

Perception of Local Populations of Bouba-Ndjidda National Park on Indigenous Knowledge and the Impact of Climate Change on Biodiversity Conservation

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Abstract

This study deals with the perceptions of indigenous knowledge in the field of conservation and the impact of climate change on biodiversity in the peripheral villages of the Bouba-Ndjidda National Park (PNBN), Department of Mayo-Rey, Cameroon. To this end, 23 out of 70 villages in the study area were selected, for a sample of 368 households surveyed through a questionnaire addressed to the heads of households. Data collection took place from August 27 to December 22, 2022. The results reveal that 70.7% of the population living near the PNBN practice agriculture as their main income-generating activity, followed by livestock (23.3%) and trade (6%). Knowledge in the field of the conservation of natural resources is rooted in occultism through rituals and sacrifices (99.50%) offered to the geniuses of nature and prohibitions on the felling of trees and sacred animals (13.00%). The populations perceive climate change through the variation of the seasons (97.60%), the increase in temperature (84.80%), the reduction in the duration of the rainy seasons (54.60%), the drop in agricultural yield (84.80%) and floods (74.70%). The consequence of these changes on wildlife is the disappearance of animal species such as the Rhinoceros, the Wild Dog, the Cheetah and the

Ostrich. In order to cope with climate change, the natives have developed strategies such as the adoption of early crop varieties (maize, millet, soybeans, etc.), the reorganization of the agricultural calendar, the practice of reforestation, extension of field surfaces, the cessation of excessive deforestation and uncontrolled bush fires, the construction of fired brick houses, the practice of irrigation, seasonal migration and occultism. This indigenous knowledge is a perfect adaptation to climate change and makes it possible to better take into account the vision of local populations in the conservation of biodiversity.

Keywords

Perception, Indigenous Knowledge, Climate Change, Biodiversity Conservation, Bouba-Ndjidda National Park

1. Introduction

Climate change is the main environmental problem faced by humanity. It is at the origin of the multiplication of extreme climatic events, such as droughts, floods, heat and cold waves [1] [2]. In Africa in particular, climate change represents a major threat to growth and sustainable development, as well as to the achievement of the Millennium Development Goals (MDGs). Strategies for adapting to extreme climatic conditions have been the subject of numerous studies on the life styles of indigenous populations, closely linked to their knowledge and know-how. Indigenous knowledge is therefore a key benchmarks used to adapt to climate change [3]. This knowledge and practices are the results of thousand-year-old observations, which are transmitted from generation to generation and which expand over time in order to act in the face of climatic variations [4].

Climate change affects all areas of human activity (health, agriculture, livestock, etc.) and its consequences are numerous, including: phenomena of desertification and increased erosion, irreversible changes in ecosystems and loss of biodiversity [2]. On a planetary scale, as direct effects, climate change is inducing a rise in temperature and a new distribution of precipitation [5]. Climate change could lead to a loss of biodiversity of 15% to 37% of terrestrial plant and animal species by 2050 [6]. The Intergovernmental Panel on Climate Change (IPCC) confirms in its 5th report that climate change due to human activities is aggravating the strong pressures already exerted by humans on ecosystems and species, thus leading us straight to the sixth species extinction crisis. Cameroon is characterized by great variability, whether in terms of climate, ecosystems or biological diversity. This is why it is often referred to as Africa in miniature and because of this biological diversity it is widely exposed to the impacts of climate change [2]. Aware of this phenomenon, the State of Cameroon has adhered to the United Nations Framework Convention on Climate Change (UNFCCC) and regularly participates in international climate negotiations [7]. The Conference of the Parties (COP) has established that in the face of climate change, all Mem-

ber States must combine two types of action: the reduction of greenhouse gas emissions and the adaptation of societies to climate change that is now inevitable in order to limit its damage [7]. At the 26th meeting in Glasgow, UK, parties took stock of progress towards the Paris Agreement goal of keeping global warming below 2°C and pursuing action to limit it to 1.5°C.

As part of the implementation of the policy for conservation and the fight against climate change, the Cameroonian government has set up an important network of protected areas, including the Bouba-Ndjidda National Park. Unfortunately, this Protected Area (PA) of the country faces multifaceted pressures and continues to deteriorate due to the advance of extreme climatic conditions and several anthropogenic activities taking place there (deforestation, bush fires, misuse of chemical pesticides) [8]. Hence the need to implement an approach for the sustainable management of its natural resources and the preservation of its biodiversity, while placing particular emphasis on the lifestyles of local populations compatible with extreme climatic conditions as well as their adaptation to climate change. A similar study on Climate change perception and local adaptation of natural resource management in a farming community of Cameroon: A case study was done in the Ntui Department, which is a forest area [9]. Except that this study did not take into account aspects related to wildlife. So far, no perception study has been done on indigenous knowledge in the sustainable use of natural resources, in Soudano-Sahelian area of Cameroon. This research will contribute to adjusting indigenous knowledge in the field of biodiversity conservation to the new climatic conditions experienced by indigenous populations. This will allow the Cameroonian government in the future to ensure sustainable management of the natural resources of this protected area. This study was therefore initiated with the main objective of contributing to documenting and popularizing the knowledge and know-how of the local populations of the Bouba-Ndjidda National Park in the field of the sustainable use of natural resources.

