ORIGINAL ARTICLE

Analysis of local livelihoods around Moukalaba-Doudou National Park in Gabon

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ABSTRACT It is important for the development of conservation projects to establish collaborative relationships with local populations, and for that, a detailed understanding of local lifestyles is required. In particular, basic information on local people's natural resource utilization is essential. In this article, the authors analyzed livelihoods in Moukalaba-Doudou National Park (MDNP), southwestern Gabon based on quantitative data obtained from long-term field research. It was shown that people inhabiting the area around the MDNP depend heavily on natural resources for their livelihoods and they produced sufficient food within the region. However, it was also shown that the variety of food items was poor compared with other protected area in Africa and the nutritional status is presumed to have been inadequate. When compared with the data before the establishment of the National Park in 2002, consumption of bush meat decreased remarkably whereas that of fish only slightly increased after ten years. It is supposed that the people around the MDNP have converted their lifestyles flexibly to coexist with the conservation projects in a part, but it is also the fact that conservation practices threaten local livelihoods to some extent.

Key words: African Rainforest, Conservation, Local People, Natural Resource Utilization

INTRODUCTION

Deforestation is progressing rapidly in the Congo Basin of central Africa because of the expansion of agricultural lands and the development of commercial logging (Barnes 1990, Laporte et al. 2007, FAO 2010, Ernst et al. 2013). In addition to the habitat loss from deforestation, the increase in the bush meat trade threatens some wildlife species, such as forest elephants and great apes, with extinction (Walsh et al. 2003, Norris et al. 2010, Nasi et al. 2011, Laurance et al. 2012). It is doubtless that the conservation of biodiversity in African rainforests is a major priority in the world. However, there are few conservation projects with effective sustainable management systems. One of the significant causes is the conflict between local people's lives and conservation practices. Millions of people depend highly on natural resources from forests for their livelihoods (Pimentel et al. 1997). They sometimes resist conservation activities both directly and indirectly because these activities restrict their access to natural resources in and around protected areas. Despite the importance of local residents' participation and the fact that community-based conservation management has been emphasized since the 1980s, conservation has not been realized adequately until now (Hackel 1999, Adams and Hulme 2001, Hulme and

Murphree 2001, Berkes 2007). Although there have been many attempted integrated conservation and development projects (ICDPs) over the last several decades, few have been successful, and some have resulted in negative impacts on local societies (Noss 1997, Christensen 2004). Especially in the protected areas of African rainforests, conservation policies are principally decided as "top-down" by governments and international NGOs, and the rights of local people are not secured appropriately (Barrow and Murphree 2001, Cernea and Schmidt-Soltau 2006, Debroux et al. 2007, Schmidt-Soltau and Brockington 2007).

For the development of conservation projects, therefore, it is important to establish collaborative relationships with local populations, and for that, a detailed understanding of local cultures and lifestyles is required first. In particular, basic information on local people's natural resource utilization is essential because this reflects the ecological and socioeconomic characteristics in the area and largely concerns the planning of sustainable natural resource management. Recently, there have been some studies on the natural resource utilization in African rainforests based on quantitative and long-term field research (Coad et al. 2010, 2013, Yasuoka et al. 2012), but the information is still limited. In addition, the same type of study is always needed in each protected area because natural resource utilization pat-

terns are based not only on ecological background but also on cultural characteristics, and there are considerable differences among areas even when they are in similar environments.

In this article, the authors focus on livelihoods in Moukalaba-Doudou National Park (MDNP), southwestern Gabon. First, the cultural background of the local community and the characteristics of their subsistence patterns are presented. Second, the authors analyze quantitative data on natural resource utilization obtained from long-term field research in collaboration with local informants. Types and amounts of food items consumed by the family of focus are reflected in the categories of carbohydrate foods, animal proteins, and other foods. The consumption of fuel and water is also examined. The proportion of natural resources in local livelihoods is analyzed, and local dependence on natural resources is discussed. Third, the authors make a comparison with previous studies. Compared with the similar studies conducted in other regions of Gabon and other African protected areas (Coad et al. 2010, 2013, Foerster et al. 2012, Kimura et al. 2012, Yasuoka et al. 2012), the authors point out that there are considerable differences in natural resource utilization in spite of the similar

