

ANTHROPIZATION OF GOROUBI FOREST RESERVE (GFR) IN NORTH BENIN, WEST AFRICA

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ABSTRACT

The Goroubi forest reserve (GFR) is under pressure leading to its extinction. This research aims to contribute to the restoration plans of the said forest in the district of Birni-Lafia in north Benin. In order to achieve this, questionnaire surveys and interviews were conducted with 79 people through random sampling in all of the villages of the district. The importance value index (IVI) of the pressures and the response rate were calculated. Mainly occupied by the rônier (*Borassus aethiopum*) originally, the GFR is particularly threatened by agriculture (IVI = 1), illegal exploitation (IVI = 0.94), grazing (IVI = 0.64), hunting (IVI = 0.51) and herbal medicine (IVI = 0.36). These pressures cause the disappearance of plant species (100 %), animal species (94 %), land degradation (89 %), etc. Today, the dominant occupation unit is a rice growing area with 327.7598 ha of cultivated territory. Therefore, it seems that the GFR is losing its forest identity. It is necessary to create new participatory management plan for the forest, initiate reforestation activities, set up a fixed co-management committee for the forest and create annual reports on the state of management of its resources in order to limit these pressures.

Keywords: Goroubi forest reserve, rice growing area, extinction, restoration, northern Benin

INTRODUCTION

Forests are useful and valuable ecosystems for humanity. They have a crucial function in regulating the greenhouse effect for the major climatic balances and in the lives of many poor populations on earth, and constitute a large reservoir of biodiversity on the planet [1]. But ever-growing societal needs and the trend towards urbanization lead to pressure on

natural resources [2, 3]. Today, with demographic growth and the growing economic needs of populations, the pressure on resources is increasing with an accelerated exploitation of flora and fauna resources, which leads to the degradation of the entire environment [4]. In the cotton basin of Benin, a quantitative analysis of land cover dynamics indicates that forest land use systems (gallery forests and riparian formations, dense dry

forests, wooded savannahs and shrublands, open forests and wooded savannahs) are being changed to anthropogenic systems (fields and fallows, plantations and dwellings) [5]. In fact, agriculture in its various forms, such as clearing, the exploitation of gallery forests for various crops, is the most destructive activity in forests and rapidly contributes to environmental degradation [6]. If, instead of clearing fallow land, undergrowth is cleared, there are adverse effects for forest conservation and biodiversity [7].

Therefore, protection and restoration of ecosystems seems to be the main concern of states and development agencies [8], because the use of natural resources by man is not necessarily the equivalent to their destruction. Indeed, the survival of man from the beginning has been conditioned by his ability to exploit the resources that provide him with food, shelter and energy. In the Commune of Karimama, more specifically in the Birni-Lafia district, agricultural activities and the

excessive use of wood for various purposes have caused the Goroubi forest reserve (GFR) to lose its forest identity. However, if it is man's right to use the natural resources of ecosystems to meet his needs, it is also his duty to protect these resources. Proceeding from this, this research is a contribution to the restoration of the GFR in the Birni-Lafia district (Commune of Karimama) in Northern Benin.

Study area

The Goroubi forest reserve is located between N11°54'51" and 11°56'49" and E3°15'23" and 3°16'17". It is located in the Birni-Lafia district, which is one of the districts of the Commune of Karimama. The GFR is under the forest management of Goun-Goun in the Guéné district (Commune of Malanville). Figure 1 shows the geographical location of the GFR.