In this context, the following specific objectives have been set:

- Identify and describe the traditional knowledge of local and indigenous populations in the field of the conservation of natural resources;
- Identify ways of intergenerational transfer of indigenous know-how;
- Evaluate the perception of the populations bordering the PNB on the management of the Protected Area, the manifestations of climate change and the faunal species that have disappeared from the Protected Area.

2. Methodology

2.1. Study Area

The study area is located in the North Cameroon region, Mayo-Rey department (150 km south-east of Garoua, capital of the North Cameroon region) with an area of 36,865 km², subdivided into four districts and municipalities namely: Tcholliré, Madingring, Rey-Bouba and Touboro. The study site (**Figure 1**) is

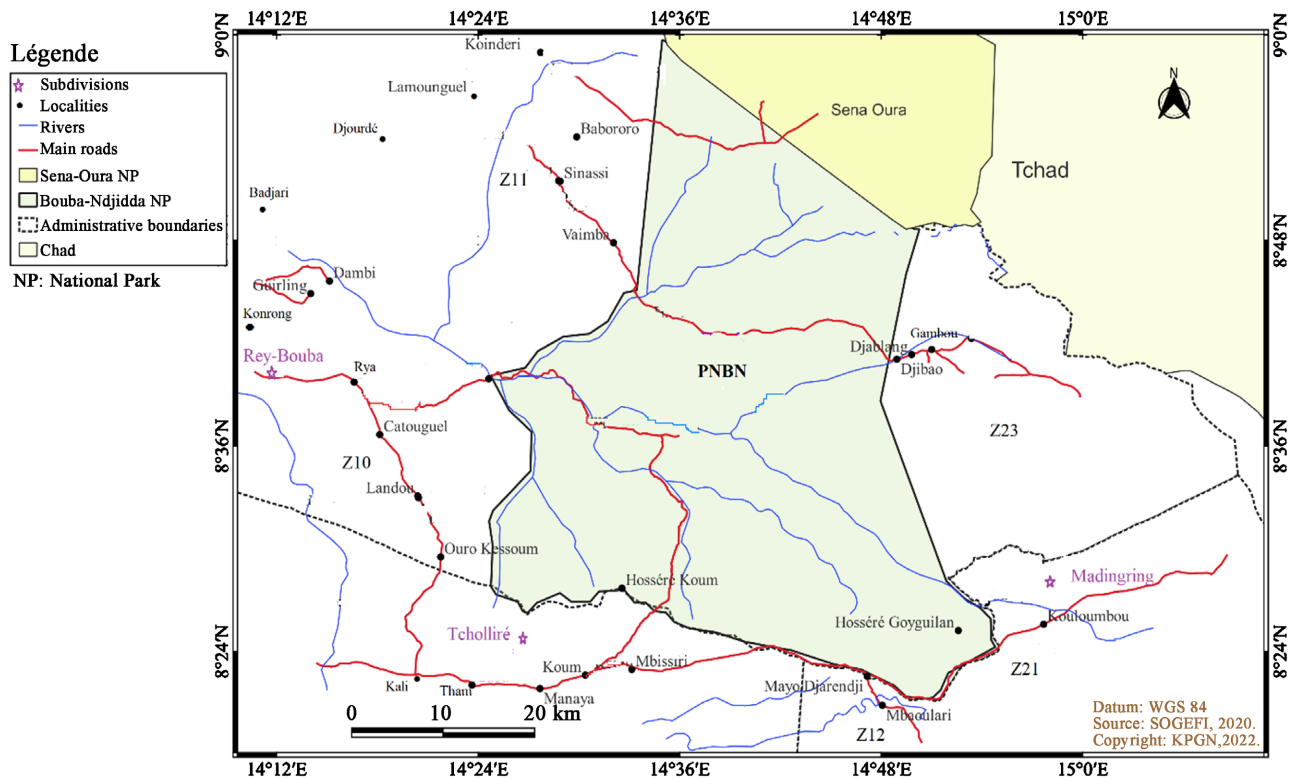


Figure 1. Map of the study area.

represented by the Bouba Ndjidda National Park (PNBN) and its peripheral zone, entirely located in the Mayo-Rey Division and straddling the districts of Rey Bouba, Tcholliré and Madingring.