ecological conditions. The authors also compare the current work's data with the data obtained in 1999 in the same area (Blaney and Thibault 2001, Blaney et al. 2009a, 2009b) and analyze the chronological changes in natural resource utilization that were largely influenced by the establishment of the national park in 2002. Finally, the authors discuss the importance of having a detailed understanding of local livelihoods for the development of effective conservation projects and the sustainable management of protected areas.

MATERIALS AND METHODS

Research Sites

Field research was conducted in three villages (Mbougou, Doussala, and Konzi) bordering the MDNP in the Nyanga Province, southwestern Gabon (Fig. 1). There are also some unofficial settlements outside of the villages, and these are inhabited by some of the villagers. These settlements were created when social conflict occurred, and even village chiefs live in them. Formerly the park was the Moukalaba-Dougoua Reserve, established in 1962; it became

Fig. 1. Research site and village distribution.

the MDNP when thirteen Gabonese national parks were created in 2002. The park covers an area of 5,028 km² consisting of a mosaic of forests and savanna. Human population density in the region is quite low (0.8 persons/km²; Thibault and Blaney 2003). Mean annual and monthly rainfall are roughly 1,776.8 mm (range 1,583–2,163 mm) and 137.6 mm, respectively (Takenoshita et al. 2008). There is a clear distinction between the dry season (from June to September) and the rainy season (from October to May).

Logging operations were carried out in the region by a logging company from the 1960s to the 1980s. There were hundreds of workers from many ethnic groups from all over Gabon and even from foreign countries, including some in Europe. Infrastructure such as logging roads, an airport, a dispensary, kiosks, and a primary school were constructed. During the logging era, the market economy penetrated deeply into the village, and the local community was culturally mixed. However, after the closure of the logging base in 1989, much of the infrastructure was abandoned, and a rural exodus occurred. The human population especially of younger people was decreasing sharply, and the infrastructure was deteriorating.

During this sharp decline in the human population and related activities, research and conservation projects were developing. Various organizations including a Japanese research team launched scientific research on fauna and flora in the area starting in the late 1990s. Japanese primatologists have been continuing ecological studies on western lowland gorillas (*Gorilla gorilla gorilla*) since 1999 and succeeded in habituating a group (Ando et al. 2008). Conservation projects have been expanding further since the creation of the MDNP in 2002. Japanese researchers have developed great ape research and are conducting a larger-scale project for biodiversity conservation and local development supported by the Japanese government (SATREPS: Science and Technology Research Partnership for Sustainable Development). A locally based NGO is also engaging in biodiversity conservation and local development activities through the promotion of ecotourism.

Although some projects are developing and local people have opportunities to earn cash income, local economic conditions have not improved sufficiently. There are few wage labor opportunities other than employment with the research and conservation projects. Except for these projects, cash income opportunities are restricted to sources such as officially paid village chief salaries and company pensions for former logging laborers but with very few occasions to sell agricultural and forest products. Access to the nearest town, a provincial capital named Tchibanga located roughly 80 km from the research sites, is considerably

difficult for local people because of bad traffic. There is only a small kiosk managed by an individual villager who sells a few seasonings and commodities. Education and welfare conditions are unfavorable. There are only a dispensary and a primary school, and these are much deteriorated because they have not been repaired since being constructed during the logging base period.

Local Community

The people in the research villages belong to western Bantu language groups, the majority being Punu (Bantu B43), Vungu (B40.3), and Varama (B40.2) (Guthrie 1967–71, Perrois and Grand-Dufay 2008). These groups are presumed to have migrated from Congo several hundred years ago and are currently distributed from central and southern Gabon to south of the Republic of the Congo (Perrois and Grand-Dufay 2008). Their society is characterized as highly mobile and less hierarchical. Because residents have a matrilineal descent system and patrilocal residence rule, there is a lack of congruence between residence and lineage in their society. Clan alliance is more important than territoriality. Ethnic categories are less important to the local people, and the primacy of clan allegiance goes beyond ethnic boundaries (Vansina 1990, Gray 2002, Mayer 2002).

