



## Problem of Management of Agro-biodiversity of riparian lands in the Nimba Mountains Biosphere Reserve – Republic of Guinea

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### Abstract

This work aims to evaluate the state of management of Agro-Biodiversities used by local populations in the Nimba Mountains Biosphere Reserve. Survey sheets, bibliographic consultations, socio-economic surveys of agro-biodiversities and field investigations are the materials and methods used in this work. This allowed us to identify 35 species grouped into 23 families including 5 poaceae followed by the solanaceae family (3) and Agro-Biodiversities with high economic value including 4 species retained (Musa sisensis, Theobroma cacao, coffea arabica, and Oriva sativa). Agriculture (48%), trade (18%), logging (10%), honey extraction (8%), livestock breeding (12%) and hunting (4%) are activities carried out in these areas. In addition, knowledge of the species commonly used in food (Oriva sativa, Manihot utissima and Zea mays (L)), the pharmacopoeia (Coffee, Ginger, Kola) as well as in marketing (Banana, Corn, Cocoa, etc.) are the main assets of agro-biodiversity in these areas.

**Keywords:** Problems, management, agro-biodiversity, riparian areas, Biosphere Reserve, Nimba Mountains.

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### 1. Introduction

Sustainable natural resource management and biological diversity are essential for humanity's economic and social development. Natural resources provide essential goods and services for life and are the basis of human aspirations, while allowing societies to adapt to changing needs and circumstances (Abou Chabi *et al.* 2003; Francis *et al.* 2003; Duru *et al.* 2015; Agbossou *et al.* 2003; Trabelsi, 2017).

The sustainable benefits that can be obtained from nature are a function of maintaining the balance between economic needs and preserving the ecological stability of ecosystems. The situation on

the African continent regarding the state of these natural resources and ecosystems is worrying (du Toit et al. 2018; Sabbahi et al. 2024). Some regions are affected by drought, others by the depletion of woodland cover and by soil erosion (Cote, et al. 2016; Babio et al. 2023; Adorgloh-Hessou, R. A. 2006; WFP (World Food Program). 2017; LE RURAL Foundation 2022). This means that agricultural biodiversity, also known as Agro-Biodiversity, plays an important role as a source of income, a lever for the resilience of the agricultural system to climate change, a reservoir of nutrients, the basis of various ecosystem services such as pollination, fertility of soils and the regulation of water cycles. Despite this potential, it has experienced significant erosion in recent years (FAO, 2008 ; FAO. 2015; Abouatallah et al. 2011; Laita et al. 2024).

Guinea's economic development is based almost entirely on the development of the rural sector, which can create or boost the industrial sector. Still, we have arrived at a time when we are increasingly threatened by abusive and irrational exploitation efforts. forests and lands.

The Nimba Mountains Biosphere Reserve, previously rich in forestry potential, suddenly experienced devastating pressure from anthropogenic activities. The local populations practice agriculture and extract service wood, timber, firewood, or charcoal within these forest landscapes. All these actions contribute to the degradation of these forests (Wezel et al. 2009; Manusset, S. 2012).

This work characterizes Agro-Biodiversity within the forest landscapes used by the local populations of the Nimba Mountains and for household food security (Lamah et al. 2023; Bawa, A. 2017).

Forests and arable land are nowadays subject to human pressure, which tends to destroy their biodiversity. These farmers plough the soil without protecting the forest area, which is a farming method that is destroying biodiversity.

The analysis of the income of populations living near forests has become an important theme in the debate on forest management. Scientists, policymakers, and donors agree that forest products contribute significantly to rural livelihoods and the national economy in many countries (M. Ouédraogo et al. 2013). This know-how constitutes an essential prerequisite for sustainable management of these resources, whether preserving productive species from their commercial exploitation or improving them, particularly through silvicultural-type actions and progressive enrichment of the forest (Priso et al.2001).

Uncontrolled fires, excessive cutting of woody species, poaching, and anthropogenic pressures have contributed to deforestation. The vegetation cover is very degraded, and the observation of this situation has become alarming. Therefore, it deserves adequate management to guarantee the conservation of the forests and arable land of these lands and their proper use. It is with this in mind that we have chosen to address this theme: “Problem of Management of Agro-biodiversities of riparian lands in the Monts Nimba Biosphere Reserve-Republic of Guinea” with the aim of making our modest contribution to the management of Agro-biodiversity in order to better conserve Guinea's forest resources.