The PNBN is located between 8°21' and 9°00' North latitude and between 14°25' and 14°55' East longitude [10]. Border by its northern limit to the National Park of Séna-Oura in Chad (created in 2010) with which it should eventually constitute the Binational Park of Séna-Oura-Bouba-Ndjidda. It was created in 1932 as a wildlife reserve and became a national park in 1968 (Order No. 120/SFDR of December 5, 1968). Bordered to the east by the line linking the Kouloumbou and Djibao villages, to the west by Mayo Vaïmba and to the south by the Koum-Madingring axis. The PNBN extends over an area of 220,000 ha, and is surrounded by 5 Areas of Hunting Interest (10, 11, 12, 21 and 23). This Park is part of the complex of protected areas in the North with the Bénoué biosphere reserve and the Faro national park. It was once the former hunting reserve of the Lamido de Rey-Bouba from which the name derives.

2.2. Data Collection

Data sources are divided into two types: primary data and so-called secondary data (compiled information related to climate variability, environment, biodiversity, natural resource management, and conservation). The primary data are those from household surveys in villages bordering the Bouba-Ndjidda National Park. For the collection of primary data, field visits were made. These field trips

enabled data to be collected through surveys and environmental observations. Both qualitative and quantitative data were collected directly on the field and through questionnaires. Data from secondary sources were collected from the Garoua Wildlife School, end-of-study reports, the PNBC management plan, publications of scientific articles.

Choice of villages and sample size

The choice of villages was made according to their proximity to the PNBC, the logistics necessary to access it, as well as the degree of relationship maintained between the local populations and the ecosystems of the park. We used the stratified random sampling method. Of the total of seventy (70) villages in the study area, 23 were selected to conduct the survey (**Table 1**) involving 368 households on 7699. To do this, we had a priori a map of the study area used for sampling planning. The unit of analysis used in our study is the household. The number of questionnaires administered per village depends on the highest population distribution rate of the three districts (Rey-Bouba, Tcholliré, Madintring). The sample size was determined at the 5% level of precision. The formula for calculating the sample size is as follows:

$$n = \frac{\frac{Z^2 Xp(1-p)}{e^2}}{1 + \left(\frac{Z^2 Xp(1-p)}{e^2 N} \right)}$$

where: n = size of the sample to be interviewed, $Z = 1.96$ (confidence level according to the reduced centered normal distribution), P = estimated proportion of the population which presents the desired characteristics (when unknown, we use $P = 0.5$), N = size of the population, $e = 0.05$ (range expressing the margin of error). The surveys of household heads were carried out gradually according to the localities defined on the sampling planning map. The studies were carried out first in the district of Rey-Bouba, then in the district of Tcholliré and finally in the district of Madintring. The technique used was direct interview with the head of household and focus groups for the production of participatory maps. At the start of each interview, the head of household was informed that their participation was completely voluntary and confidential. The interviews were done in the morning and in the evening when the people had finished going about their daily tasks.

The target population was sampled from different villages, based on factors

Table 1. Summary of the number of villages and households surveyed in the three districts.

Districts	Rey-Bouba	Tcholliré	Madingring	Total
Distribution (%)	62	16	22	100
Number of village	14	4	5	23
Number of households surveyed	224	64	80	368

such as the density of the population, the level of socio-ethnic heterogeneity (indigenous people and migrants), the diversity of activities, and the frequency of extreme climatic events. In each villages choose, the households were randomly selected, and the questionnaire was addressed to the head of household, 10 to 12 people were chosen to participate in a focus group organized by the village.

The members of this focus group were selected according to age (elderly, adults, and young people), gender (men and women), membership of user groups and farmers' organizations, hunting group, ethnic diversity, and the distribution between indigenous and settled migrants.

3. Data Analysis

The data was processed and analyzed using Microsoft Excel 2016 spread sheet, for the establishment of a raw database of results collected in the field, the production of graphs resulting from the descriptive analysis of the data. SPSS V20.0 and Past 4.03 softwares were used for data processing after analysis and coding of variables. Coding consists of assigning a code to each variable in the questionnaire in order to carry out a statistical analysis. The chi-square statistical tests made it possible to verify the significance of perception between the variables (significance level $P < 0.05$).

4. Results and Discussion

4.1. Socio-Economic Characteristics of Households

The people surveyed were made up of 93.7% men and 6.3% women, 41% are illiterate, 32.1% and 26.6% respectively followed a primary and secondary education. Agriculture is 70.7% the main income-generating activity in the locality (**Table 2**), followed by livestock (23.3%) and trade (6%). The people interviewed were mainly of Cameroonian nationality (89.9%) and a minority of Chadian nationality (10.1%). There are natives (77.2%) and non-natives (22.8%). A total of 17 ethnic groups have been identified, the most numerous being the Lamés, the Mboums and the Peuls.