The total population of the 3 villages including the unofficial settlements was 187 persons as of January 2012: 143 persons in Doussala, 25 persons in Mbougou, 5 persons in Konzi, and 14 persons in unofficial settlements. The ethnic group composition with excluded unidentified persons was Punu (117 persons: 66%), Vungu (51 persons: 31%), and Varama (eight persons: 5%). When comparing the population of Doussala and Konzi in 1999 (Blaney and Thibault 2001) with that in 2009 (by personal observation; people in unofficial settlements were included because they were registered in these two villages), the number of villagers was stable (142 persons in 1999 vs. 146 persons in 2009), but the age and sex compositions had changed. The numbers of teenagers had decreased because they had migrated to towns for education and wage labor. In contrast, there was a sharp population increase (more than 20%) in 2012 largely because of a research and conservation project by the Japanese research team launched in 2009. Young people who had lived in town came to stay with their relatives in Doussala looking for labor opportunities on the project. Children fostered in town also came back to live with their parents in Doussala because their household economic situations had improved. Some women in town

brought their children to their parents' homes in Doussala because of difficulty taking care of them in town. Although the population of Doussala is increasing, those of Mbougou and Konzi are decreasing as a result of villagers migrating to town or to Doussala given the convenience of living in Doussala to work on the projects.

Data Collection

Field research was conducted seven times over a total of approximately nine months: (1) August to September 2008, (2) February to March 2009, (3) October 2009 to January 2010, (4) August to September 2010, (5) January 2011, (6) December 2011 to January 2012, and (7) August 2012. In periods (1) and (2), the authors conducted semi-structured interviews and collected basic information on inhabitants of the villages, their family relationships, and the patterns of their subsistence activities. The authors then selected five families for livelihood monitoring research: four families in Doussala and one family in Mbougou. It was impossible to find a suitable family in Konzi because the population was extremely small. Although employment in research and conservation projects constitutes an important part of villagers' livelihoods at present, families in which no member worked regularly or received a high income from the projects were selected because the principal aim of the study was to assess the impact of human subsistence activities on the natural environment. Instead, the authors paid participants a small amount of money (25,000 CFA francs, approximately 38 euros per month) in gratitude for their collaborative efforts. This was not a large enough amount to cause changes in their household economies. They normally spent the money on seasonings such as oil and salt and on favorite items such as alcoholic beverages and cigarettes. It was supposed that the payments did not influence their natural resource utilization patterns.

Referring to the same research methods used in other regions (Yasuoka et al. 2012), the authors provided all of the focused families with a 10 kg hanging spring scale and notebooks and requested that they weigh and note their entire daily flow of food, fuel, and other items derived from the natural environment. They weighed these items before processing and cooking them. Items obtained from the market and village were also recorded along with information on how the foods were obtained. A preliminary trial had been conducted for six months or so between 2008 and 2009. As Yasuoka et al. (2012) pointed out, the major difficulty of the research was that informants could falsify recordings. Thus, these authors trained a field assistant and

asked him to check records every day during the preliminary trial period. After the records' reliability was examined, data collection was conducted for two years, from October 1, 2009, to September 30, 2011. The authors checked the notebooks in each research period and provided materials for recording if necessary. Changes in memberships of each family were also verified regularly because resource acquisition and utilization are closely related to the number and composition of family members. The authors corrected careless mistakes if they were judged as having no doubt, but uncertain data were excluded from the analysis. In spite of the frequent checking, there were much suspicious information from one family. Therefore, all of the data from that one family were excluded from the analysis.

