

Potentials and Endogenous Practices in the Exploitation of Natural Resources of a Forest Ecosystem in the Southern Sudanian Zone of Burkina Faso

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Abstract: The Kuinima Classified Forest (KCF) is undergoing increasing degradation due to climatic hazards and anthropogenic pressures. The aim of this study is to propose options for conserving the forest resources of the KCF for the various ecological and socio-economic functions it provides. To this end, a survey was carried out among local residents. This survey involved a sample of 113 producers (chosen on the basis of availability) spread across the four villages bordering the FCK. The villages concerned were: Dingasso, Kouakoualé, Farakoba and Kuinima (Sector 6). In total, the survey concerned one hundred and thirteen (113) people, 70% of whom were men compared to 30% women. The main axes of the investigation are: (i) the potential and importance of the forest for the local populations, (ii) the endogenous practices of the exploitation of forest resources and (iii) the perception of the degradation of the forest and associated environmental problems. It appears that plants and animals are the most mentioned with 45% and 40% frequency respectively. The results of the study reveal the existence of plant and animal potential to be preserved. These include *Vitellaria paradoxa*, an abundant species (89%) used for food, medicine and fuel. The shea caterpillar (*Cirina butyrospermi*) is used by 100% of people interviewed, while 30.09% use it for medicinal purposes. Local residents (59.29%) believe that the condition of the KCF has improved, compared with 36.28% who consider it to be very degraded. To ensure sustainable management of the forest, local residents are unanimous on the need to continue planting, raising awareness and monitoring.

Keywords: Kuinima Classified Forest, Degradation, Non-Wood Forest Product

1. Introduction

Since the 1970s, natural resources in West Africa have been suffering severe degradation due to physical, agro-climatic and/or anthropogenic factors [1-3]. The main reasons for this are drought, extensive agriculture as well as demographic growth, which has led to overexploitation of the land [4-9].

In the 1990s, a number of reports warned of an environmental catastrophe in Africa. Indeed, between 1990

and 1995, the African continent recorded an annual deforestation rate of about 0.7%, more than twice the global rate [10].

In Burkina Faso, data on land cover dynamics and rates of deforestation and forest degradation vary [11]. According to the ministry in charge of the environment, the total area of all forest formations (open forest, gallery forest, shrub savannah, wood savannah, steppe) was estimated at 13,305,238 ha in 2002, while the FAO estimated it at 5,649,000 ha in 2010.

According to FAO [12], the annual deforestation rate in Burkina Faso from 1990 to 2010 was about 19%. The main causes cited in current literature are: extensive agriculture; high demand for firewood and charcoal; overgrazing and, more recently, mining. As for industrial and semi-industrial mining sites, they cover a land area of more than 1,000 km² [11]. In addition to these direct factors of deforestation and forest degradation, there are indirect factors whose consequences lead to the appearance of one or more direct factors.

And yet the Kou watershed, covering a surface area of 1,821 km² and including the classified forests of Dindéresso, Kou, Kua and Kuinima, is recognized as the perimeter that protects the drinking water resources of the city of Bobo-Dioulasso. It is the geographical area that contains the water system associated with the Kou River, its tributaries and the Nasso springs. It should therefore be protected to ensure the sustainability of the resource [13].

The people living in the Kou watershed are 85% farmers, and depend on the forest for their livelihood. The forest is thus devastated to make way for fields or to supply Bobo Dioulasso with firewood, charcoal or timber [14]. The disappearance of these classified forests poses a threat to the entire municipality of Bobo Dioulasso, given their role as an "ecological lung". The most vulnerable members of the population (women, young girls) are resorting to legal exploitation of forest products as a means of fighting poverty. According to a study by Ouédraogo *et al.* [15], 92.8% of households living in the Boulon and Koflandé classified forests are more or less financially dependent on NWFPs.

However, overexploitation of these NWFPs is a threat of extinction for natural resources in forest cover. In fact, the viability of tree formations is linked to certain harvesting practices observed. In reality, NWFPs are harvested by picking up, plucking or stoning. These practices are said to have a negative impact on the natural regeneration capacity of some species [11].

