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IMPACTS OF VEGETATION-COVER DEGRADATION ON USEFUL PLANT SPECIES IN BOULLERÉ DISTRICT, BOKÉ PREFECTURE, REPUBLIC OF GUINEA

Aïssatou Bobo DIALLO [1,*], Yaya Kenda Bailo DIALLO [2], Fatoumata Binta Sombily Diallo [3], Assiatou Djoherè DIALLO [2], Johny RAHBENANTOANDRO [4] and Alpha Issaga Palle DIALLO [5]

[1] Interdisciplinary Doctoral Program in Environmental Sciences, Gamal Abdel Nasser University (UGAN).
[2] Higher Institute of Mining and Geology of Boké (ISMGB), Applied Laboratory of Environmental Geoscience, Geological Services Department.
[3] National Centre for Environmental Documentation (CNDE), Ministry of Higher Education, Scientific Research (MESRS), Guinea.
[4] Johny ONG Madagasikara Ekôlôjia, Madagascar.
[5] Marine and Coastal Research Center of Guinea (CEREMAC), Ministry of Higher Education, Scientific Research (MESRS), Guinea.
* Corresponding Author

ORCID Details
Aïssatou Bobo Diallo: https://orcid.org/0009-0009-7590-1253
Yaya Kenda Baïlo Diallo: https://orcid.org/0009-0005-7838-9399

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ABSTRACT

The degradation of vegetation cover in bauxite exploitation areas threatens the plant resources on which rural communities depend. This study analyses its impacts on useful plant species in the Boulleré district (Sangarédi, Boké, Guinea). Floristic inventories were carried out from 2 to 24 April 2025 in ten village sites divided between galleries, secondary forests and degraded forests (10 plots of 100 m2 per plot of 1 ha and one travelling transect of 500 m per site). A semi-structured questionnaire survey was conducted among 200 people, including 196 usable responses. The inventory identified 791 woody individuals from 130 species, 98 genera and 43 families (H' = 4.17; J = 0.86). The gallery forests comprise 106 species and 62 of 102 large trees, compared to 28-35 species per village elsewhere. wood cutting (93 out of 184) and agriculture (48) dominate the observed disturbances. The guides cited 27 useful species, mainly medicinal (17 species, 134 citations) and food (7 species, 51 citations). Respondents attributed degradation to mining (94.8%), charcoal production (82.5%) and lumber (82.0%), and reported declining agricultural yields (97.8%) and pharmacopoeial products (61.3%). Of 26 taxa perceived as affected, 25 were inventoried; *Afzelia africana* (43.2 per cent of respondents, 8 individuals), *Khaya spp*. and *Milicia* spp. are both highly cited and rare. Degradation mainly results in loss of useful species and large trees. Protection of gallery forests and participatory monitoring of priority species are recommended.

Keywords: Vegetation-cover degradation; Useful plant species; Floristic inventory; Community perceptions; Bauxite; Boulleré

1 INTRODUCTION

In West Africa, open pit mining, agricultural expansion, charcoal production and logging are among the main drivers of the degradation of vegetation cover [40] Beyond forested area loss, this degradation alters floristic composition and stand structure. It also reduces the availability of plants on which rural populations depend for food, pharmacopoeia, energy and construction [24], [28]. Mining can also lead to deforestation that far exceeds the limits of concessions, through infrastructure, the installation of new populations and the demand for resources it generates.

Studies by Diallo et al. [11] concluded that, in Guinea, mining in general, and particularly bauxite, is the third-largest after agriculture and logging (deforestation, firewood,) threats to biodiversity. The authors also noted that these threats have a significant impact on ecosystems and the forest landscape. In the same study, the authors also noted that in Lower Guinea, mining has divided agricultural land, resulting in erosion and reduction of fields in many villages. Nearly 35% of the farmers living near the mines had to abandon their land to find new ones, which damaged the surrounding nature.

Thus, in the Republic of Guinea, as in other countries of the world that operate bauxite such as Australia, construction and operation activities are the main sources of environmental degradation. These consequences are manifested in the destruction of natural habitats, soil degradation, the reduction of agricultural land, overexploitation of water resources and the contamination of [12] ecosystems.

The vascular flora of Guinea has approximately 3,900 species [20], a significant part of which is used by communities for food, medicine or construction [28]. Several timber or multi-use trees are threatened there [7], and Couch et al., 2019). In the rural municipality of Sangarédi, the exploitation of the bauxite has profoundly transformed a mosaic of savannas, bowle and gallery forests. The gallery forests in this area have integrity levels ranging from almost intact formations to highly degraded [33] formations.

The effects of vegetation cover degradation are often assessed by remote sensing, but their impact on plant species useful to communities remains poorly documented at the local level. Local knowledge informs on the evolution of species that do not allow one-off inventories to track in time [6] Inversely, inventories provide an independent measure of their current abundance and presence. Confrontation of these two sources remains rare in Guinean bauxitic areas.