RESULTS

Subsistence Activities

People in the research villages live principally by agriculture. Their fields are located in the forest area near the border with savanna roughly two kilometers from the village (Fig. 2). Some households have fields in the same locations so as to reduce the burden of farm work and to avoid crop raiding by wildlife. However, the families do not share these fields but each possess their own fields; families work independently because they need to be able to pay wages if they ask other people to help. Farmers slash and burn forests in the dry season (July to August), plant in September and October, and harvest beginning in February. Harvesting can take place for two years or so in one field. The two main crops are cassava and plantain banana, which are planted in mixed cropping. They also cultivate taro, yam, sugarcane, peanuts, maize, and other vegetables. Some of them cultivate pineapple.

This lifestyle is supplemented by fishing and hunting. Villagers often fish in the Moukalaba River and the Dibotsa River (see Fig. 2). There are several types of fishing materials: casting net, gill net, fixed net, rod, and creel. They also fish with toxic plants and water bailing in small streams and/or puddles. Two hunting methods are used: snare hunting and gun hunting. They set steel-wire snares on animal trails in the forest around their fields and patrol each time they go to the fields. Small to medium-sized mammals such as rodents and duikers are captured. Some villagers own guns and hunt monkeys and medium-sized mammals.

They also gather edible wild plants and mushrooms in both the forest and the savanna, and some fruits such as

Fig. 2. Distribution of the fields for farmers in Doussala and Mbougou Village.

mango, guava, and citrus that were introduced during the logging period. Honey and edible insects are gathered only a few times in a year. They usually gather firewood and obtain water for cooking and other housework from the natural environment.

Natural Resource Utilization

The total number of days that available data were collected and the average number of members in each family in the research period were calculated. Counting children under eleven years old as 0.5 a person (Yasuoka et al. 2012), the total number of adult-days was also calculated.

As a result, the total number of adult-days was 11,143 (Table 1). The member composition and information of each family are indicated in Table 1 as well. In general, all families are small and composed principally of relatively old persons. This is because the authors selected families in which no member works regularly on any of the projects. Based on Yasuoka et al. (2012), items were categorized as carbohydrate foods, animal proteins, water and firewood, and other items. The total weight of each item in each category consumed by each of the four families were aggregated collectively and are shown in Tables 2–4.

During the investigation period, four kinds of carbohydrate foods from the fields were recorded: cassava, cooking bananas, taro, and yam (Table 2). The families

Table 1. Number of days data collected and total adult*days in four focused families

Family	Residence	No. of days data collected	Average no. of the members		Adult*days	Main members
			Adults	Children		
A	Doussala	730	4.0	0.0	2920.0	a man in his sixties, his two wives in fifties, and two sons in twenties
B	Doussala	730	4.0	2.0	3650.0	a man in his sixties, his wife in her sixties, their daughter in her thirties with her two children
C	Doussala	675	3.0	0.0	2025.0	a man in his sixties, his wife in her fifties, and their children
D	Mbougou	728	3.5	0.0	2548.0	a man in his sixties, his wife in her fifties, and his mother in her eighties
total		2863			11143.0	

sometimes bought rice at the shop in the village and cassava stick (batôn de manioc) from other villagers. Among the four families of focus during the investigation period, 17,085.5 kg in total and 1.53 kg per capita per day (dividing 17,085.5 kg by 11,143 adult-days) of carbohydrate foods were consumed. Cassava occupies more than half of the total net consumption (58 %), and cooking bananas represents roughly one-quarter (27 %). These two kinds of foodstuffs constitute a large proportion of the daily local dishes. Nearly 90 % of carbohydrate foods were harvested from the families' own fields and small gardens in the village. Commercial items comprise only 10 % of food intake, and local people rarely exchange and/or share food with other families. Normally, they do not buy cassava because it is abundant almost all seasons in each field. Rather, they sometimes buy cassava sticks because it is time-consuming to make them. In comparison with cassava, bananas are used frequently for commercial transactions within the village.