4.2. Know-How in the Conservation of Natural Resources

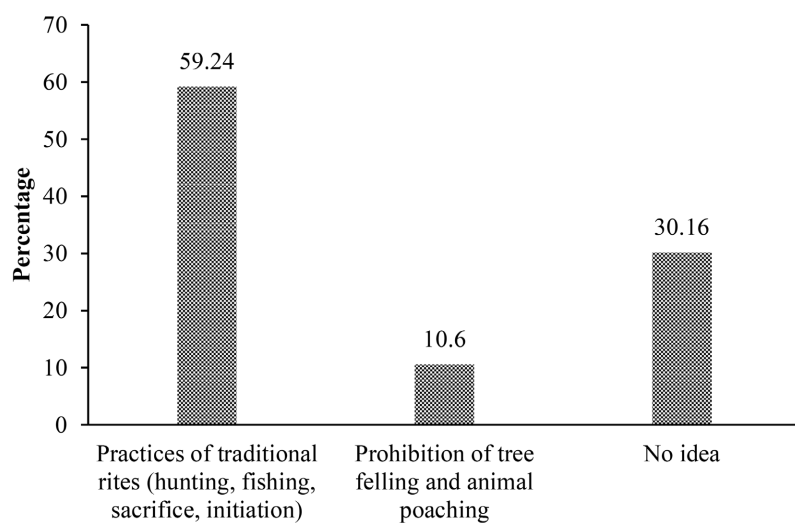
The know-how in the field of conservation is rooted in occultism through rituals and sacrifices offered to the geniuses of nature and the prohibition of felling of trees and sacred animals. It appears that the practice of traditional rites (traditional hunting, traditional fishing, animal sacrifices, traditional initiation) appear to be the most important with a perception threshold of 59.24%, followed by prohibitions on felling of trees and sacred animals (10.6%) (**Figure 2**).

The traditional rites here are religious or mystical activities practiced on animals or plants by the different ethnic groups in the study area, so that the Gods and ancestors watch over the community's resources.

Of the 368 heads of households interviewed, 111% or 30.16% say they have no idea about conservation practices (**Figure 2**). The statistical test ($\chi^2 = 198.4$; dof

Table 2. Main socio-economic characteristics of surveyed households.

Variables	Classification	Distribution (%)
Gender	Male	345 (93.7)
	Female	23 (6.3)
Ethnicity	Lamé	122 (33.2)
	Mboum	60 (16.3)
	Peul	55 (14.9)
	Autre	131 (35.6)
Education level	Primary	118 (32.1)
	Secondary	98 (26.6)
	Superior	1 (0.3)
	None (illiterate)	151 (41)
Age	18 - 30	49 (13)
	31 - 45	147 (40)
	46 - 60	92 (25)
	>60	80 (22)
Main activities	Agriculture	260 (70.7)
	Animal husbandry	86 (23.3)
	Trade	22 (6)
Nationality	Cameroonian	331 (89.9)
	Chadian	37 (10.1)
Residence	Aboriginal	284 (77.2)
	Allogenic	84 (22.8)

**Figure 2.** Perception of indigenous practices contributing to the conservation of natural resources.

= 2; $P = 8.2814E-44$) shows a significant difference at the threshold of 0.05. This means that the populations of Bouba-Ndjidda do not have the same vision of the indigenous practices contributing to the conservation of the natural resources of their localities.

Understanding the state of mind that underlies the management of the environment in general and of the biodiversity in particular of the local populations of the Bouba-Ndjidda National Park is the greatest challenge for our study. The survey carried out made it possible to collect several cultural heritages considered by the local populations as part of the indigenous knowledge of the preservation of natural resources. Knowledge in the field of conservation is rooted in occultism through rituals and sacrifices offered to the geniuses of nature and the prohibition of the felling of trees and sacred animals. Concretely, each custom present around the park determines a period during which traditional rites (hunting, fishing, and animal sacrifice) are practiced for religious purposes or intended to solve societal problems or problems related to climatic disturbances.

Among the Lamé, traditional hunting takes place every year in November. It consists of bringing together all the men from the Lamé villages (Djibao, Djablang, Gambou, Vaimba, Sinassi, Babororo, Koinderi, Lammouguel) to go into the bush to the sacred places called “Djou” to practice hunting there. During this traditional ceremony, animals such as antelopes and hedgehogs are hunted to make sacrifices to the ancestors. The legs of the hippotrague are the parts solicited for the ritual; the skin is used for the sacred drum of the village of which the village chief is the guarantor. These sacrifices offered to the ancestors mark the price to be paid so that the gods of the ancestors take care of the well-being of the entire community (in terms of health, agriculture, livestock, rainfall, multiplication of wild and domestic fauna). Similarly, the practice of traditional fishing among the Lamé each year at the start of the rainy seasons (May – June) in the sacred Mayo called “Yahadgaou” is an essential rite for maintaining social stability. In the absence of this rite misfortunes such as the absence of rains, loss of human and animal life (wild and domestic) without cause will befall the village.

