed solutions to threats

Local attitudes regarding which actors should be responsible for designing or implementing solutions to the threats indicate that the majority (75%) of groups believe the government should be responsible, 20% cited non-governmental organizations (NGOs), and just 10% put the responsibility on the community.

Communities proposed several solutions to mitigate crop raiding as a threat: 30% of groups proposed permitting the hunting of elephants, while 30% proposed erecting barriers or using mechanisms to scare away elephants (30%). Two groups also noted compensation from the government for losses from crop damage. Additional proposed solutions to the threats of industrial logging and overhunting included working with the government to clearly delineate the forest area under logging concessions, requiring industry to employ locals, enforcing restrictions on outsiders entering the forest to hunt, and generating alternative employment opportunities for hunters. In response to logging, 15% of groups simply noted that logging must stop. One quarter of the groups could not suggest any specific solutions to any of the threats they identified.

Community forest perceptions

Only one village in the study area had completed the legal process to formally establish a community forest, and the remaining six villages were at varying stages of the legalization process - from the first step of legalizing their village association to the final stage of getting the sustainable forest management plan approved. Key informant interviews demonstrated that the

majority of these villages had collaborated to some degree with DACEFI (71%), and some also identified the government (29%) and neighboring communities (29%) as partners.

Communities shared common motivations for establishing a community forest, with the primary reasons including forest protection and community development (47% of chiefs noting each). Two chiefs identified the importance of community-scale land ownership and the potential to generate profits from logging companies as the driver behind participation in community forestry initiatives. One chief underscored the importance of reforestation and restoration.

Villages also shared common barriers, including difficulties unifying and organizing their community into an association (43%) and the lengthy application process for community forests at the national administrative level (43%). Village chiefs also cited complex bureaucratic processes (29%), and lack of technical (29%) and financial support (one village) as barriers.

Perceptions of forest access

At a regional scale, communities are content with their access to the forest and the quantity of forest resources presently available to them (Figure 11). However, they also perceived that overall forest area has decreased and that hunting and harvesting of forest products have become more difficult because of reduced resource availability.

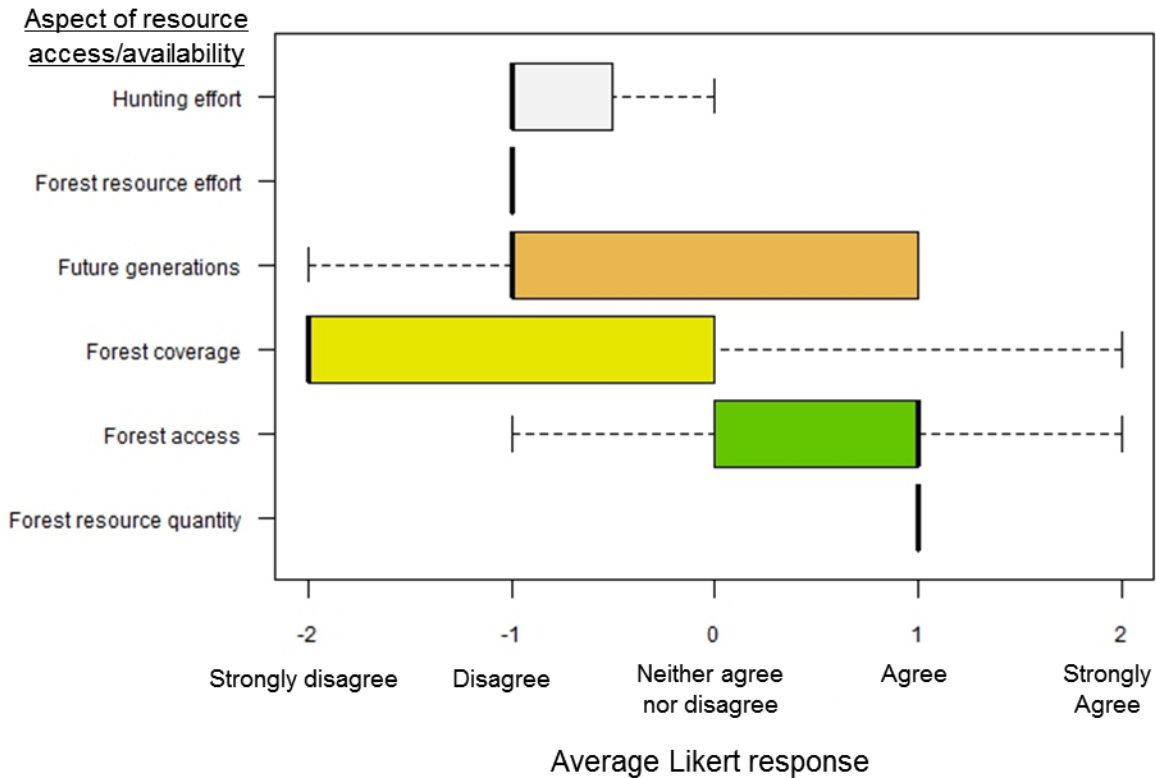


Figure 11. Perceptions of forest availability and access, based on level of agreement with the following Likert statements: (a) effort required to hunt bushmeat has not changed in recent years, (b) effort to harvest forest resources has not changed in recent years, (c) there will be enough forest resources available for future generations, (d) forest coverage has not changed in recent years, (e) I am satisfied with my current level of forest access, and (e) I am satisfied with the current quantity of forest resources available. Negative responses indicate perceptions of restricted forest access or reduced resource availability.

Despite an overall positive perception of forest access, satisfaction with forest access increased with distance to the park (Figure 12; $F_{1,48} = 10.04$, $R^2 = 0.17$, $p = 0.002$). Although villages nearest the park are also nearest the city, there was no correlation between distance to city and satisfaction with forest access.