Regarding animal proteins, fish and bush meat were obtained from the natural environment and canned sardines (125 g per can) were purchased from the shop (Table 3). Among the four focused families during the study period, 4,133 kg in total and 0.371 kg per capita per day (divided 4,133 kg by 11,143 adult-days) were consumed as animal proteins. Roughly 80 % of the animal proteins were obtained by the families themselves, and 20 % were purchased from other villagers. Similar to the carbohydrate foods, the studied families rarely exchange and/or share animal proteins with other families. Among these items, fish is the most important, constituting 86 % of the total (0.319 kg/

capita/day). Because they fix nets in the river and patrol them frequently, they obtained fish on most days, roughly two-thirds of the total number of days during the study period. In contrast, the amount of bush meat consumed was not large (13 %, 0.049 kg/capita/day).

There were four animal species recorded as bush meat: brush-tailed porcupine, blue duiker, cane rat, and slender-snouted crocodile, in order by amount consumed. The amount of bush meat consumption significantly differed among families (Table 5). Whereas Family 1 and Family 2 rarely consumed bush meat, Family 3 and Family 4 did so regularly because they have snare traps around their fields and control them regularly. However, even in Family 3, who consumed the most bush meat, the proportion of bush meat consumed was only half that of fish. The consumption of canned sardines was only occasional because they were costly; sardines constitute a quite small proportion of the consumed animal proteins. Although the villagers had livestock such as chickens and goats, these foodstuffs were not recorded. It was observed that the livestock was not cooked for daily dishes but consumed only on special occasions such as funerals and official ceremonies. These meals were then distributed to nearly all participants in each event. Therefore, it was difficult for the focused families to note the precise amounts. Insects and wild reptiles were not consumed during the period of investigation, and nor did the authors ever observe the consumption of these food items during the research periods.

Among the four focused families during the study period, 11,627.5 kg in total and 1.04 kg per capita per day

Table 2. Way of acquisition and consumption of carbohydrate food (kg)

Item	Harvest	Commercial	Gift	In all	%	/capita/day
cassava	9733	113	0	9846	57.6%	0.884
banana	4065.5	451	70	4587	26.8%	0.412
taro	1270.5	22	14	1306	7.6%	0.117
yam	167.5	2	0	170	1.0%	0.015
cassava stick	0	475	2	477	2.8%	0.043
rice	0	689	12	701	4.1%	0.063
total	15236.5	1752	98	17086	100.0%	1.533
%	89.2%	10.3%	0.6%			

Table 3. Way of acquisition and consumption of animal protein food (kg)

Item	Harvest	Commercial	Gift	Total	%	/capita/day
fish	2759.5	764.0	35.0	3558.5	86.1%	0.319
bushmeat	516.5	33.5	0.0	550.0	13.3%	0.049
sardine can	0.0	24.6	0.0	24.6	0.6%	0.002
	3276.0	822.1	35.0	4133.1	100.0%	0.371
%	79.3%	19.9%	0.8%	100.0%		

of firewood and 25,914.5 kg in total and 2.33 kg per capita per day of water were consumed (Table 4). The places where each family harvested firewood and water were also analyzed (see Table 6, excluding Family 3 because of incomplete data). Although there were minor differences in harvest places according to people's residences, there was a common general tendency among these families. They obtain most firewood from the fields and the surrounding fallow when they go farming and rarely use primary forests. Water is acquired from the river in the dry season (June to September) and from rain in the rainy season (October to May). In the rainy season, the amount of precipitation is sufficient to supply water for housework not including washing clothes and bathing, which are done in the river.

It was difficult to analyze the exact weights and proportions of other items because a lot of data were omitted, but the recorded items are enumerated below. As for manufactured alcoholic beverages, beer and red wine were sold at a shop in the village. Alcoholic beverages made from natural resources in the village were palm wine, honey wine, and sugarcane wine. The focused families sometimes produced these and bought them from other villagers at other times. As agricultural products, cassava leaf, chili pepper, African eggplant, peanuts, and sugarcane were recorded. The families also frequently harvested palm nuts for seasoning. As other merchandise, there were sugar, salt, bouillon cubes, coffee, and canned tomatoes for cooking

and soap and kerosene for daily use.