## **2- Materials and methods**

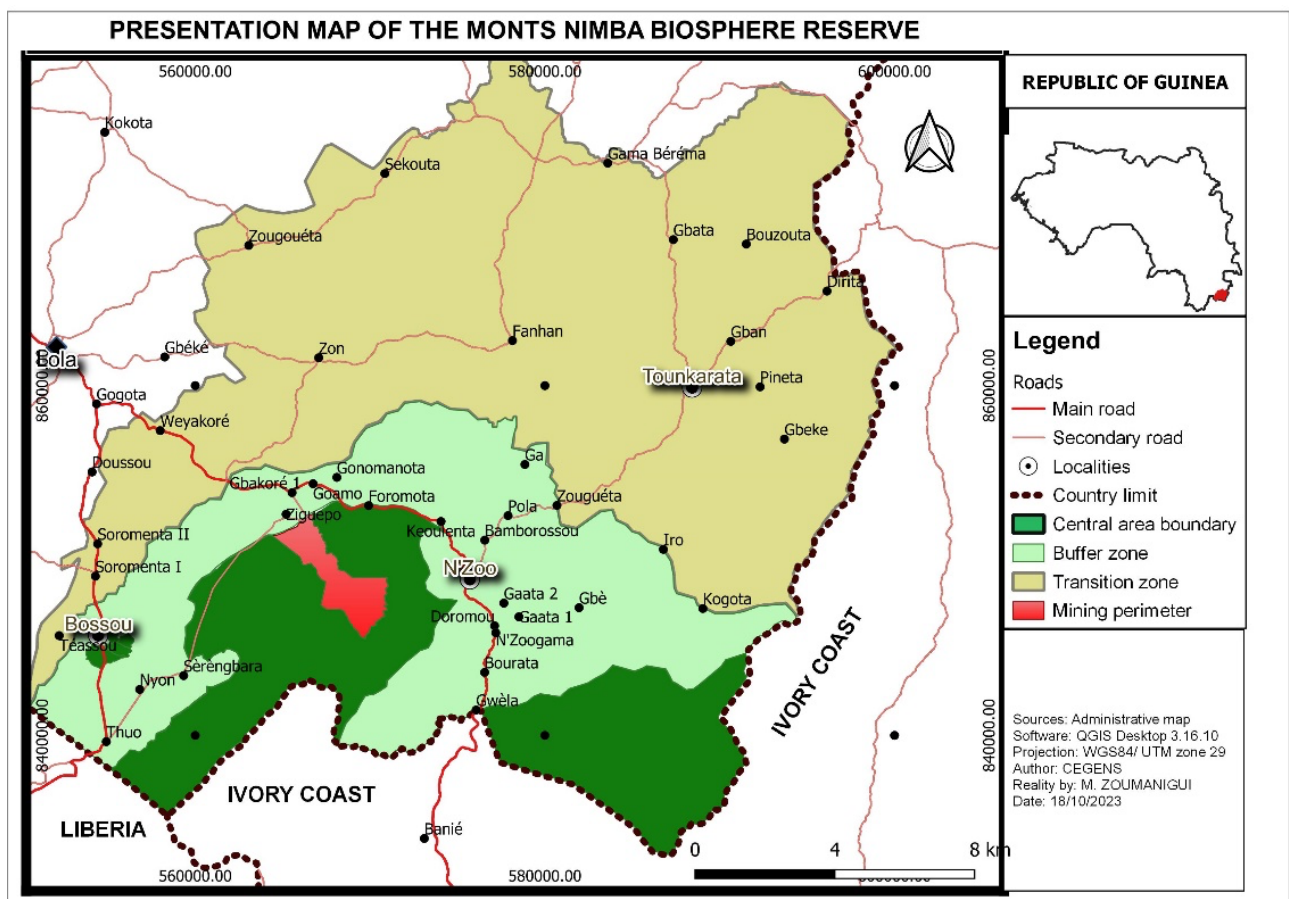
### **2-1- Materials**

#### **-Presentation of the Study Area**

The Nimba Mountains Biosphere Reserve (RBMN) is heir to the Nimba Mountains Strict Nature Reserve (RNIMN) created in 1944. It is the result of numerous scientific research projects and successful