Among the Mboums, animal sacrifices are offered to the gods in case of late rain or misfortune (epidemic of disease, reduction in game, deaths without cause, etc.). The land chief (“Gpol toussiba”) who is the guarantor, offers animal sacrifices (Cops, guinea fowl, goat) on a sacred altar called “Gpol gbana” which is accessible only to him. Similarly, traditional fishing among the Mboum is practiced when the rain is slow to set in, the leaders summon all the inhabitants of the village to go to the sacred lake (the “Voïtikla” lake) to practice fishing there in order to summon the rain. This practice is very effective and is treasured today in this locality. These results obtained from populations living near the BNNP are similar to those reported by in North-Cameroon which stipulates that the traditional rites among the Duupa aim at the control of the elements of nature such as: rain, the multiplication of game, the production of cultivated plants

or even concerning phenomena such as famine and dead [11].

Respect for customary prohibitions such as the ban on the felling of certain sacred trees (baobab, fig, tamarind, shea, etc.) implies a traditional strategy favourable to the conservation of flora and fauna in these localities. These results are similar to those obtained in Burkina Faso on cultural practices, safeguarding and conservation of biodiversity [12]. In the Mboum tradition, for example, the *Colobus guereza* represents the traditional totem. During traditional ceremonies and dances, only initiates are allowed to tie the skin of this animal around their waist. The fact that this animal occupies a sacred place in the Mboum tradition, gives it special protection within the community and therefore a reason for the conservation of the said species for the community. The sacred animals considered as totem in the localities of Bouba-Ndjidda are among others: the Eland of Derby, the Hartebeest, the Leopard, the Lion. These animals are patronized by traditions because it is forbidden to slaughter them and consume them at the risk of attracting misfortune within the community.

4.3. Ways of Intergenerational Transfer of Indigenous Knowledge

Regarding the transmission channels of know-how within the communities, four channels were listed, namely: transmission from father to son, from mother to daughter, from elders to young people and finally transmission by the intra-family channel (between the different relatives of the family) (Figure 3).

This study shows that fathers (33.1%) are more perceived as transmitters of knowledge than mothers (14.9%). A highly significant difference ($\chi^2 = 143.27$; dof = 2; $P = 7.7326E-32$) is highlighted in the perception of intergenerational transfer pathways within the populations surveyed. The transmission of intra-family know-how (31.1%) is based on parental relationships and takes place between close relatives (uncles, aunts, cousins and grandparents). Beyond the knowledge provided to the child by his own parents (father and mother), close relatives also contribute to the inclusion of the know-how received from the ancestors and witches, which can be knowledge (in the fields of black magic, hunting,

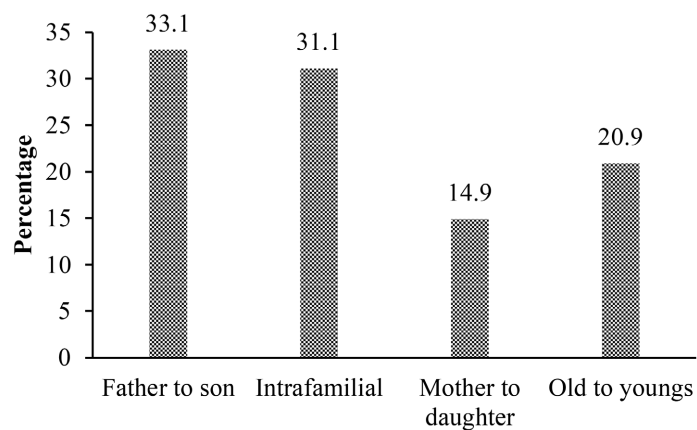


Figure 3. Perception of the populations on the ways of intergenerational transfer of indigenous knowledge.

traditional medicine, crafts etc.) particularly kept within the family. The knowledge transmitted from elders to young people (20.9%) requires a more or less long initiation time. This knowledge transmitted from generation to generation through initiation is perceived as being secret and should not be delivered to the uninitiated. The initiates are therefore responsible for guarding them very jealously.

The transmission of know-how within the communities can be done from father to son, from mother to daughter, from elders to young people and through the intra-family route. The choice of children to whom we want to transmit knowledge is based on the attention that they pay to the knowledge of the parents and the respect that they show towards them. In most cases, the knowledge received from the elders requires a more or less long initiation time (one to two months) depending on the ethnicity. Initiation ceremonies are organized every year and constitute privileged moments during which those who undergo initiation (the younger generations) learn about the rules and values essential to the well-being of the community. Initiation sessions and traditional rites take place on sacred sites and represent real schools of intergenerational transfer of traditional knowledge. These means of knowledge transfer are consistent with those reported on “the modes of transmission of technical knowledge in Africa” relating that the transmission of know-how can be done from father to son or from mother to daughter [13]. The modes of transmission of knowledge were grouped into two large complementary groups: the sacred or initiatory modes where the transmission of know-how is magical, mythical, mystical and irrational and the profane modes of transmission which do not present a mystical character and of which, the dissemination of its knowledge (healers, potters, weavers) would make it possible to relatively improve the standard of living of the community [13].