DISCUSSION

The present study showed that people inhabiting the area around the MDNP depend heavily on natural resources for their livelihoods. Nearly 90 % of carbohydrate foods, mainly cassava and cooking bananas, were harvested from the families' own fields, and only 10 % were purchased commercially. Even among the commercial purchases, some items such as bananas and cassava sticks were harvested or made from crops in the region to be bought and sold among the local people. The only carbohydrate food derived from outside the region was rice, which constituted 4 % of the net consumption. Regarding animal proteins, most were fish and bush meat, and only less than 1 % was manufactured, canned sardines. The consumption of livestock was only occasional, the livestock were seldom brought from outside, and even when it was, consumed the amounts were quite small. It was supposed that the people around the MDNP produced sufficient food within the region. Carbohydrate foods supplied 1.53 kg per capita per day, or 1,196 kcal (an edible ratio of 0.6 and energy value of 1.3 kcal/g; Yasuoka et al. 2012). Although this amount was less than that in other areas (Kalinzu in Uganda: 1610 kcal, Luo in DRC: 1650 kcal, Yasuoka et al. 2012), it was a presumably sufficient calorie intake. In addition, given the age compositions of the focused families in the present study, who were relatively older, these amounts were sufficient to satisfy calorie demands. Animal proteins supplied 0.371 kg per capita per day, or 0.223 kg by assuming an edible ration of 0.6. This amount is as large as

Table 4. Consumption of firewood and water (kg)

Item	Harvest	/capita/day
firewoods	11627.5	1.04
water	25914.5	2.33

Table 5. Source and consumption of animal protein food in four families (kg)

Family	Fish	/capita/day	Bushmeat					/capita/day	total /capita/day
			porcupine	blue duiker	cane rat	crocodile	in all		
A	556.5	0.191	1.0	0.0	0.0	0.0	1.0	0.000	0.191
B	1365.5	0.374	0.0	38.0	0.0	0.0	38.0	0.010	0.385
C	658.0	0.325	192.0	132.0	6.0	0.0	330.0	0.163	0.488
D	978.5	0.384	12.0	50.0	110.0	9.0	181.0	0.071	0.455
total	3558.5	0.319	205.0	220.0	116.0	9.0	550.0	0.049	0.369

Table 6. Source and consumption of water (kg)

Family	R. Moukalaba	R. Dibotsa	R. Dougougou	Rain	In all	/capita/day
A	5464.0	20.0	0.0	2104.0	7588.0	2.6
B	4024.0	0.0	0.0	3155.0	7179.0	2.0
D	2195.0	0.0	2456.0	1619.0	6270.0	2.5
total	11683.0	20.0	2456.0	6878.0	21037.0	2.3

or larger than those of other areas in Africa (Wilkie and Carpenter 1999, Nasi et al. 2008, Yasuoka et al. 2012).

Although the people around the MDNP obtained sufficient amounts of food, the variety was poor and the nutritional status is presumed to have been inadequate (Blaney et al. 2009a, 2009b). Although the number of sorts of carbohydrate foods was not abnormal, those of animal proteins and other foods were considerably small compared with other areas. Whereas the people around the MDNP only take fish and bush meat, the people of Luo, in the DRC, consume not only fish and wild mammals but also several species of insects and reptiles, domestic mammals and fowl, wild birds, and eggs (Kimura et al. 2012, Yasuoka et al. 2012). In Kalinzu, in Uganda, milk, beef, and domestic fowl are frequent sources of protein (Yasuoka et al. 2012). As for bush meat, there were only four species recorded as being consumed by the four families during the two years. According to the studies on hunting activities and bush meat offtakes in the villages of central Gabon (Coad et al. 2010, 2013); red duikers, small pangolin, African palm civet, and moustached guenon were caught frequently in addition to the 4 species recorded in the MDNP, and more than 20 species in total were targeted. A larger survey on bush meat hunting and household economies in 3 Gabonese national parks (Foerster et al. 2012) also listed more than 20 species as bush meat, including protected animals. The amount of bush meat consumption was 0.282 kg per capita per day (Foerster et al. 2012), more than five times larger than that of the MDNP (0.049 kg per capita per day).