approaches by eminent researchers such as Roger Heims, M. Lamotte, R. Schnel, J.C. Leclerck, R. Roy etc. from 1939 to 1944. This integral nature reserve became a Biosphere Reserve in 1980 and its first central area became a UNESCO World Heritage Site in 1981, following the gradual degradation observed in this reserve, the first part of the area central (world heritage site)) was included on the list of heritage in danger in 1992 by the UNESCO World Heritage Committee. The Monts Nimba Biosphere Reserve covers an area of 145,200ha and corresponds to the Guinean part of the Cavally river basin. It includes three (3) categories of protected areas including:

- A cluster of three (3) central areas of 21,780 ha strictly protected including:
  - The Guinean part of the Nimba Mountains range which constitutes the UNESCO world heritage site of 12,540 ha is our main area of investigation;
  - The Bossou chimpanzee hills of 320 ha and,
  - The Déré forest of 8920 ha.
- A buffer zone of 35,140 ha where activities are strictly controlled and,
- A transition area of 88,280 ha where activities are monitored (Moloumou et al. 2011).



**Figure 1** - Map of the Nimba Mountains Biosphere Reserve (RBMN)

## 2.2- Methods

To properly carry out this work, we adopted the following methodology:

### **2.2.1- Documentary research**

In this part, works from memoirs, journals, archives in the SSMN libraries and websites were consulted, which allowed us not only to have a general idea of our theme, to write the related literature, but also to have information relating to the monograph of the prefecture of Lola, the sub-prefecture of N'Zoo, the riparian areas and on the Monts Nimba Biosphere Reserve.

### **2.2.2- Socio-economic survey**

Using the MARP method (Accelerated Participatory Research Method) with semi-structured tools, we were interested in socio-professional groups based on a developed sheet but also in people individually. This allowed us to visit 10 villages in the N'Zoo sub-prefecture (N'Zoo center, Keoulenta, Foromota, Zougouta, Gbakoré, Gblayéoumon, Gouamo, Ziguepo, Sérengbara and Gonomanota) among many others for the realization of our investigations and to know the traditional use; commercial and food use of certain species inventoried in the study area.

### **2.2.3-Field investigation**

In order to obtain accurate information from the populations, this investigation allowed us to visit some crops and plantations of rubber, cocoa, coffee, oil palm, pineapple, rice, cassava, etc. During this study, the MARP method (Accelerated Participatory Research Method) with semi-structured tools allowed us to interview groups of people in order to identify information or data on the different uses of some species in this area. It also allowed us to know the scientific, commercial, vernacular name as well as the families of the identified species.

### **2.3-Analysis and processing of data**

Word, Excel and koboTollbox software allowed us to analyze and process the various data collected in the field, the results of which are mentioned in the results and interpretation section.

## **3. Results and interpretations**

### **3.1-Agro-biodiversities of socio-economic importance Identified**

The results of the socio-economic surveys associated with those of the actual investigations in the riparian areas made it possible to list some Agro-biodiversities of the different areas of investigation, the general appearance of which is recorded in [table 1](#).

It appears from this table that the species identified number 35 elements grouped into 23 families, the most representative of which are the Poaceae family (5) followed by the Solanaceae family (3) ([T. I. Ndotam et al. 2017](#)).

### **3.2- List of some Agro-biodiversities with high economic value**

The socio-economic surveys associated with those of the investigations in the riparian areas made it possible to list some Agro-biodiversities with high economic value of the different areas of investigation, the general appearance of which is recorded in [table 2](#).

**Table 1-** List of Agro-biodiversities having socio-economic importance for the populations bordering the Nimba Mountains.