In Morocco, two strategies were revealed for transmitting local know-how to young people: on the one hand, the practical strategy provided by peasants well trained in agriculture and by “maâlems” in traditional masonry, and on the other part of the theoretical strategy through technocrats particular to the fields concerned [14]. Similarly, it emerges from our study that the local populations of the periphery of the Bouba-Ndjidda National Park devote themselves mainly (43.50%) to the practical strategy of transmission of know-how. According to the heads of the households surveyed, practical learning would be more effective and better assimilated, unlike theoretical learning (26.90%). Moreover, traditional education also accounts for 29.60% in the process of transmitting knowledge, because in the eyes of the elders, not all young people are eligible to keep the secrets of tradition. Indeed, education is part of the sinequanone conditions for a parent with specific knowledge (mysticism, crafts, local medicine, hunting, forging, etc.) to agree to transmit them to offspring. Otherwise, the wise prefer to die with their skills.

4.4. Perception of Local Residents on the Management and the Current State of the Natural Resources of the BNNP

The majority of the local population (59.78%) believe that the Park is effectively

managed by the BNNP conservation services and that this management is good (Figure 4). On the other hand, very few people (4.10%) attested that the Protected Area is badly managed and therefore all the biodiversity in the region. From the perspective of local indigenous people, the work of protecting and conserving natural resources also requires collaboration with local populations. According to them, the best way to manage the natural resources of the park would be through respect for the traditional rites and values of the indigenous peoples. The natives pointed out that the main causes of the current degradation of natural resources would result from the anger of the gods following the marked absence in recent years of rituals or traditional ceremonies in the sacred places located within the protected area. Data analysis showed a very significant difference ($\chi^2 = 622.79$, $ddl = 5$ and $P = 2.4096E-132$) in the perception of local populations on the effectiveness of the management of Bouba-Ndjidda National Park.

With regard to the perception of the state of natural resources by the populations bordering the park, the people interviewed (50.80%) attest that the resources have been constantly increasing for the last ten years (Table 3), particularly for the fauna (33.00%). Resources such as flora (38.80), pharmacopoeia (15.90%), non-timber forest products (7.70%) and water (4.60%) are perceived as being in decline in the riverside villages.

Statistical analysis showed a highly significant difference ($\chi^2 = 345.1$; $dof = 3$; $P = 1.7153E-74$) on the perception of the state of natural resources and products

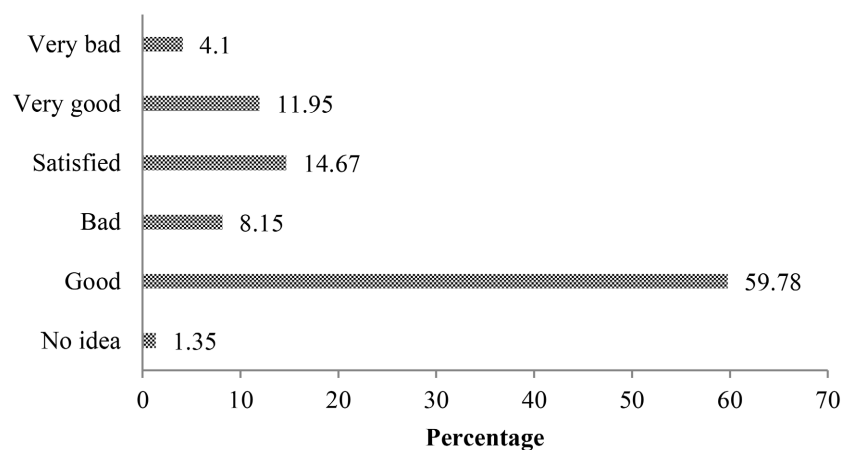


Figure 4. Perception of local residents on the effectiveness of BNNP management.

Table 3. Perception of the state of the park's natural resources by local populations.

	Perception	Distribution
Answers	Increase	187 (50.8%)
	Decreases	147 (39.9%)
	Stable	33 (9%)
	No idea	1 (0.3%)

related to the evaluation ($\chi^2 = 463.58$; dof = 3; $P = 3.7208E-100$). The populations of Bouba-Ndjidda significantly perceive the increase, decrease or stability of natural resources (plants, animals, pharmacopoeia, non-timber forest products, water) in and around the protected area.