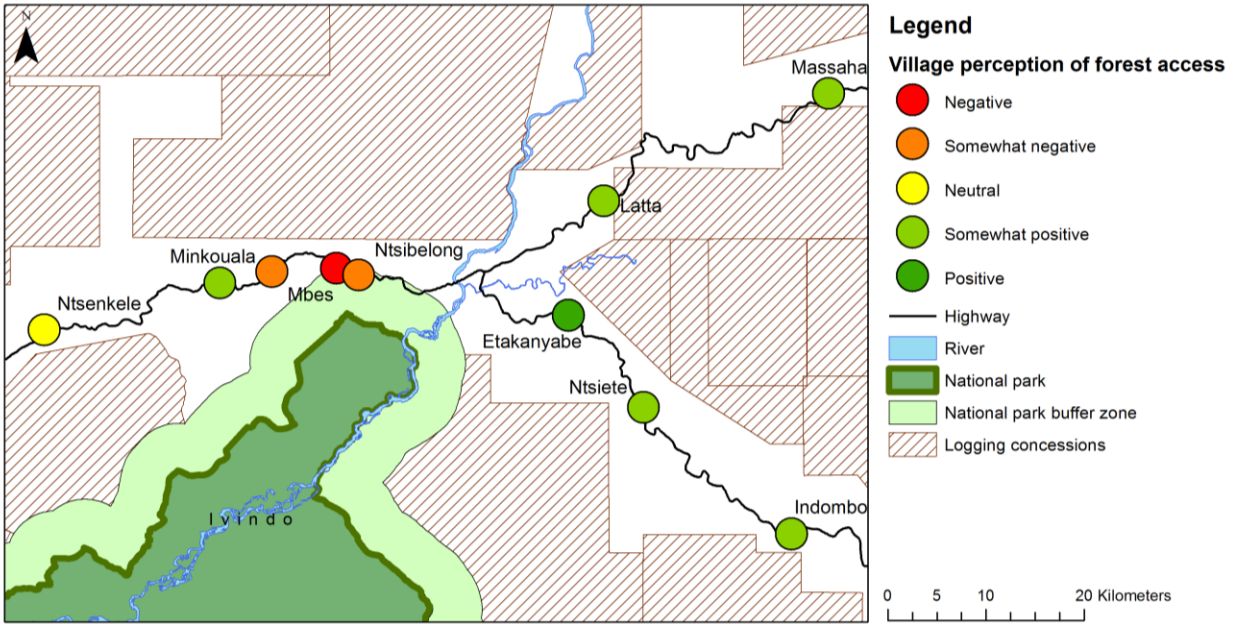


Figure 12. Map of villages and neighboring national parks and logging concessions, with village color representing perception of forest access. Satisfaction with forest access increased with distance to the park.

Discussion

This study highlighted the high value that local communities in Makokou, Gabon, place on agriculture and a wide range of forest resources, and the widespread local concerns of threats to subsistence and income-generating resources, most notably elephant crop raiding and perceptions of restricted access due to the national park and logging concessions. I recommend ways in which these local priorities, identified through a participatory approach, can inform national level decision making mitigate tension and promote strategies that are compatible with both local and national needs.

Importance of agriculture

On average, local communities in northern Gabon value croplands more than any other natural resource. The livelihoods of rural people are highly dependent on small scale agriculture for subsistence and revenue generation, partially because of a lack of alternative income-generating activities in these rural villages. In Central Africa, people primarily practice slash and burn agriculture in which forest patches are cleared, burned, cultivated with crops for several years, and then left to fallow once nutrients have been depleted, moving on to clear new patches.

The primary crops in the region are cassava, maize, groundnuts, bananas, and vegetables, and plots are typically cultivated for 2-4 years before being abandoned for approximately 10 years, with a total crop rotation of 12-14 years (Feintrenie et al. 2015). Although slash and burn agriculture provides a consistent food source for subsistence households, it is not highly profitable or ecologically sustainable, forcing communities to clear land farther from the village radiate out further from the village to meet their subsistence needs.

At the national level, agriculture makes up only 4% of the GDP. Gabon imports 60% of its food (WTO 2013), and is highly dependent on imported agricultural products from neighboring countries (FAO 2014). Gabon has yet to develop agrarian systems as diversified as those of its Cameroon neighbors, which presents both opportunities and challenges for the integration of rural, forest-dependent communities into progressive agricultural development programs and international forest conservation strategies.

With the lowest population density in Central Africa (< 8 persons per km²) (FAO 2017), slash and burn agricultural practices have not yet posed a serious threat of deforestation in Gabon (<0.05% deforestation rate from 2000-2010) compared to other countries in the region (0.13% in Cameroon, 0.20% in Democratic Republic of Congo) where the growing population and demand for food forces farmers to reduce rotation time and clear more forest area (CBFP 2015). These pressures to clear forest further from the village could threaten the availability of valuable forest resources and undermine national biodiversity conservation objectives. The government of Gabon has an opportunity, before slash and burn agriculture contributes to large scale deforestation, to integrate local communities into forest management practices that would decrease projected rates of deforestation expected from the ‘business as usual’ crop rotation and deforestation model observed by other central and west African nations. This could be facilitated by the implementation of spatially-planned, environmentally conscious agricultural intensification programs to both conserve forest cover and meet the country’s agricultural demands.