N <sup>o</sup>	Scientific names	Business name	Name Könon	Family
1	<i>Alium sativum</i>	Garlic	Yabha	Liliaceae
2	<i>Alium sepa</i>	Onion	Yabha	Liliaceae
3	<i>Ananas comosus</i>	Pineapple	Yarapipi	Bromeliaceae
4	<i>Arachis hypogea</i>	Peanut	Guèen	Fabaceae
5	<i>Caccharum officinarum</i>	Sugar cane	Ghuilö	Poaceae
6	<i>Capsicum frutescens</i>	Pepper	Quiyée	Solanaceae
7	<i>Carica papaya</i>	Papaya	Yérétiquée	Caricaceae
8	<i>Citrus aurantium (L)</i>	Orange tree	Gaain	Rutaceae
9	<i>Citrus reticulata blanco</i>	Mandarinier	Kwi gaain	Rutaceae
10	<i>Coffea arabica</i>	Arabica coffe tree	Kawhée	Rubiaceae
11	<i>Coffea robusta</i>	Coffe tree	Kawhée	Rubiaceae
12	<i>Cola acuminata</i>	Colatier	Toukouléyhourou	Sterculiaceae
13	<i>Colocasia esculenta</i>	Taro	Gbounain	Araceae
14	<i>Cucurbita sativus</i>	Cucumber	Clikama	Cucurbitaceae
15	<i>Digitaria axilis</i>	Fonio	M'gbéré	Poaceae
16	<i>Eleasis guineensis</i>	Oil palm	Twohourou	Palmaceae
17	<i>Garcinia kola</i>	Small Kola	Toukoulé-logoro	Guttiferaceae
18	<i>Gingibier officinalis</i>	Gingembre	Lemouquiyée	Gingiberaceae
19	<i>Hevea brasiliensis</i>	Hevea	Lébahourou	Euphorbiaceae
20	<i>Hibiscus esculentus</i>	Okra	N'nwoh	Malvaceae
21	<i>Ipomea patatas</i>	Potato	Gbölöwèen	Convolvulaceae
22	<i>Lycopersicon esculentum</i>	Tomato	Wöloukölin	Solanaceae
23	<i>Mangifera indica</i>	Mango	Mangolohourou	Anacardiaceae
24	<i>Maninot ultissima</i>	Cassava	N'boh	Euphorbiaceae
25	<i>Musa sinensis</i>	Banana	Ghui	Musaceae
26	<i>Oryza sativa</i>	Rice	M'gba	Poaceae
27	<i>Oryza glaberrima</i>	Rice	M'gba	Poaceae
28	<i>Persea gratissima</i>	Avocado	Vocka(piyah)	Lauraceae
29	<i>Piper guinéensis</i>	Pepper plant	Hean	Piperaceae

30	Psidium guajava	Guava	Biakiy	Myrtaceae
31	Rhaphis sorghum	Sorgo	Kpèclin	Poaceae
32	Solanum melongina	Eggplant	Kölin	Solanaceae
33	Spondias mombin	Cashew tree	Mouwöwulu	Anardiaceae
34	Theobroma cacao	Cocoa tree	Cacao	Sterculiaceae
35	Zea mays L	Corn	Kpaï	Graminées

**Table 2-** Agro-biodiversities with high economic value

N°	Scientific names	Business name	Organs used	Use	Sale			Price (GNF)
					Heap	Attached	Measure	
1	Oryza sativa	Rice	Grain	Eating ; Economic		+	+	6000-7000 450000-550000/sac
2	Manihot utissima	Cassava	Tuber	Eating ; Economic	+			2000-5000
3	Zea mays (L)	Corn	Grain	Eating ; Economic	+			2000-5000
4	Theobroma cacao	Cocoa	Grain	Economic			+	8000-10000 /kilo 800000/sac
5	Musa sinensis	Banana	Fruit	Eating ; Economic	+			15000-25000
6	Hibiscus esculentus	Okra	Fruit	Eating ; Economic	+	+		500-1000 75000 /sac
7	Gingibier officinalis	Gingembre	Tuber	Eating ; Economic ; Medical	+			2000-5000
8	Eleasis guineensis	Oil palm	Grain ; Nut ; Oil	Eating ; Economic	+		+	500-1000 1200-1500 10000 /litre
9	Colocasia esculenta	Taro	Tuber	Eating ; Economic	+	+		1000-2000 500000/sac
10	Cola acuminata	Cola	Nut	Economic ; Medical			+	5500-6000
11	Coffea arabica	Coffee	Grain	Economic ; Medical			+	10000/kilo 600000/sac
12	Capsicum frutescens	Pepper	Fruit	Eating ; Economic	+			500-1000

From the analysis of this table, we note that the species (*Musa sinensis*, *Theobroma cacao*, *coffea arabica*, *Oryza sativa*) are agrobiodiversities with high economic value, which explains their high exploitation in these riparian areas (T. I. Ndotam *et al.* 2017).