The contribution of Non-Wood Forest Products (NWFPs) to the national economy was estimated at 0.63% in 2008 [16]. Protecting biodiversity necessarily involves protecting ecosystems. As poverty is biodiversity's worst enemy, compromises must be found between environmental protection and economic development constraints [17].

This is the background to this survey with local people organized into a Forest Management Group (FMG/K), whose aim is to contribute to the protection and sustainable use of forest resources in the Kuinima Classified Forest (KCF) for the well-being of local people.

2. Materiel and Methods

2.1. Study Area

The Kuinima classified forest is located south of the city of Bobo-Dioulasso (Burkina Faso), between 11°03' and 11°07' north latitude and 04°19' and 04°36' west longitude. It borders sectors 6 (Kuinima), 17 and 19 of this city and the villages of

Kouakoualé, Dingasso and Farakoba. According to the classification order dated November 20, 1935, it covered an area of 4,000 ha. Today, it covers only an area of 2,150 ha, as part of it was declassified on May 31, 1947.

The climate of the area is characterized by an alternating dry season (November to April) and rainy season (May to October). The former is dominated by the harmattan and the latter by the monsoon. The study site is located in the southern Sudanian zone [18]. According to rainfall data from 2008 to 2017 collected at the Farako-ba station, annual rainfall varies between 744.6 mm and 2262.5 mm, with an annual average of 1315.96 mm.

2.2. Sampling

During the fieldwork, a sample of 113 growers (chosen on the basis of availability) from the four villages bordering the KCF was surveyed. The villages concerned were: Dingasso, Kouakoualé, Farakoba and Kuinima (Sector 6).

A total of one hundred and thirteen (113) people were interviewed, 70% of them men and 30% women. The youngest respondent was 27 years old and the oldest was 90. The average age was 49.12. The socio-demographic characteristics of the people surveyed are summarized in Table 1.

2.3. Data Collection and Analysis

The survey data collection tools were interviews and field observations. An interview guide sheet with questions focusing on the following aspects:

- 1) the potential and importance of the forest;
- 2) endogenous practices for exploiting forest resources;
- 3) perception of forest degradation and related environmental problems;
- 4) constraints and solutions for sustainable management of forest resources.

Data were manually compiled, coded, entered and analyzed using EXCEL Version 2013 software. Results were summarized using descriptive statistics.

3. Results

3.1. Socio-Demographic Characteristics of Respondents

The results for some demographic characteristics are shown in Table 1. According to these results, half (50.44%) of the people interviewed are between 40 and 60 years old.

In terms of educational level, 38.05% are literate and 33.63% are illiterate. The others attend school, 15.93% at primary level and 12.39% at secondary level. As for religious practices, Muslims are the most numerous (68.14%) compared to Catholics (24.78%). The Bobo ethnic group represents 69.03%.

Table 1. Socio-demographic characteristics of respondents.

Variable	Size	%
Age group (year)	[27-40]	24.78
	[40-60]	50.44

Variable		Size	%
Group/association membership	[60-80]	26	23.01
	≥ 80	2	1.77
	Yes	60	52
	No	53	48
	Literate*	43	38.05
Educational level	Illiterate	38	33.63
	Primary	18	15.93
	Secondary	14	12.39
	Higher	0	0
Religion	Muslim	77	68.14
	Catholic	28	24.78
	Animist	4	3.54
	Protestant	4	3.54
	Bobo	78	69.03
Ethnic group	Tiéfo	20	17.70
	Mossi	10	8.85
	Fulani	2	1.77
	Others**	3	2.65
Main occupation	Farmer	76	67.25
	Housewife	35	30.97
	Breeder	1	0.88
	Plant nursery worker	1	0.88
Secondary occupation	Trader	14	12.38
	Vegetable grower	9	7.96
	House builder	5	4.42
	Others***	11	9.73

(*)= arab and/or dioula; (**) = (Dioula, Gourounsi, Senoufo);

(***) = (blacksmith, painter, carpenter, photographer, hunter, marabout, driver, breeder)

3.2. Potential and Importance of the Forest

According to local residents, the KCF is rich in potential (Table 2). Plants and animals are the most frequently mentioned resources, with 45% and 40% respectively. 9% of the respondents say that cultivated fields are also a potential resource.