For example, national efforts to boost agricultural production could provide opportunities for rural people to engage actively in the national agricultural sector and provide an avenue for recognition and support of the challenges facing Gabon’s small-holder farmers. Specifically, Gabon’s recent National Plan for Agricultural Investment and Food and Nutritional Security, adopted in 2015, announced plans to invest in agricultural expansion to reduce dependency on

food imports and promote rural economic development (Oxford Business Group 2015). To meet that goal, the government launched the Gabonese Initiative for Achieving Agricultural Outcomes with Engaged Citizenry (GRAINE) in 2014 under a public-private partnership to support smallholder farmers with training, start-up costs, equipment, land titling for cash crop cultivation (Oxford Business Group 2015). This marks a shift away from traditional slash and burn agriculture toward practices that may be more compatible with measures to protect forest resources over the long term.

Gender differences

I identified significant differences in how men and women value natural resources, which are closely linked to the traditional roles that each gender plays in natural resource use, primarily with hunting (men) and agriculture (women). Understanding how customary differences in resource use, land rights, and the access to benefits of resource use are partitioned among community members is often integral to designing equitable (Rocheleau and Edmunds 1997) and more effective (Agrawal et al. 2006) natural resource management interventions. As demonstrated in this study, conducting separate community mapping sessions for each gender provided women equal space to share their values, perspectives, and concerns. In Gabon, as with other Central African communities that practice slash and burn agriculture, differentiation among men and women with respect to their contributions to household food sources strongly affected their perceptions of natural resources. Men generally carry out the short term labor for clearing and burning fields, whereas women invest much more time to the cultivation of crops, pest management, and plot management (Feintrenie et al. 2015). Women ensure daily sustenance for the family, whereas men supply additional protein through hunting and fishing. This division of labor, and the resulting values that men and women attribute to resources, highlight the importance of considering gender roles in environmental decision making at both local and national scales.

To account for gender roles and ensure equal gender participation in land use planning in Gabon, I recommend that practitioners incorporate gender-sensitive participatory approaches. Numerous published guides and handbooks are available that walk through step-by-step activities for discussing gender rights and roles, such as the *Gender in Agriculture* sourcebook (World Bank 2009) which includes a module on natural resource management. Taking such steps

can help identify social dynamics that, without consideration within the design of conservation and development activities, can increase gender inequality (Fonjong 2008). Focused capacity development for women can also empower women to be facilitators, who are better at working with women and can use their gender-specific traditional knowledge in environmental decision making (Fonjong 2008). In northeastern Gabon, women are responsible for making longer-term decisions than men; thus the input of women's groups will be crucial for community-based planning.

Subsistence and income-generation

My findings align with the growing literature on the importance of forest products in forest-dependent communities, indicating that rural communities depend on a range of natural resources for primarily subsistence use and income generation, and that these values differ by resource. For example, in my study site, crops and bushmeat are equally valued for subsistence and income generation, whereas firewood primarily fills subsistence needs (sometimes sold for income) and medicinal plants represent many types of value.

Medicinal plants are an illustrative example of the complexity and range of values guiding natural resource use by forest dependent people. In Gabon, medicinal plants were cited to be of great importance for subsistence, economic, health, and cultural reasons. Although the total value of the resource ranked fourth, loss of access to this resource could have disproportionate impacts on forest dependent people because it would have consequences for all aspects of life. This demonstrates the importance of recognizing the complex values local communities attribute to forest resources to ensure resources are managed in ways that are compatible with local uses and cultural norms (Pretty and Smith 2004, Lawrence et al. 2005, Mugisha and Infield 2012). As one approach to balance conservation and rural development, resource managers should consider resources with more types of value associated with them, such as medicinal plants, as high conservation priority due to their additive value for local resource use.

Common-pool resource (CPR) theory posits that open-access resources are most likely to be depleted “where those involved, or external authorities, have not established effective governance” (Ostrom 1999), and studies have empirically confirmed, on a global scale, that forests with both high subsistence and commercial value are more likely to be degraded (Chhatre

and Agrawal 2008). External regulation and public control has historically been the predominant recommendation for effective governance of CPR for “individuals...remorsefully trapped into destroying their own resources” (Ostrom 1990). However, Ostrom (1999) found that under certain conditions communities self-organize to establish and enforce rules governing resource use.

Consideration of these attributes that facilitate self-organization, particularly 1) autonomy and 2) prior organizational experience (Ostrom 1999), could inform interventions to promote CBNRM in Gabon. First, communities are most likely to self-govern resource use when they have the autonomy to “determine access and harvesting rules without external authorities countermanding them” (Ostrom 1999). Efforts to help communities in this region regain a sense of ownership over their traditional forests through more formal structures (such as community forests) or through avenues to be involved in national scale decision making, could improve local autonomy. Second, communities must have “minimal skills of organization”, such as through experience with village associations (Ostrom 1999), which is lacking in this region where communities have cited difficulties uniting into community organizations. The national parks agency, in particular, could work with communities around the park to facilitate the creation of local committees, focused on building capacity for basic skills in organizational management, to help communities establish and enforce local rules to govern the sustainable use of forest resources.

Threats to natural resources

From the perspective of local communities, crops are the most threatened resource, and elephants and logging operations impose overarching threats to multiple natural resources on which they depend. Although elephant crop raiding was cited as the greatest threat to important natural resources in all 20 focus groups, elephants also consume NTFPs (medicinal plants, leaves, and fruits), damage water springs from drinking water, and disrupt fish habitat by uprooting raffia palms. Furthermore, elephants are perceived as an overall danger to human life, both in the forest and in the village. As explained by a community member,

"The village is threatened because the elephants come right to the village, right to the houses. Behind the kitchen we can see the damage of elephants, so if someone is back there, it's dangerous."