### 3.3- Definition of the impact of different anthropogenic activities

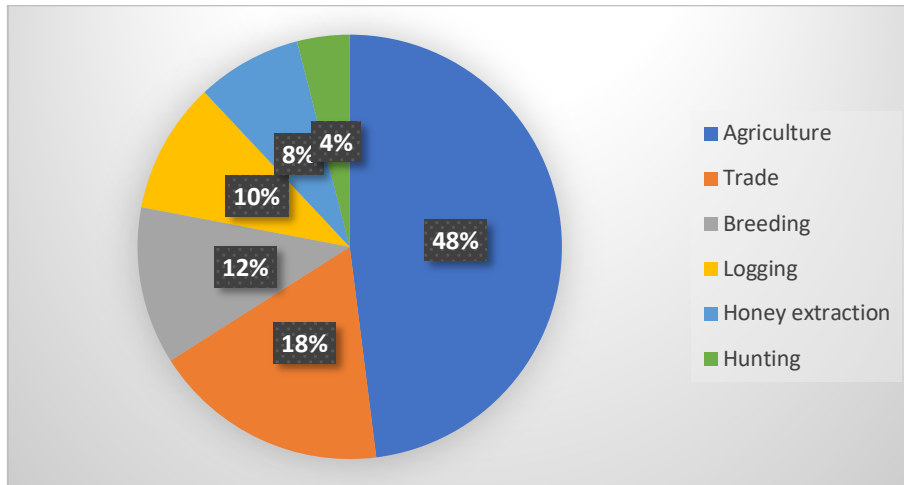
To enable us to better represent the advantages and disadvantages observed at the level of the different economic activities of the biophysical and human environment of the Nimba Mountains Biosphere Reserve, we have summarized them in the table below, see table3.

**Table 3-** Advantages and disadvantages of the different activities in the riverside areas

N°	Types of activities	Techniques used	Effects	
			Positives	Negatives
1	Logging	Felling by machine, ax and cutter	- Satisfaction of wood needs for populations. -increase in their income	-Risk of disappearance of wood and certain plant species. -Destruction of the habitats of certain animal species. -Modification of forest ecosystems. -Worsening of erosion.
2	Agriculture	Extensive slash-and-burn cultivation	-Satisfaction of the food needs of the populations -Availability of sources of organic fertilizers usable in agriculture;	-Soil impoverishment -Siltng of watercourses. -Reduction of plant cover. -Destruction of ecological nests of certain animal species
3	Breeding	Breeding in the open air and in enclosures	-Diversity and importance of animal resources; -Availability of crop residues that can be used to intensify livestock farming; -Possibility of offering raw materials to other socio-economic sectors (crafts).	-Unavailability of pastoral land. -Low level of organization of breeders; -Insufficient infrastructure and pastoral equipment (tracks, wells, boreholes, parks, etc.); -Conflicts between farmers-breeders; -Wandering of animals; -Weak integration of livestock farming into other socio-economic sectors.
4	Honey extraction	Artisanal hives; use of fire	Improved economic income	-Destruction of plant cover. -Outbreak of bush fires.
5	Hunting	Poaching	-Existence of forest resource management structure. -Faunal potential and diversity; -Possibility of operating ecotourism.	-Insufficient means of action by forestry services. -Difficulties in controlling the sampling of wildlife potential and the identification of poachers; -Degradation of wildlife habitat due to anthropogenic actions (bush fires, excessive logging, etc.)
6	Trade	In general and in detail	-Existence of a range of manufactured and local products; -Existence of rural and urban markets.	-Difficulties in transporting local and manufactured products; -Poor condition of commercial facilities. -Food deficit (starvation) after marketing.