The vision of the local populations on how to manage the PNBPN suggests at first sight a good perception of the management of the natural resources of the park, this because they notice the intense activity of the eco-guards and the military in the fight against poaching, within the territory of the protected area. This is also the reason why half of the people interviewed (50.80%) attest that resources (particularly for wildlife (33.00%) have been constantly increasing for the past ten years. The descriptive analysis gives an average of 6.51/10 reflecting the degree of current improvement of the natural resources of the PNBPN according to the local populations. These findings go in the opposite direction to that of those which points out that the general trend of the wildlife potential of this park is downward [15]. On the other hand, the densities obtained suggest that the Bouba-Ndjidda National Park is the most important in the region from the point of view of biodiversity [16].

In addition, some indigenous people point to a lack of conservation services because they do not take into account traditional or spiritual values and the participation of indigenous peoples in decision-making in the management of the PA. This aspect shows that the effective involvement of local populations in the management of this protected area is often not achieved.

4.5. Perception of the Manifestations of Climate Change

The main perception of the manifestations of climate change (Figure 5) by the local peoples of the BNNP refers to a recent evolution of the order of ten years. The answers collected following an open question from the heads of households refer to the variations of the seasons (97.60%), the increase in temperature (84.80%), the shortening of the rainy season (54.60%), the drop in agricultural yield (84.80%) and flooding (74.70%). Statistical analysis showed a significant difference ($\chi^2 = 229.37$; ddl = 4; $P = 1.8055E-48$) in the perception of local residents

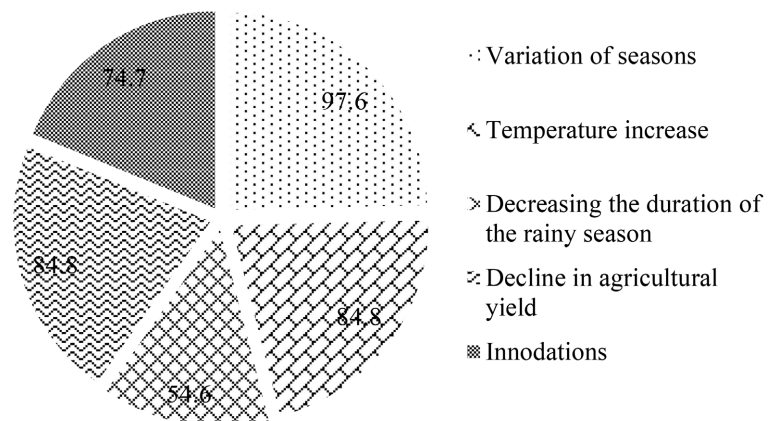


Figure 5. Indigenous perceptions of climate change manifestations.

to climate change, demonstrating that the populations of Bouba-Ndjidda have a more or less clear of the manifestations of climate change within their localities.

The natives perceive climate change over the past ten years through the variations of the seasons (97.60%), the more or less increase in temperature (84.80%) each year, the shortening of the rainy seasons (54.60%), the decline in agricultural yield (84.80%) and frequent flooding (74.70%). These climatic changes are pushing people of the study area to rearrange their agricultural calendar and to adopt the cultivation of early varieties (cowpea, maize, millet, peanuts, soybeans) with improved high-yielding, short-cycle varieties. Similar results were obtained in the locality of Ntui, Central Region (Cameroon) on cultural adaptations linked to climate change [9]. The main causes attributed by the natives to these natural phenomena are: non-respect of rites and traditions, deforestation, but also divine will. These results are in agreement with those who confirms farmers' perceptions according to which climate change is manifested through the drop in rainfall, the decrease in the number of days of precipitation, the scarcity or fairly rapid disappearance of rainy seasons, flood and more intense and oppressive heat [17]. Our results are similar to those done in South-East Benin which reports that the causes of climate change are linked to local norms and beliefs [18]. These causes have as explanations the non-respect of rituals and social norms, the non-respect of deities, the occult practices of cloud neutralization and deforestation.

4.6. Perception of Wildlife Species that Have Disappeared from the BNNP

Almost all the inhabitants around the park perceive more the disappearance of the rhinoceros (99.40%) and the wild dog (94.90%), while few people are informed of the disappearance of the cheetah (44.60%) and ostrich (26.00%) in the park (Figure 6). Only the oldest of the interviewees attest to having had the privilege of seeing the rhinoceros, the cheetah and the ostrich. According to them, the rhinoceros and the cheetah would have disappeared about forty years ago and the wild dog, about ten years. Only two old men interviewed aged 95 and 99 were able to estimate the disappearance of the ostrich in the localities of

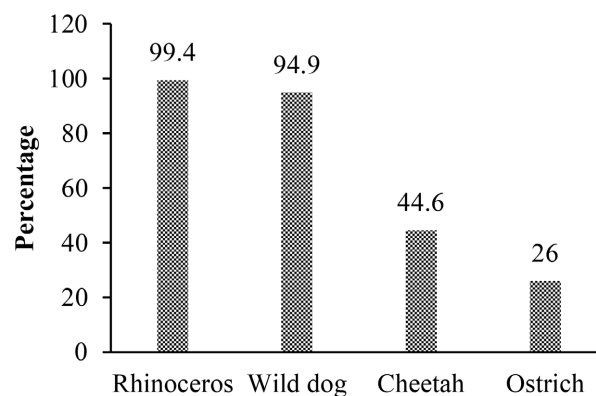


Figure 6. Perception of the populations on the animal species that have disappeared from the BNNP.