Among the plants found in the KCF, 100% of the respondents say that *Vitellaria paradoxa* and *Parkia biglobosa* are found in the classified forest, while 20% think that the species *Adansonia digitata* is endangered.

Regarding the density of these three species, all respondents list them in descending order as follows: *Vitellaria paradoxa* - *Parkia biglobosa* - *Adansonia digitata*.

The local populations of the KCF are unanimous in stating that the fruits of *Parkia biglobosa* and *Vitellaria paradoxa* are available between April and May and June and July respectively. To harvest these products, they use the picking method for *Vitellaria paradoxa* and the plucking method for *Parkia biglobosa*.

According to local residents, hare (*Lepus capensis* L.), francolin (*Francolinus bicaratus* G. R. G.), red monkey (*Erythrocebus patas* L.), grasscutter (*Thryonomis swinderianus* F.), etc. are the wild animals that can be found in the classified forest. Only 38.94% see people entering the KCF to hunt when the hunting season is open. Almost 60% of respondents reported the presence of a sacred place in the Kuinima classified forest. These include trees, hills and streams. *Vitellaria paradoxa*, *Parkia biglobosa* and *Adansonia digitata* are not sacred trees.

Table 2. Potential resources of the forest.

Natural resources	Frequency
Aggregate	3%
Animals	40%
Farms	9%
Water	3%
Plants	45%

3.3. Endogenous Practices for the Use of Forest Resources

Table 3 shows the uses to which local people put the three main NWFP species by plant parts. The fruits of all three species are used for food, as are the leaves of *Adansonia digitata* (100% of respondents). For medicinal purposes, all other parts of the three species are used except the stem. Thus, 34.51%, 45.13% and 14.16% of respondents mentioned the roots of *Vitellaria paradoxa*, *Parkia biglobosa* and *Adansonia digitata* respectively. The respondents say that the bark of *Vitellaria paradoxa* (76.11%), *Parkia biglobosa* (87.61%) and *Adansonia digitata* (53.98%) is used for medical care. For the same purpose, *Vitellaria paradoxa* (15.04%), *Parkia biglobosa* (77.88%) and *Adansonia digitata* (46.86%) are used. Finally, according to the respondents, the fruits of *Vitellaria paradoxa*, *Parkia biglobosa* and *Adansonia digitata* are used for medical purposes, with frequencies of 53.10%, 57.52% and 39.82% respectively.

At the same time, the stems of *Vitellaria paradoxa* (84.07%) and *Parkia biglobosa* (69.03%) are used as fuelwood. 23.89% of the respondents indicated that they use the stems of *Vitellaria paradoxa* as construction wood.

Shea caterpillars (*Cirina butyrospermi*) are consumed by 100% of the respondents while 30.09% use them in their medication.

In terms of use, the fruits of all three species are consumed directly (100% of respondents). The local populations (100%) of the KCF transform the fruits of *Vitellaria paradoxa* and *Parkia biglobosa* into different products: butter in the case of *Vitellaria paradoxa*, and soumbala in the case of *Parkia biglobosa*. In addition, 36.28% can make soap from shea butter.

Table 3. Different uses of the three main NWFP species by parts.

Parts	Usage type	Frequency (%)		
		<i>V. paradoxa</i>	<i>P. biglobosa</i>	<i>A. digitata</i>
Roots	Local medicine	34.51	45.13	14.16
	Fuelwood	1.77	0.88	-
	Handicrafts	1.77	-	-
Bark	Local medicine	76.11	87.61	53.98
	Fuelwood	7.08	4.42	-
	Fuelwood	84.07	69.03	-
Stem	Construction wood	23.89	3.54	-
	Handicrafts	9.73	0.88	-
Leaves	Local medicine	15.04	77.88	46.90
Fruit	Local medicine	53.10	57.52	39.82
	Fuelwood	3.54	1.77	0.00
Caterpillars	Food	100.00	-	-
	Local medicine	30.09	-	-

3.4. Perception of Forest Degradation and Related Environmental Problems

The perception of the degradation of the KCF is related to the assessment of the current condition of the forest (Table 4).