It appears from this table that almost all of the respondents practice agriculture (48%) marketing of products is higher than those consumed (18%) because of the multiple needs of these inhabitants and the

low yield of crops. Logging is practiced at 10% while honey extraction is at 8%. Livestock breeding practiced in these villages is extensive (12%) with small numbers intended mainly for religious ceremonies. The species raised are sheep, goats and poultry. Hunting is also practiced in these areas (4%). *See figure 1.*



**Figure 1**-Activities practiced in the study area

We note that all these exploitation practices have harmful effects on all natural resources with techniques used which are the basis of the destruction of forest formations in the environment.

#### 4- Proposal of possible solutions for sustainable management

In order to slow down the process of land degradation in areas bordering the Nimba Mountains Biosphere Reserve, it is important to consider solutions which are, among others:

- ✓ Improving farming techniques through the use of organic and chemical fertilizers and the introduction of improved varieties with a view to reducing the cropping intensity coefficient;
- ✓ The introduction of the fallow technique improved by sowing legumes and fast-growing species during the last crop cycle;
- ✓ The enrichment of the natural fallow which follows a cultivation phase on slash and burn in order to allow the role of constituting the soil of the fallow to be combined with a productive role;
- ✓ The development of fallow land so that economic and ecological objectives can be combined;
- ✓ Development of the rice-growing and market-gardening lowlands;
- ✓ Taking traditional knowledge into account in the sustainable management of biodiversity;
- ✓ The implementation of actions to classify village forests and the development of existing classified forests as well as large-scale reforestation;
- ✓ Raising awareness among the local population for the development of agroforestry with a view to protecting forests against bush fires;
- ✓ Promotion and popularization of the establishment of fast-growing forest species in reforestation as well as research and dissemination of crops at the local level;
- ✓ The revitalization of forestry administration services in the control of the Nimba Mountains Biosphere Reserve;

- ✓ The establishment of collective parks for livestock management that is more organized in space and more rational in time;
- ✓ Strengthening social peace within rural populations with the extinction of social conflicts between farmers and breeders by putting an end to the wandering of animals and these consequences;
- ✓ The development and implementation of real measures to combat erosion and land degradation;
- ✓ The involvement of NGOs in raising awareness among local populations and local participation with a view to combating damage to ecosystems and promoting their sustainable exploitation;
- ✓ The establishment of committees for the management and rehabilitation of degraded areas;
- ✓ The revitalization of local radio stations in their environmental management education broadcast;
- ✓ The development of less harmful income-generating activities in neighboring areas with a view to limiting the degradation of natural resources;
- ✓ Presentation of the results of these surveys to all neighboring areas.

The above solutions do not allow us to conclude exhaustively that they constitute the class of resolution of all the problems of the biophysical and human environment of the riparian lands that we have examined. However, they can serve as a basis for further deepening of researchers' knowledge.

## Conclusion

At the end of our research work, we reached the following results:

- ✓ The identification of 35 species grouped into 23 families including 5 Poaceae followed by the Solanaceae family (3).
- ✓ Agro-Biodiversities with high economic value including 4 species selected (*Musa sisensis*, *Theobroma cacao*, *Coffea arabica*, and *Oriva sativa*).
- ✓ Agriculture (48%), trade (18%), logging (10%), honey extraction (8%), breeding (12%) and hunting (4%) are activities carried out in these areas.
- ✓ In addition, knowledge of the species commonly used in food (*Oriva sativa*, *Manihot utissima* and *Zea mays* (L)), the pharmacopoeia (Coffee, Ginger, Kola) as well as in marketing (Banana, Corn, Cocoa, etc.) are the main assets of agro-biodiversity in these areas.

This is why the problem of managing Agro-Biodiversities in these areas remains a major concern because of the related constraints and the application of these possible solutions mentioned above becomes a necessity to preserve the ecosystem of the Reserve. Nimba Mountains Biosphere.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors declare that there are no conflicts of interest. *Compliance with Ethical Standards:* This article does not contain any studies involving human or animal subjects.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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