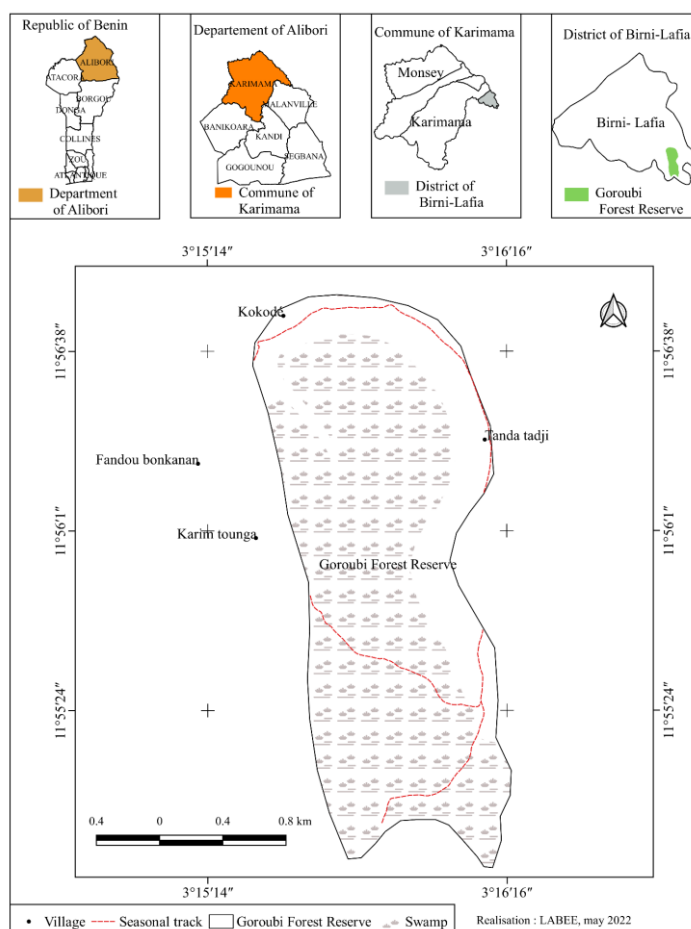


Figure 1. Geographical location of the Goroubi forest reserve

MATERIALS AND METHODS

Sampling

The GFR covers only part of the Birni-Lafia district. The local population of all villages was surveyed randomly. The Birni-Lafia district has 17,332 inhabitants [9]. The formula of B. Marien and JP. Beaud [10] was used to determine the sample size:

$$T = \frac{N \times 400}{N + 400} = 391 \quad (1)$$

where is: T - sample size, N - total population size. A sampling rate of 20 % was applied to this size. Thus, T is equivalent to 79 respondents. These respondents include various stakeholders, such as farmers, breeders/transhumant, operators, herbalists, and hunters. In addition, interviews were conducted with forest agents, local elected officials and resource persons (traditional chiefs).

Data collection and processing

The interviews were carried out using a questionnaire and a maintenance guide. The first data collecting took place in May 2019 and March 2020, conducting a complementary survey. During the surveys, questions were asked about pressures, the condition of land cover and the restoration measure of the GFR.

After the surveys, a database was created. Then the importance value index (IVI) was calculated using the following formula:

$$IVI = \frac{pm}{pt} \implies IVI \in [0 ; n] \quad (2)$$

where is: IVI - importance value index, pm - range of a pressure, pt - total range of pressures on the forest and n - total number of modalities. The IVI expresses the intensity of a pressure on the forest. As for the response rate, it was determined by the following formula:

$$Tr = \frac{S}{N} \cdot 100 \quad (3)$$

where is: Tr - respondent response rate (%), S - number of people who gave an answer in relation to the given modality and N - total number of interviewed people. These parameters made it possible to create the graphic representations using R 4.2 software.

RESULTS AND DISCUSSION

Population perceptions of the pressures on the Goroubi forest reserve

The GFR was a territory mainly occupied by the rônier (*Borassus aethiopum*). According to all respondents (100 %), it is a swamp area that has been demarcated and classified by the State, in order to protect the forest with purpose of preserving its biodiversity and ecological values. It is placed under the forest management of Goun-Goun (Commune of Malanville), which should ensure its proper management. The forest does not have standing maintenance officers. So, when it is necessary to carry out activities in the forest, the management employs temporary workers, and after the activities have been completed, the group is dissolved. However, with population growth, some human activities are developed to meet human needs. These activities are related to agriculture (IVI = 1), illegal exploitation (IVI = 0.94), grazing (IVI = 0.64), hunting (IVI = 0.51) and the removal of parts of some plants for medicinal purposes (IVI = 0.36) and represent different pressures on the forest today (Figure 2). From the surveys, 91.49 % claim that the GFR is freely accessible to everyone. Indeed, the latter declare that when the forest management agents come to the forest, the populations abandons their activities and is no longer in danger of punishment.

Agriculture

Agricultural activities are developed by the local populations of GFR to meet their needs. But it represents the main pressure on forest resources with a maximum IVI (1). Indeed, the

population grows food crops and mercantile crops, such as maize (*Zea mays*), yam (*Dioscorea alata*), cotton (*Gossypium hirsutum*), and especially rice (*Oryza sativa*) in the forest. Furthermore, *D. alata* is a heliophilous plant and needs sufficient sunlight, which leads producers to cut down other plant species. The felling of trees and the expansion of arable land contribute to the loss of biodiversity. Agriculture has greatly contributed to the conversion of the forest into a rice growing area.