Table 4. Frequency of citing the reasons for the improvement in the current state of the FCK.

Reasons for improvement	Frequency (%)
Awareness,	5.95
Surveillance,	2.99
Reforestation,	25.37
Wareness and reforestation,	29.85
Wareness, surveillance and reforestation,	7.46
Surveillance and reforestation,	23.88
Awareness and monitoring.	4.48

Several reasons were given for the improvement of the current state of the forest. About 59.29% of the local residents think that the condition of the forest has improved. The main reasons are reforestation and sensitization (29.85% of respondents), reforestation (25.37%), surveillance and reforestation (23.88%).

In addition, actions for the sustainable management of forest resources, and specifically the three woody species, have been listed. These included reforestations, surveillance, granting cultivation plots to local residents, maintenance work, avoiding bush fires, and capacity building of members of the forest management group.

4. Discussion

The results of the survey shown that the KCF is full of potential in the eyes of local residents. Plants and animals were the most frequently mentioned by 45% and 40% of respondents respectively. Among the plant species of the KCF, all respondents indicated that *Vitellaria paradoxa* and *Parkia biglobosa* were the most abundant. These results are corroborated by those obtained by Noula [19] and Lompo [20], who listed 57 woody species in which *Vitellaria paradoxa* was the dominant species in the same forest. Similarly, [21] in their study of shea dynamics in the agrarian systems of Burkina Faso, noted that *Vitellaria paradoxa* accounted for 70% of the adult woody species recorded, followed by *Parkia biglobosa* (6%), etc. This result is linked to the practice of agroforestry, introduced more than two decades ago with the aim of participatory management of natural resources in this forest. The abundance of *Vitellaria paradoxa* and *Parkia biglobosa* could be due to the practice of assisted natural regeneration which focuses on fruit trees, and then the other species.

Parkia biglobosa fruits reach maturity in April or May, depending on latitude [22], *Vitellaria paradoxa* fruits mature at the start of the rainy season (May-June), coinciding with the lean season [23]. There are various techniques for harvesting NWFPs, namely standing harvesting, picking up and felling trees or uprooting certain species [24, 11]. *Vitellaria paradoxa* fruits are collected when they are ripe,

which could explain the method of picking them up when they fall. *Parkia biglobosa* fruits, on the other hand, are harvested in their unripe state. Some authors [22], have reported cases of harvesting practices in some areas of the park in Néré on the Abomey plateau (Benin), where *Parkia biglobosa* fruits are picked before they are fully ripe.

The trees in the hills and watercourses of this classified forest are sacred places for local residents (60%). The work of Adjossou *et al.* [25] has shown that the forest islands still present in Benin, Burkina Faso and Togo are generally places of worship the sacralization of which has enabled the forest cover to be maintained or a tree cover to be established. As the current vegetation dynamics are forest-based, these sacred sites could contribute to the conservation of biodiversity by restricting access to and use of forest resources.

The fruits of all three species are used as food, as well as the leaves of *Adansonia digitata* (100% of respondents). Several studies have shown that NWFPs play a role as food supplements in several countries. They are a survival food during the lean season in years of drought, and a supplementary food during periods of generous rainfall in the Sahel [26].