Similarly, logging directly threatens the availability of timber and NTFPs, and indirectly threatens bushmeat by degrading wildlife habitat and opening logging road networks that increase forest access for poachers. Logging concessions also bring with them logging towns, increased demand for bushmeat, and increased commercial bushmeat trade, potentially threatening wildlife populations (Poulsen et al. 2009). Furthermore, community members see logging as the primary cause of a recent increase in elephant crop damage, with the perception that logging has driven elephants out of the forest and into the plantations as a result of the loss of fruit trees harvested for timber and noise pollution from machinery. As stated by another community member:

"This is what encourages the elephants to come eat the plantations. Because over [in the forest] they don't eat much anymore, the wood is cut, cut, by logging companies, so they now come. They leave the bush to eat in the village. In the secondary forest they find a lot of food, a lot of fruit, young fruit. Even here near the village...where we collect fruit, the elephants come and eat."

These strong negative perceptions of forest elephants are amplified by the tension and distrust between communities and the federal government, threatening the long-term success of efforts to conserve the forest elephant, which is facing extinction (Poulsen et al. 2017). One community leader asked:

"...all the billions [of CFA] that are being poured into Gabon for the conservation of elephants, for the conservation of wildlife. What would it cost the Gabonese state to release even one-tenth to compensate populations when elephants ravage plantations?"

This further demonstrates that the negative perceptions of elephants need to be addressed before (or in conjunction with) efforts to promote sustainable wildlife management to have the buy-in of local communities.

In addition to the threats common to all villages, threats to resources at the village-level also deserve consideration. For example, although only four focus groups noted overharvesting by villagers or poachers as a threat to fish and wildlife, a recent study found a defaunation gradient in proximity of villages in the Makokou region, suggesting that overhunting has led to a decline in wildlife populations (Koerner et al. 2016). Furthermore, water did not appear significantly threatened at the regional scale, yet one village noted serious reductions and alterations in streams and water springs caused by industrial mining adjacent to the village. By recognizing both widespread disturbances such as logging and more localized disturbances such

as mining, resource managers and land use planners will be better prepared to mitigate threats in other villages if the threat re-occurs.

Recommendations

This study suggests that increased efforts by national decision makers to address the perceived threats of wildlife and logging to highly valued forest resources would facilitate integration of local community interests into conservation and developmental policies. Such actions might decrease feelings of community marginalization and maximally result in policy changes that promote local buy-in, encouraging sustainable environmental, social, and economic outcomes. Specifically, I suggest prioritizing the following activities: (1) mitigation of crop raiding with transition to intensified agriculture, (2) work with forestry operators and NGOs to improve local perceptions of industrial logging operations and promote community forestry, and (3) implement a decentralized approach for communities to access information on and participate in regional land-use decisions.

Mitigating human elephant conflict

The most frequently mentioned solutions to elephant crop raiding demonstrated that rural populations predominantly think that solutions need to be initiated at the government level. Furthermore, many people expressed that “you” (NGOs and foreigners) must find the solution, or that they have no suggestion for what could be done at any level. Externalization of the solutions suggests that communities have similarly externalized the problem. Though Gabon has recently piloted the use of electric fences, human elephant conflict mitigation techniques identified to date are often ill-suited for small scale slash and burn agriculture (Nelson et al. 2003), which is comprised of widely distributed patches of crops interspersed with secondary forest. The move to fixed, intensified agriculture with GRAINE may facilitate a solution to both food security and protecting fields from animals, as permanent, centralized fields are more compatible with investments in electric fences. Care must be taken to employ conservation agriculture practices to ensure long-term fertility and production within this permanent, intensified agriculture system. While these efforts aim to change the negative value of elephants into a neutral (conflict-free) value in the eyes of the communities, pathways to building positive local value for elephants should also be explored for truly sustainable conservation outcomes.

For example, ecotourism could bring both livelihood benefits and increased appreciation of protected wildlife by giving elephants a positive economic value.

Perceptions of logging operations

Communities have similarly strong negative perceptions of logging operations and largely think the government has the responsibility for finding solutions. Negative perceptions are related not only to the removal of valuable tree species, but are also connected to human elephant conflict, with widespread belief that logging has pushed elephants toward villages resulting in frequent crop raiding within the last 10 years. Although very few solutions were proposed in the focus groups for protecting resource access, there are two pathways through which natural resource managers and land use planners can address the negative perceptions and ensure resource access for communities: 1) timber certification schemes and 2) land tenure reform.

First, timber certification schemes, such as the Forest Stewardship Council (FSC), can promote socially and environmentally responsible standards by providing logging companies with economic incentives to consider the potential impacts of their activities on local livelihoods and thus integrate communities into land use planning. In Gabon, these standards can even become formalized under Gabonese law and be centrally enforced in the form of concession-specific management plans. Although weakly enforced, Gabonese law requires that logging companies consult with local communities and implement a government-approved forest management plan meeting the minimum requirements of the forestry code, to receive a permit. Once a management plan is approved it becomes legally binding, meaning that if companies were to list additional responsible practices within their management plan, they would be legally bound to fulfill them. Free, prior and informed consent, an FSC requirement that ensures communities approve of operations that may pose a threat to traditional forests or livelihoods, is one example of a practice that certifications can promote to ensure communities' voices are heard (FSC 2012). This has been done successfully in Congo through a public-private partnership in Congo between the Wildlife Conservation Society (WCS), Government of Congo, and the timber company Congolaise Industrielle des Bois (CIB) (Clark and Poulsen 2012).