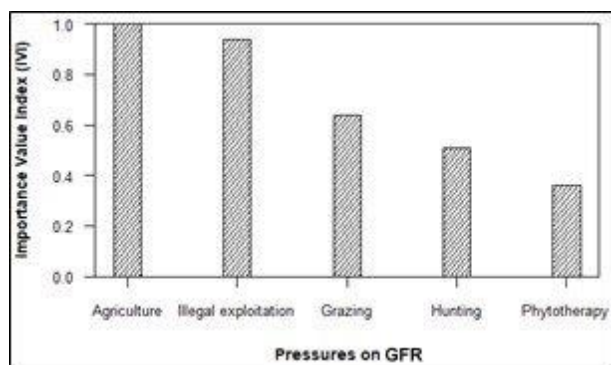


Figure 2. Pressures on the Goroubi forest reserve

Illegal exploitation

Illegal exploitation of the GFR has an importance value index of 0.94 and therefore contributes to the degradation of the vegetation cover. This activity is the basis for the complete conversion of the GFR's open forest and wooded savannah. Indeed, the management is located in another commune (Malanville) and the foresters only make rare visits. So, the populations exploit the resources to their need. Some of the species used are: *Azalia africana*, *Khaya senegalensis*, *Isberlinia doka*, *Isberlinia tomentosa*, *Pterocarpus erinaceus*, *Prosopis africana*, etc. Unfortunately, most of these species are recognized as threatened species and included in the Red List of the International Union for the Conservation of Nature (IUCN).

Grazing

Grazing is an activity practiced by both transhumant Peuls and local populations and contributes to the loss of biodiversity with an IVI of 0.64. In addition to the natives, transhumant Peuls from neighbouring countries (Niger, Mali, etc.) pass through the Commune of Karimama with their cattle to reach southern Benin. The animal grazing and trampling is a limiting factor in the natural regeneration of plant species.

Hunting

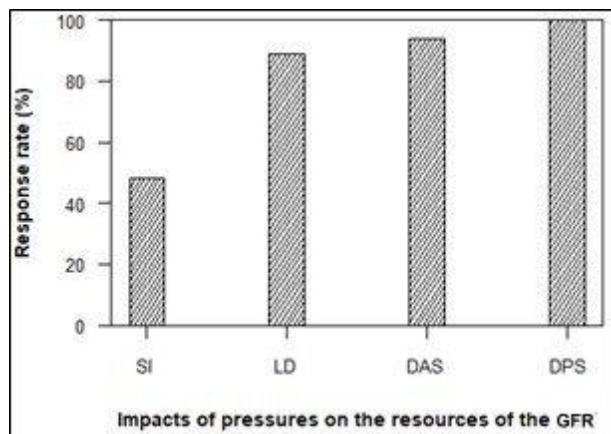
Hunting is also a form of pressure identified in GFR. In the dry and rainy seasons, hunters pass through the forest to exploit animal resources. It contributes to the degradation of vegetation cover with an IVI of 0.51. Hunters most often pass unarmed and unnoticed through the forest in order to initiate the burning of the forest. After the fire spreads, they go in the opposite direction to hunt animals fleeing from the fire. In addition, after the passage of the fire, they pass through the burned areas to dig up the habitats of rodents and reptiles. The consequence of this activity is the loss of biodiversity.

Phytotherapy

Phytotherapy represents another form of pressure on the resources of the GFR. Indeed, since the population is mostly poor, the inhabitants bordering the GFR go there for non-timber forest products (bark, stems, roots, leaves, etc.) to treat disease in traditional way. Some of the species used are: *Vitellaria paradoxa*, *K. senegalensis*, *B. aethiopum*, and *Isberlinia* sp. The stems of young species are used to make vegetable brushes, especially by producers who collect them daily on the way to farm.

Otherwise, the identified pressures (agriculture, illegal exploitation, grazing, hunting and phytotherapy) have consequences such as disappearance of plants (100 %) and

animal (94 %) species, the degradation of land (89 %) and soil infertility (48 %) (Figure 3).