The purpose of this study is to analyze the impacts of vegetation cover degradation on useful plant species in the Boulleré district. It (i) characterizes the composition, diversity and structure of the woody flora of ten site-villages divided between galleries, secondary forests and degraded forests; (ii) identifies useful species and their uses; (iii) describes the causes and impacts of degradation perceived by communities; and (iv) compares species perceived to be assigned to their presence in inventories.

2 MATERIALS AND METHODS

2.1 Study area

At the local level, the Boulleré District is the West African study area in the northwestern part of the Republic of Guinea. It is located in the Sangarédi sub-prefecture in Boké Prefecture. It is located at 11° 07′ north latitude and 13° 58′ west longitude at an altitude of approximately 109 metres and covers an area of 32,648 hectares[10] (Figure 1).

The climate of Sangarédi, to which the district of Boulleré belongs, is of tropical type with strong seasonal alternation. The Sangarédi CR is characterized by a rainy monsoon-dominated season from June to October and a dry season dominated by harmattan. Annual rainfall between 1,200 and 3,200 mm [10]

Thus, the vegetation cover of Boulleré corresponds to a heterogeneous landscape in which relatively preserved natural formations coexist with more strongly transformed spaces. In this study area, gallery forests are important cores of biodiversity and ecological connectivity, while secondary formations show the cumulative effects of agricultural practices, fires, grazing and other land uses [32]

To these agro-pastoral pressures is added the exploitation of bauxite, particularly important on plateaus. Surface stripping, road and track construction and development of mining infrastructure contribute to changes in land use and fragmentation of vegetation cover. gallery forests, mainly located in valleys, are less directly impacted by plateau stripping, but remain exposed to the indirect effects of runoff, sedimentation, opening of access roads and intensification of human activities (EME, 2014).

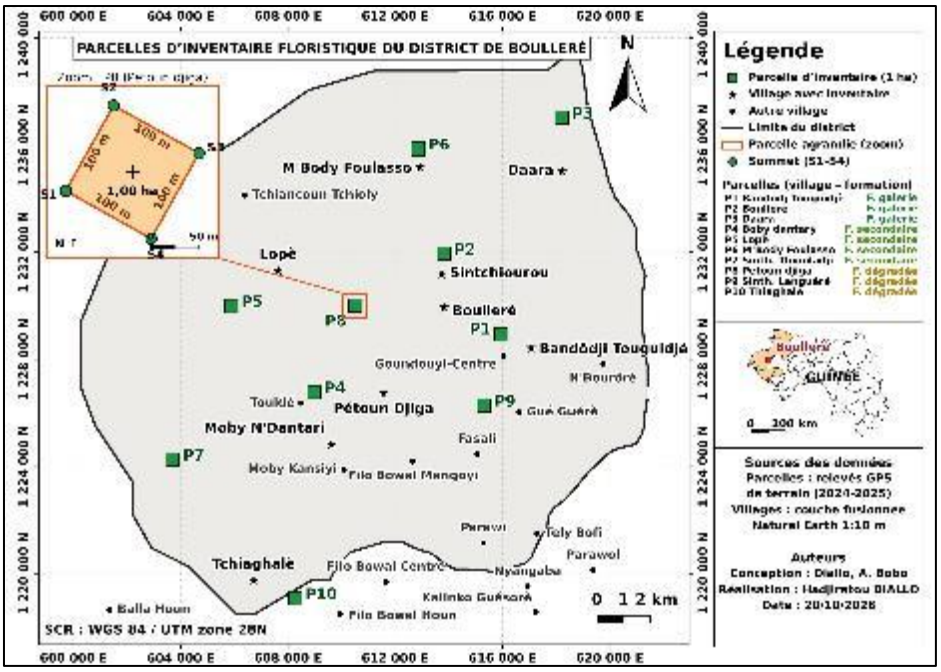

Figure 1: Location of the ten floristic inventory plots in the Boulleré district. Source: GPS field surveys (2024-2025).

2.2 Floristic inventories

2.2.1 Sampling and inventory system

Floristic characterization of the Boulleré district is based on ecological inventories and community knowledge. It describes the composition, structure and diversity of woody vegetation and describes the main local uses of species. Fieldwork conducted between April 2 and 24, 2025 was performed using random multi-level sampling. Ten villages were selected and a plot of 1 ha was defined in each. Each plot was divided into 100 plots of 100 m2, 10 of which were randomly selected and inventoried. This creates an entire area of 1 ha for the entire installation (Figure 2).

This work was carried out by an inventory team composed of a botanist, three people to support dendrometric measurements and community guides per village. These guides helped identify inventory areas and access sampling plots. They also identified plant species and their vernacular names in local languages and provided information on the main uses of plants in communities. As a result, the work was done and inventories were conducted in areas where land and access were critical (Morales et al., n.d.; Tongco, 2007).