Second, land tenure reform and efforts to facilitate the legalization of community forests could promote sustainable forest management at the community level. There was widespread awareness among village chiefs about the benefits of establishing community forests to secure

forest resources from future land use change, ensure sustainable forest management, and promote community development. However, significant barriers constrain putting community forests into practice, including the challenge of uniting community members and self-organizing in a region with a weak history of communal governance. With the short-term commitment of DACEFI, which provided technical training for community forestry in the region from 2010 to 2014, only one village successfully established a community forest. Many communities who participated in DACEFI's training remain midway through the administrative process, and struggle to complete the legal and technical process without external technical support. One community leader stated the community had lost trust in DACEFI after it "did not play its part". Although this only represents the views of the community, and not the NGO, comments such as this suggest a need for more long-term commitments to maintain community trust and involvement in programs such as DACEFI.

NGOs can play an important role in facilitating community-level change by acting as available technical partners, who work hand-in-hand with communities, while serving as a transparent link between government and civil society. However, NGO funding cycles, and therefore project timelines, are often at much shorter time scales than that needed to enact long-term change on the ground, particularly when working with local communities and lengthy government processes. This presents a need for a streamlined administrative and legal process to establish community forests, and greater efforts by the government to distribute information and resources to demystify the process, with more short-term involvement of NGOs for technical support and oversight.

Regional land use planning and forest access

The finding that communities perceive that their access to forests has been limited by the national park and logging operations suggests that national land use planning affects rural communities. Villages nearest the park were the most outspoken regarding the lack of village-level consultation in national-level decision making. Although community consultations are a required step in the establishment of national parks in Gabon (Loi n°003/2007 du 27 août 2007), one community member asked: "How could that [park creation] happen without asking us? Without us at the very least being warned." However, it is important to ask whether the establishment of the park resulted in perceived or actual restriction of land access. In this study, time constraints prevented the creation of historical land-use maps with local community

participants; thus it is not known whether park creation actually limited forest access. Discussions with villages adjacent to the park suggest that the delineation of the 5km park buffer zone surrounding the park, not the park boundary itself, served as the greatest source of village tension and most significantly contributed to perceptions of denied access rights, even though the buffer zone is simply designated as a zone for sustainable resource management as regulated by the State (Loi n°003/2007 du 27 août 2007). This suggests that there may be a lack of local awareness on users' legal rights within the park and buffer zone. People voiced similar sentiments across the study area, claiming that government regulations are incompatible with rural livelihood needs, including hunting regulations, the concessioning of forest to logging companies, and the protection of forest elephants. Since colonial times, Gabon has had a history of struggle between the state and rural populations regarding land and resource access (Wily 2012). This clear tension between communities and the State confirms the need for natural resource policy and decision-making processes that reconcile conservation, economic development, and rural community needs.

Understanding that sound land use planning will be critical to its ability to achieve its sustainable development and conservation goals, the Government of Gabon recently launched a National Land Use Plan (PNAT) (Government of Gabon 2015). As envisioned, the PNAT will serve as the government's primary tool for the design and implementation of sustainable development policy and for the sound management of its national territory. A multi-ministerial committee and several technical and legal advisors oversee the PNAT, which is tasked with making land use decisions using economic, social, and environmental spatial data, as well as sorting out contradictions in land use allocations (such as overlap between a mining and a logging concession).

The launching of this process, if implemented through a participatory process, could provide an unparalleled opportunity for Gabon to avoid tension with marginalized communities and open a dialogue between national and local stakeholders. Given the challenges of community self-organization, formal facilitation of community dialogue from the government side would enable communities to participate and provide input. Dialogue with communities could take the form of extension agents placed at the township or commune level, who report to a regional office. Agents could serve the dual role of sharing information about regional land use decisions that may affect a village, and relaying community input and concerns to regional decision

makers.

The rapid assessment mapping tool is ideal for a program that has national breadth, but local depth. Through this assessment, each village would create a community map to contribute to the regional planning office. With this in mind, I make the following suggestions:

- Incorporate women, separately if needed, at all stages of the consultation and planning process. This may require meeting men and women at different times of day depending on traditional gender roles. Use female facilitators, if possible, to ensure women participants feel they have an open space for dialogue.
- Provide base maps with key landmarks, including roads, rivers, and streams to facilitate the process of reconciling contradictions between customary and administrative village boundaries. Rivers and streams are particularly important for mapping traditional forest areas as community members often designate traditional boundaries along these landmarks.
- Provide time, upon completing the map, to discuss what the community has learned or gained from the participatory process. And, leave the original or a copy of the final map with the community – they created and have ownership over it.

Moving forward

"If we do not work with the communities on everything related to the forest, things are not going to work." – Village chief

The results of this study highlight important aspects of local values and perceptions that should be incorporated into future regional land use planning to achieve sustainable environmental, social, and economic outcomes. In contrast to other Central African nations, Gabon's history of prosperity from oil, the centralization of most policy decisions, and the resulting perception of rural communities that the government should be responsible for handing out solutions, may present a challenge for facilitating change at the community level. However, the above analysis of potential solutions indicates that there may be pathways to merge more participatory, bottom-up approaches with top-down approaches. Rapid assessments, when tailored to the local context, are highly valuable, low-cost tools for gaining an integrative understanding of community resource use. Their application should be explored in Gabon as a means to bridge the national agenda with local priorities.