DPS - disappearance of plant species, DAS - disappearance of animal species, LD - land degradation, SI - soil infertility

Figure 3. Impacts of pressures on the resources of the Goroubi forest reserve

The pressures identified in the GFR significantly changed the structure and the floristic composition of the plant formations and therefore affected the land use of the said forest. Therefore, the mosaics of farms and fallows, the rice growing area and the swamps are the occupation units of the forest. The rice growing area is the most dominant (327.7598 ha) with a share of 81.39 %. The savannah unit is the least represented with 1.11 % of the total share. Therefore, the GFR seems to be losing its forest identity, giving way to an agricultural area.

Restoration and conservation measures for the Goroubi forest reserve

Faced with the effects of the multiple pressures identified in Birni-Lafia district on the GFR, certain measures are suggested below. They are made for local populations, forest administration and local elected officials.

Suggestions for the local population

To protect and preserve the GFR, the local populations in particular must:

- avoid the destruction of woody flora during the performance of anthropogenic activities,
- avoid charcoal production near the forest to protect wildlife habitats,
- form village groups to take over tree nursery activities.

Suggestions to the forest administration and local elected officials

The main decisions and actions for the protection, restoration and conservation of the GFR resources belong to these stakeholders. Therefore, they must:

- raise public awareness of the risks to the forest environment through the practice of anthropogenic activities,
- develop a new forest management plan with the participation of local population,
- ensure compliance with the laws governing the GFR,
- sensitize the populations living near the GFR to participate in the maintenance work,
- establish information, education and communication systems to ensure rational and long-term use of plant resources,
- prepare annual reports on the state of management of GFR resources,
- encourage income-generating activities that contribute to the preservation of plant cover, such as the nursery, silvicultural treatments, etc.,
- make a list of hunters in order to create a hunting calendar and provide each hunter with a hunting license and a list of the animal species that he can hunt,
- establish a management committee for grazing areas and corridors in the district,
- carry out an inventory and count, in cooperation with all involved actors, of all endangered plant and animal resources in order to establish a system for the conservation and restoration of these resources.

Discussion

From the conducted survey, it is evident that the GFR is significantly threatened by main pressures, namely agriculture, illegal exploitation, grazing, hunting and phytotherapy. All these pressures are anthropogenic and are the basis of the degradation of forest ecosystems. Some recent scientific works had already identified these pressures and concluded that they threatened the biodiversity of Abomey reforestation perimeter and Ouémé-Boukou classified forest [3, 11]. For Toko Imorou *et al.* [12], agriculture, logging and carbonization are the three main degradation factors of the Upper Alibori Classified Forest (FCAS).

In the GFR, these pressures caused the disappearance of animal and plant species, land degradation, the soil infertility, etc. The use of chemical products (herbicides, insecticides and fungicides) for the expansion of plantations suppresses the natural regeneration of plant species, reduces animal diversity and denatures the soil. For Tenté [13], farming and pastoral practices are the basis of soil degradation and the reduction of vegetation cover in the Atchérigbé classified forest. Similarly, the use of plant resources has serious negative impacts on the Bahazoun forest in the Commune of Abomey-Calavi with threats to the survival of dependent populations [14]. The evolution of these pressures in the GFR is mainly related to the absence of forest agents in this forest. Indeed, the forest management of the GFR is located in the Commune of Malanville and forest agents visits to the forest are almost non-existent.

In order to restore Goroubi's forest identity, this research proposes the prohibition of any activity that could affect the balance of biodiversity within the borders of the GFR and the creation of annual reports on the state of management of the GFR. For Toko Imorou *et al.* [12], the development of a participatory management plan seems to be the most appropriate solution for the restoration of the Upper Alibori classified forest. In addition, improving the living conditions of the

populations proved to be crucial in the process of reducing the pressures on the forest resources [11].

CONCLUSION

This research is a contribution to the restoration plans of the GFR in northern Benin. At the end of the field surveys, five pressure factors were identified. This includes the destruction of vegetation to extend arable land and increase production. Therefore, these activities contribute to the loss of biological diversity, land degradation and soil infertility. The local population of GFR is very connected to its resources. Now the GFR has been converted into a rice-growing area and, if nothing is done, it is in danger of disappearing completely. Therefore, it is suggested to the competent authorities to prohibit the performance of any activity that could affect the balance of biodiversity within the borders of the GFR and to prepare annual reports on the state of management of the forest resources. In addition, it is a necessary to create a new forest management plan with the participation of the local population and involve them in the resource management process.

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