The forest as a whole is perceived as a generous space, because it provides food and offers the prospect of healing through its products [27]. Vaney [28] believes that herbal medicine is an age-old practice that uses empirical knowledge (local knowledge); it is unquestionably the oldest medicine in the world. All societies, ancient and modern, have some form of plant medicine. In the present study, it appeared that the parts (roots, leaves, bark and fruit) of all three species are used in local medicine, according to the respondents. Several studies confirm this result. Indeed [29], in an ethnobotanical study of medicinal plants used in the Department de Transua, Zanzan District (Côte d'Ivoire), showed that the parts most widely used in herbal medicine are leaves (63.96%) and roots (10%). Furthermore, [30] found that, with a few exceptions, all plants have medicinal virtues for the different communities surveyed in the area around the Haut-Sassandra classified forest (west-central Côte d'Ivoire). Plant parts contain substances that enable them to fight diseases. Plant leaves are used in local medicine because they are where photosynthesis takes place and where the secondary metabolites responsible for the biological properties of the plant are stored [29]. Reliance on these plants is justified by the absence of health centers, their remoteness or lack of financial means [30].

At the same time, *Vitellaria paradoxa* and *Parkia biglobosa* stems are used as fuelwood. These results confirm those of Yaméogo [13], who shows that the entire forest (KCF) is subject to the exploitation of firewood, charcoal, bush fires and grazing.

In addition to their direct use (direct consumption and sale of almonds), the fruits of the three main NWFP-providing species are processed by local residents into various products, particularly butter (100%) and soap (36.28%). As for the fruits of *Parkia biglobosa*, they are transformed into

soumbala (100%). These results are in line with Kaboré [21], who claimed that the almonds harvested by women are processed into butter or sold dried. In addition, other studies [22], have highlighted the possibility of making afitin (soumbala) at any time, from néré seeds, which can be found on the market almost all year round. It should also be mentioned that the seed of *Parkia biglobosa* is an important source of protein (30–40%), essential amino acids, fatty acids, riboflavin, thiamine, niacin in the diet of low-income families [31].

Local residents consider that the condition of the KCF is currently improving. The reasons given for this improvement include: reforestation, sensitization and surveillance. According to a study carried out in 2009, 1.5% of the area of the KCF is occupied by plantations [32]. Surveillance is carried out by the forestry service, supported by local people organized into Forest Management Groups (FMG). However, those who consider the forest to be highly degraded agree with Yaméogo [13], who believes that the entire forest is subject to anthropogenic activities (grazing, bush fires, firewood and charcoal collection) which, by fragmenting the overall landscape, have weakened the entire forest ecosystem, creating pockets conducive to both soil erosion and biodiversity loss. In the same vein, Gnoumou and Adouabou [33] have shown that in areas under human influence, the surface area of plant cover is shrinking miserably in favor of cultivated areas. This contradiction could be explained by the fact that the majority of agroforesters find that their crop yields have increased, so they keep more *Vitellaria paradoxa* and *Parkia biglobosa* in the agricultural plots.

According to local residents, demographic pressure on the availability of resources is the cause of the low productivity of woody species.

5. Conclusion

This study shows that the KCF is rich in plant, agricultural and more or less animal potential. *Vitellaria paradoxa* is dominant, followed by *Parkia biglobosa* as the main NWFP-providing species. *Adansonia digitata* is almost non-existent in this classified forest. The fruits of *Vitellaria paradoxa* are collected by picking and those of *Parkia biglobosa* are plucked. Sacred sites (trees, hills and streams) can be found in the KCF. In terms of product use, the fruits of all three species are used for food, as are the leaves of *Adansonia digitata* (100% of respondents). As with many plants, local people use the parts of the three species for health care. Residents transform the fruit of *Vitellaria paradoxa* into butter and then into soap, and the fruit of *Parkia biglobosa* into soumbala.

The majority of local residents consider that the current state of the KCF has improved as a result of multiple reforestation efforts, awareness-raising and surveillance. They recognize that the main constraint is the strong pressure of human action and demographic pressure on the availability of resources. Another is the low productivity of woody species. The exploitation of the three main NWFP species is undervalued due to production and processing constraints.

In order to better conserve this classified forest, the inhabitants of Kouakoulé, Farakoba and Dingasso in the KCF will be allocated cultivation plots, while ensuring that the relevant environmental regulations are implemented. This will be achieved by continuing to train and revitalize the FMGs in these villages. FMG members in the villages and neighboring sectors will be continuously sensitized on various issues related to sustainable management of forest resources.

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