Bouba-Ndjidda at more than eighty years. Statistical analysis showed a significant difference ($\chi^2 = 590.89$; dof = 3; $P = 9.5123E-128$) in the perception of the populations on the species that disappeared from BNNP.

The alarming consequence of human activities on wildlife in the Park is the disappearance of certain animal species. According to the comments collected from local natives, these animal species that have disappeared in the PNB are: the black rhinoceros (*Diceros bicornis*), the wild dog (*Lycaon pictus*), the cheetah (*Acinonyx jubatus*) and the ostrich (*Struthio camelus*), while in the neighboring Benoue National Park (PNB), it was reported that certain species of carnivores such as the wild dog (*Lycaon pictus*) and the panther (*Panthera pardus*) are becoming rare, but the black rhinoceros (*Diceros bicornis*) was eliminated from BNP [19]. The Rhinoceros was highly sought after for its therapeutic horns (powerful aphrodisiac), the African Dog hunted for its flesh, the Cheetah for its skin (symbol of power) and the Ostrich for its fat playing several roles in traditional medicine. The local populations mention as the main causes of the disappearance of wildlife in these localities: commercial poaching by the natives and poachers from other neighboring countries (Chad, Sudan). Poaching is done either by homemade weapons, locally called “Gandhal”, or by poisoning animals with chemicals, or using traditional traps. The intense activities of transhumant herders camping in and around the protected area have scared and dispersed wild animals away from their natural habitats. This is why many local leaders point out that the activities of the shepherds have influenced the disappearance of the Black Rhinoceros in the locality because of their strong sensitivity to human presence. The lack of practice of traditional rites in the sacred sites of the park is also mentioned by the natives as being part of the causes of the disappearance of certain animals from the park following the anger of the deities of the environment.

Although the main cause of wildlife extinction is commercial poaching, habitat degradation plays an important role in it. Indeed, the villagers claim that the impact of climate change on agricultural yield (decline in agricultural yield) and their way of life (adaptation to climate change) pushes them on the one hand to practice commercial poaching in order to provide for certain financial and nutritional needs, on the other hand, they are forced to increase their field surfaces in order to maximize the harvest and boost agricultural yields. These practices undoubtedly contribute to the degradation of natural habitats and the loss of biodiversity in the region. These results prove that local people are well aware of the conditions and factors that cause biodiversity loss. The increasing use of chemicals (pesticides, fertilizers) in the fields would also be one of the causes of the alteration of terrestrial and aquatic ecosystems near cultivation areas. Also the loss of the natural habitat by the establishment of many hamlets around the park is also perceived as probable causes of dispersal of wildlife.

4.7. Limitations of the Study

The main results emerging from this study allow us to affirm that the indigenous

knowledge and lifestyles of the populations bordering the Bouba-Ndjidda national park promote the conservation and sustainable management of natural resources, and adaptation strategies to climatic changes developed, depend on the level of indigenous perception of climatic disturbances. These strategies, although innovative, still have their limits and their impacts on the sustainable management of the natural resources of the protected area. Indigenous biodiversity conservation practices should be evaluated on their relevance with regard to their probable or proven impacts on the natural environment. Likewise, indigenous methods of seasonal forecasting should be elucidated and their positive impacts on park resources.

5. Conclusion

This study is part of the management of wildlife and protected areas and has enabled us to document and popularize the knowledge and know-how of the local populations of Bouba-Ndjidda National Park in the field of sustainable use of natural resources. The results of this study show a difference in perception of indigenous knowledge in the field of conservation and this knowledge is mainly based on occult practices and customary prohibitions such as: hunting tradition, traditional fishing, animal sacrifices, traditional initiation and prohibitions on the felling of trees and sacred animals. The ways of intergenerational transfer of indigenous know-how are perceived differently in the neighboring villages and is done from father to son, from mother to daughter, from elders to young people and through the intra-family route. There is a strong dissimilarity in the perception of the local populations on the management of the park, as well as on the manifestations of climate change and the faunal species that have disappeared from the PNB such as the Rhinoceros, the Cheetah, the wild dog and the Ostrich. The populations of Bouba-Ndjidda, based on their endogenous know-how transmitted from generation to generation, have also developed strategies to adapt to these climatic upheavals. These strategies, although innovative, still have their limits and their impacts on the sustainable management of the natural resources of the protected area. The involvement of local leaders in decision-making will further motivate them to put their indigenous know-how at the service of park conservation. In addition, awareness and information campaigns for local populations on the importance of the protected area must be set up in the villages bordering the BNNP.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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