References

- Décret n°161/PR/MEF du 19 janvier 2011 fixant les conditions de délivrance des permis et licences de chasse et de capture. Gabon.
- Décret n°692/PR/MEFEPEPN du 24 août 2004 fixant les conditions d'exercice des droits d'usage coutumiers en matière de forêt, de faune, de chasse et de pêche. Gabon.
- Décret no. 164/PR/MEF du 11 janvier 2011 reglementant le classement et les latitudes d'abattage des espèces animales. Gabon.
- Loi n°003/2007 du 27 aout 2007, relative aux parcs nationaux. Gabon.
- Loi n°16-01 du 31 décembre 2001. Code forestier, Gabon.
- Agrawal, A., G. Yadama, R. Andrade, and A. Bhattacharya. 2006. Decentralization and environmental conservation: gender effects from participation in joint forest management.
- Angelsen, A., P. Jagger, R. Babigumira, B. Belcher, N. J. Hogarth, S. Bauch, J. Börner, C. Smith-Hall, and S. Wunder. 2014. Environmental Income and Rural Livelihoods: A Global-Comparative Analysis. *World Development* **64**, **Supplement 1**:S12-S28.
- Brechin, S. R., P. R. Wilshusen, C. L. Fortwangler, and P. C. West. 2002. Beyond the Square Wheel: Toward a More Comprehensive Understanding of Biodiversity Conservation as Social and Political Process. *Society & Natural Resources* **15**:41-64.
- CBFP. 2015. The Forests of the Congo Basin - Forests and climate change. Weyrich, Belgium.
- Chambers, R. 1981. Rapid rural appraisal: Rationale and repertoire. *Public Administration and Development* **1**:95-106.
- Chhatre, A., and A. Agrawal. 2008. Forest commons and local enforcement. *Proceedings of the National Academy of Sciences* **105**:13286-13291.
- CIFOR. 2005. Contributing to African development through forests: strategy for engagement in sub-Saharan Africa. CIFOR, Bogor, Indonesia.
- Clark, C. J., and J. R. Poulsen. 2012. Tropical Forest Conservation and Industry Partnership: An Experience from the Congo Basin. Wiley.
- Eba'a Atyi, R., J. Ngouhou Poufoun, J.-P. Mvondo Awono, A. Ngoungoure Manjeli, and R. Sufo-Kankeu. 2016. Economic and social importance of fuelwood in Cameroon.
- Endamana, D., K. A. Angu, G. N. Akwah, G. Shepherd, and B. C. Ntumwel. 2016. Contribution of Non-Timber Forest Products to Cash and Non-Cash Income of Remote Forest Communities in Central Africa. *International Forestry Review* **18**:280-295.

- FAO. 2014. Statistical Yearbook – Gabon.
- FAO. 2017. Living in and from the forests of Central Africa, Rome.
- Feintrenie, L., P. Gillet, C. Garcia, A. L. Boulaud, A. Ferlay, E. Codina Llavina, C. Lehnebach, and C. Vermeulen. 2015. Family farming in a changing landscape: how activities change when forest disappears. Annual World Bank Conference on Land and Poverty: Linking Land Tenure and Use for Shared Prosperity.
- Fonjong, L. N. 2008. Gender Roles and practices in natural resource management in the North West Province of Cameroon. *Local Environment* **13**:461-475.
- FSC. 2012. Guidelines for the implementation of the right to free, prior and informed consent (FPIC): Version 1., Bonn.
- Government of Gabon. 2011. Etude diagnostique pour l'elaboraton d'une strategie nationale d'habitat et de developpement urbain au Gabon. Ministere de l'Habitat, du Logement, de l'Urbanisme, de l'Environnement et du Developpement Durable, UNDP & UN-HABITAT.
- Government of Gabon. 2015. Plan National d'Affectation des Terres (PNAT). Conseil National Climat.
- Klain, S. C., and K. M. A. Chan. 2012. Navigating coastal values: Participatory mapping of ecosystem services for spatial planning. *Ecological Economics* **82**:104-113.
- Koerner, S. E., J. R. Poulsen, E. J. Blanchard, J. Okouyi, and C. J. Clark. 2016. Vertebrate community composition and diversity declines along a defaunation gradient radiating from rural villages in Gabon. *Journal of Applied Ecology*:n/a-n/a.
- Langat, D. K., E. K. Maranga, A. A. Aboud, and J. K. Cheboiwo. 2016. Role of Forest Resources to Local Livelihoods: The Case of East Mau Forest Ecosystem, Kenya. *International Journal of Forestry Research* **2016**:10.
- Lawrence, A., O. L. Phillips, A. R. Ismodes, M. Lopez, S. Rose, D. Wood, and A. J. Farfan. 2005. Local values for harvested forest plants in Madre de Dios, Peru: Towards a more contextualised interpretation of quantitative ethnobotanical data. *Biodiversity & Conservation* **14**:45-79.
- Lescuyer, G., A. Karsenty, and R. Eba'a Atyi. 2009. A new tool for sustainable forest management in Central Africa: Payments for environmental services. Publications Office of the European Union, Luxembourg.
- Levang, P., G. Lescuyer, D. Noubissi, C. Déhu, and L. Broussolle. 2015. Does gathering really pay? Case studies from forest areas of the East and South regions of Cameroon.
- Mascia, M. B., J. P. Brosius, T. A. Dobson, B. C. Forbes, L. Horowitz, M. A. McKean, and N. J. Turner. 2003. Conservation and the Social Sciences. *Conservation Biology* **17**:649-650.