It is possible that this difference arose from differences in sampling methods. Coad et al. (2010, 2013) collected data on all hunting trips among 90 adult men in two villages during one year, and Foerster et al. (2012) conducted interviews in 751 households. However, it is supposed that the difference is not only because of the different sample sizes but also because of different livelihood patterns. As shown in the proportion of animal protein consumption, people around the MDNP spend less time and labor on hunting activities. In addition, the authors never observed consumption of any animals other than the four species listed during any of our field research periods.

From an optimistic view, it is assumed that the people around the MDNP respect conservation laws and have converted their lifestyles flexibly to coexist appropriately with the conservation projects. According to a previous study conducted in the same area in 1999 (Blaney and Thibault 2001), people took a great deal bush meat including protected animals before the establishment of the national park. They consumed 0.460 kg of bush meat (62 %) and 0.281 kg of fish (38 %) per person per day, and 53 % of the animal

proteins came from protected animals; only 17 % were non-protected animals (Blaney and Thibault 2001). In contrast, bush meat consumption was 0.049 kg (14 %) and fish consumption was 0.319 kg in the present study, and only the crocodile (0.2 % of animal protein food) that was caught once unexpectedly was a protected animal. The ratio of bush meat to fish also changed drastically (1:0.61 in 1999 and 1:6.47 at present). Therefore, consumption of bush meat decreased remarkably whereas that of fish only slightly increased after ten years. This is considered to be largely because of the establishment of the national park. All hunting activities in the national park were strictly prohibited, and control of the hunting of protected animals even outside of the park was strengthened. In fact, there have been several cases in which people in the research village were arrested for illegal hunting after the national park was established. Therefore, it is said that the local people have obeyed the law for fear of penalty and they have skillfully adopted the natural resource management system of the national park since its establishment in 2002, likely because they have had sufficient options for their subsistence.

However, it is impossible to conclude that the management system at the MDNP is successful and sustainable. Rather, conservation practices threaten local livelihoods to some extent. Local people's utilization of the natural resources was largely restricted after the establishment of the national park. Blaney et al. pointed out that although natural resources contribute to the nutritional well-being especially of vulnerable people such as children and adolescents, access has been restricted without necessarily taking into account their reliance on them for their welfare (Blaney et al. 2009b: 60). The authors also claimed that in addition to activities related to conservation objectives, more efforts need to be dedicated to appreciating the full role of natural resources for the populations living within and around protected areas (Blaney et al. 2009b: 60). The problem of crop raiding by wildlife has also become increasingly serious and has been influenced by conservation practices. Although the wildlife population is supposed to be growing and the human-wildlife conflict is increasing, farmers cannot hunt these animals freely because of conservation laws. Because there are no effective protection methods, farmers spend much money as well as considerable labor and time to protect their fields (Walker 2012).

Nevertheless, existing livelihood supports or effective poverty alleviation policies are inadequate. Infrastructure and public facilities are not well developed. The government does not sufficiently compensate farmers for their crop losses and seldom takes measures to protect people's fields. Although research and conservation projects provide

local people with some labor opportunities, it is only temporal and partial at present, and the local economic situation has not changed smoothly. Recently, the Gabonese government has stressed the importance of nature conservation for sustainable development and aims to promote the ecotourism industry (Laurance et al. 2006). Diverse actors such as governmental institutions, researchers, international and local NGOs, and private companies are planning to participate in the ecotourism sector, which is the case in the MDNP as well. However, ecotourism is still under development, and there is potential risk to the local social and economic systems if it is introduced too hastily without an appropriate understanding of local livelihoods. The present study, which revealed local livelihoods in detail based on long-term quantitative data, will contribute to developing effective ways to support local livelihoods and establish national park management systems in collaborative relationships with local populations.

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