- Mbete, R. A., H. Banga-Mboko, P. Racey, A. Mfoukou-Ntsakala, I. Nganga, C. Vermeulen, J.-L. Doucet, J.-L. Hornick, and P. Leroy. 2011. Household Bushmeat Consumption in Brazzaville, the Republic of the Congo. *Tropical Conservation Science* **4**:187-202.
- MEFEPA, and WRI. 2013. Aménagement Forestier au Gabon. Open Data Forest Atlas Gabon.
- Meunier, Q., M. Federspiel, C. Moumbogou, B. Gregoire, J. L. Doucet, and C. Vermeulen. 2011. The first community forests of Gabon: towards sustainable local forest management? *Nature & Faune* **25**:40-45.
- Mugisha, A., and M. Infield. 2012. “The Role of Cultural Values in the Management and Conservation of Rwenzori and Lake Mbuoro National Parks in Uganda.”. Pages 244–251 in S. Weber, editor. *Rethinking Protected Areas in a Changing World*, Proceedings of the 2011 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites. George Wright Society, Hancock, Michigan.
- Mustalahti, I., A. Bolin, E. Boyd, and J. Paavola. 2012. Can REDD+ Reconcile Local Priorities and Needs with Global Mitigation Benefits? Lessons from Angai Forest, Tanzania. *Ecology and Society* **17**.
- Nasi, R., A. Taber, and N. Van Vliet. 2011. Empty forests, empty stomachs? Bushmeat and livelihoods in the Congo and Amazon Basins. *International Forestry Review* **13**:355-368.
- Nelson, A., P. Bidwell, and C. Sillero-Zubiri. 2003. A review of human-elephant conflict management strategies. Wildlife Conservation Research Unit, Born Free Foundation Partnership.
- Ntiamoa-Baidu, Y. 1997. Wildlife and food security in Africa. FAO Conservation Guide 33, Rome, Italy.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- Ostrom, E. 1999. *Self-governance and forest resources*. CIFOR, Bogor, Indonesia.
- Oxford Business Group. 2015. *Agriculture & Forestry. The Report: Gabon 2015*. Oxford Business Group.
- Persha, L., A. Agrawal, and A. Chhatre. 2011. Social and Ecological Synergy: Local Rulemaking, Forest Livelihoods, and Biodiversity Conservation. *Science* **331**:1606-1608.
- Pierre, J.-M., P. Kialo, F. Okoue, J. Zeh Ondoua, and G. Zomo Yebe. 2000. Etude de faisabilité des forêts communautaires au Gabon. Rapport final, Projet Forêts et Environnement (PFE) Gabon.
- Poulsen, J. R., C. J. Clark, G. Mavah, and P. W. Elkan. 2009. Bushmeat supply and consumption in a tropical logging concession in northern Congo. *Conserv Biol* **23**:1597-1608.

- Poulsen, J. R., S. E. Koerner, S. Moore, V. P. Medjibe, S. Blake, C. J. Clark, M. E. Akou, M. Fay, A. Meier, J. Okouyi, C. Rosin, and L. J. T. White. 2017. Poaching empties critical Central African wilderness of forest elephants. *Current Biology* **27**:R134-R135.
- Pretty, J., and D. Smith. 2004. Social Capital in Biodiversity Conservation and Management. *Conservation Biology* **18**:631-638.
- Raymond, C. M., B. A. Bryan, D. H. MacDonald, A. Cast, S. Strathearn, A. Grandgirard, and T. Kalivas. 2009. Mapping community values for natural capital and ecosystem services. *Ecological Economics* **68**:1301-1315.
- Reed, M. S. 2008. Stakeholder participation for environmental management: A literature review. *Biological Conservation* **141**:2417-2431.
- Rocheleau, D., and D. Edmunds. 1997. Women, men and trees: Gender, power and property in forest and agrarian landscapes. *World Development* **25**:1351-1371.
- Sheil, D., R. Puri, M. Wan, I. Basuki, M. v. Heist, N. Liswanti, Rukmiyati, I. Rachmatika, and I. Samsodin. 2006. Recognizing Local People's Priorities for Tropical Forest Biodiversity. *AMBIO: A Journal of the Human Environment* **35**:17-24.
- Smith, W., and T. C. Meredith. 1999. Identifying biodiversity conservation priorities based on local values and abundance data. Pages 372-375 in D. A. Posey, editor. *Cultural and Spiritual Values of Biodiversity*. UNEP.
- Sunderlin, W. D., A. Angelsen, B. Belcher, P. Burgers, R. Nasi, L. Santoso, and S. Wunder. 2005. Livelihoods, forests, and conservation in developing countries: An Overview. *World Development* **33**:1383-1402.
- Timko, J. A., P. O. Waeber, and R. A. Kozak. 2010. The socio-economic contribution of non-timber forest products to rural livelihoods in Sub-Saharan Africa: knowledge gaps and new directions. *International Forestry Review* **12**:284-294.
- Vandeweghe, J. P. 2006. *Ivindo and Mwanga: Black Water, Virgin Forests, and Bais*. Wildlife Conservation Society (WCS).
- Waylen, K. A., A. Fischer, P. J. K. McGowan, S. J. Thirgood, and E. J. Milner-Gulland. 2010. Effect of Local Cultural Context on the Success of Community-Based Conservation Interventions. *Conservation Biology* **24**:1119-1129.
- Wily, L. A. 2012. *Land Rights in Gabon: Facing up to the Past – and the Present*. FERN.
- World Bank. 2009. *Module 10: Gender and Natural Resources Management. Gender in Agriculture: Sourcebook*. World Bank, Food and Agriculture Organization of the United Nations, and International Fund for Agricultural Development, Washington, D.C.
- World Bank. 2015. *World Development Indicators: Data on Gabon*.

WTO. 2013. Annex 3: Gabon. Trade Policy Review: Cameroon, Congo, Gabon, Central African Republic and Chad.

Appendices

- A. Initial village chief interview guide
- B. Mapping activity guide
- C. Perceptions survey
- D. Community forest interview guide

Appendix A: Initial village chief interview guide

Contexte personnel

- Quelle est votre position et le rôle que vous jouez dans votre communauté?
- Comment êtes-vous devenu le chef de votre communauté?
- Comment êtes-vous impliqué dans la gestion des ressources naturelles dans votre communauté? – son niveau d'intervention, à quel niveau vous intervenez, interaction avec l'industrie, sensibilisation pour la gestion communautaire

Activités

- Quelles sont les activités principales menées dans votre village ?
- Comment est-ce que ces activités sont gérées? (par famille, par la communauté, par individu)
- Est-ce que les limites entre les zones d'activités de votre village et celles des villages voisins sont claires?
- Est-ce que des gens des villages voisins viennent pratiquer des activités dans vos forêts sans votre autorisation ?
 - Si oui, est-ce que cela engendre des conflits entre vous ?

Des menaces

- Quelles sont les menaces principales qui pèsent sur vos activités et sur vos ressources naturelles?
- Est-ce que ces menaces étaient les mêmes il y a 20 ans ? Si non, pourquoi ?

Les valeurs et les priorités

- Comment est-ce que vous classeriez ces activités et ressources dans votre communauté:

Activités : chasse, agriculture, pêche, orpaillage, cueillette,

Ressources : faune, produits ligneux, produits non-ligneux, poisson, terre (pour l'agriculture)

- Il y a 20 ans, est-ce que l'importance accordée à vos ressources naturelles a changé? Si oui, pourquoi ?

Appendix B: Mapping activity guide

- 1) Dessinez les zones d'activités :
 - a. La chasse
 - b. L'agriculture
 - c. La pêche
 - d. Les produits ligneux (bois de construction, chauffage)
 - e. Les produits non-ligneux (feuilles, écorce, fruits, plantes médicinales)
 - f. Les zones sacrées
 - g. La source de l'eau

- 2) Précisez sur la carte, pour chaque zone :
 - a. La distance de la route
 - b. La fréquence que vous utilisez ce zone (combien de fois par semaine)

- 3) Distribuez les 20 pièces jaunes sur la carte entre : les plantations, la forêt, la rivière, les sources de l'eau

- 4) Distribuez les 40 pièces blanches sur la carte entre les types de ressources naturelles : *les plantations, bois de construction, bois de chauffage, produits non-ligneux, chasse, pêche, sources de l'eau*

- 5) Colorez les pièces pour indiquer si la zone a l'importance pour :
 - a. La subsistance (à manger, pour l'utilisation familiale)
 - b. La revenu (à vendre, travail rémunéré)
 - c. La santé (l'eau potable, plantes médicinales)
 - d. L'importance spirituelle/culturelle (zones sacrées)

- 6) Distribuez les 10 pièces rouges où les zones d'activités sont menacées.

- 7) Pour chaque zone où ils ont placé des pièces rouges :
 - a. Pourquoi est-ce que la zone est menacée ?
 - b. Qu'est-ce qu'on peut faire pour réduire cette menace ?

- 8) Il y a 10 ans, est-ce que ces zones étaient les mêmes ?
 - a. Quelles zones ont changées, et comment ont-elles changées ?
 - b. Pourquoi est-ce qu'on a vu ces changements ? (A cause de quoi ?)

Appendix C: Perceptions survey

Each question is recorded on a Likert scale of 1 (strongly disagree) to 5 (strongly agree), except for questions 11 and 12.

1. Il est important de protéger la forêt pour assurer qu'elle est disponible dans la future.
2. Je suis content(e) avec la quantité des produits forestiers disponible à moi.
Pourquoi?
3. Je suis content(e) avec mon niveau d'accès à la foret.
Pourquoi?
4. Si non, mon niveau d'accès à la forêt au présent est plus limité qu'avant.
Pourquoi?
5. La couverture de la forêt autour de mon village a augmenté / pas changé / réduit.
Pourquoi?
6. D'ici 20 ans, il y aura toujours assez de forêt pour les enfants de ce village.
Pourquoi?
7. C'est plus difficile de trouver les produits forestiers au présent.
Pourquoi?
8. C'est plus difficile de chasser au présent.
Pourquoi?
9. Nous devons protéger plus les produits qu'on trouve dans la forêt.
10. Nous devons protéger plus les animaux qu'on chasse.
11. C'est a qui la responsabilité de protéger la forêt autour du village ?
12. Avez-vous déjà entendu parler des forêts communautaires? [Oui/Non]

Appendix D: Community forest interview guide

1) Quel est le but initial de votre forêt communautaire?

2) Est-ce que vous avez reçu l'aide d'une organisation, du gouvernement, d'un homme politique?

Si oui, de quelle façon vous avez été aidé? L'aide financière, légale, sensibilisation, technique ou matériel

3) Dans quelle étape êtes-vous pour établir la forêt communautaire ?

- Est-ce que les villageois ont des opportunités de participer à la prise des décisions sur la création de la forêt communautaire?

- Est-ce que la forêt communautaire est délimitée?

- Est-ce qu'elle a déjà un statut légal avec le gouvernement?

4) Quelles sont les difficultés principales que vous avez rencontrées pour établir la forêt communautaire?

Ex. Les procédures légales/gouvernementales sont trop compliquées, la sensibilisation de la communauté, les fonds pour l'établir ou renforcer, trop d'effort et de temps, pas bonne connaissance de la technique pour l'établir

5) Quels bénéfices avez-vous reçus de la forêt communautaire?

6) Quels bénéfices espérez-vous recevoir de votre forêt communautaire dans 5-10 ans?

7) Est-ce que vous pensez que ça vaut la peine d'établir la forêt communautaire? Pourquoi?

Ex. Le temps pour faire les réunions, le renforcement des capacités, etc.