Field observations were conducted both in easy-to-access areas (secondary and degraded forests) and in hard-to-reach areas (gallery forest with steep lianas and slopes). Thus, while accessibility was an operational constraint during field work, it was not considered an ecological criterion for the selection of sampling units [45]A total of 1,000 m2, or 0.1 ha per plot, was surveyed. The entire system consists of 100 sample plots for a total inventory area of 10,000 m2 or 1 ha. The 10 hectares represent the footprint of the plots in which the observations were made [1].

The area sampling fraction in the demarcated plots is 10%, corresponding to 0.1 hectares per plot of one hectare. Thus, 1 hectare per 10 hectares delimited is inventoried in this configuration. This number represents the sampling effort in the plots, but does not represent 10% of the area of the Boulleré district [23]..

These plots are located in ten villages (Bandodj Touguijè, Boulleré, Daara, Boby dantary, Lopè, M'Body Foulassa, Sinthiourou Thiouladji, Petoun djiga, Sinthiourou Lenguéré and Thiaghalè) of the Boulleré District, respectively. This method was used by several authors as part of the [1] floristic inventory. Table 1 summarizes the list of villages, forest types and forest classes according to [33].

As a result, the stages of conservation or degradation of plant formations have been attributed according to a combination of structural, floral and anthropogenic criteria. In particular, vegetation cover structure and continuity, density of woody plants, distribution of individuals according to height and diameter classes, presence of large trees, natural regeneration and disturbances such as wood cutting, clearing, fire, agricultural activities and grazing [33].

Thus, formations with good structure and relatively continuous cover, and few signs of disturbance were considered to be the best preserved and decreased density and size of woody plants, discontinuity of cover, and increased disturbance, showed that degradation was more severe. Stages were assigned based on the convergence of characteristics in each plot rather than the type of degraded plant formation (Morales et al., n.d.; Rosenfield et al., 2023; Vásquez-Grandón et al., 2018),23).

Table 1: Villages, forest types, degradation classes and sampling intensity

Village	Forest type	Class	Subplots	Transect observation points	Individuals in subplots	Individuals along transect	Total individuals
Bandodj Touguijè	gallery forest	Stage 1	10	18	81	14	95
Boulleré	gallery forest	Stage 1	10	18	82	9	91
Daara	gallery forest	Stage 1	10	18	63	14	77
Boby dantary	Secondary forest	Stage 2	10	18	62	0	62
Lopè	Secondary forest	Stage 2	10	18	78	4	82
M'Body Foulasso	Secondary forest	Stage 2	10	18	53	6	59
Sinthiourou Thiouladji	Secondary forest	Stage 2	10	18	86	6	92
Petoun djiga	Degraded forest	Stage 4	10	18	83	0	83
Sinthiourou Lenguere	Degraded forest	Stage 4	10	18	59	4	65
Thiaghalè	Degraded forest	Stage 4	10	18	76	9	85
Total	3 formations		100	180	723	66	791

Source: Rabenantoandro et al. [33] for the degradation classes; Boulleré floristic inventory data, 2025 field campaign.

To complete the inventory in each one-hectare plot, a travelling floristic inventory was conducted along a 500-metre transect along a nearby trail or stream. Five observation points spaced 100 metres apart were placed along the transect. At each stop point, trees and shrubs in a 20 metre radius circle were recorded. The results of this additional survey were recorded in the same database collected in the plots (P. A. Silue et al., 2021). This transect model is illustrated in Figure 2.

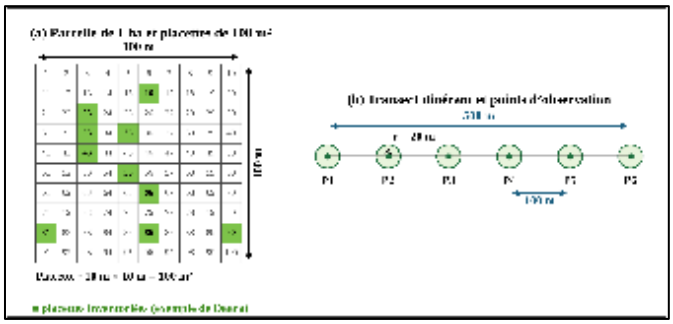

Figure 2: Inventory system: (a) plot of 1 ha divided into 100 plots of 100 m2 (e.g. Daara); (b) itinerant floral survey transect. Source: field operation, April 2025

2.2.2 Dendrometric measurements and species identification

The woody species encountered were recorded as part of the floristic inventory. For dendrometry, measurements of diameter at breast height were taken on the stems with a DBH ≥ 10 cm. The diameter is measured at a reference height of 1.30 m above ground [23]. If trunk irregularities prevent representative measurement at this height, the measuring point will be adjusted according to the technique used by [24]. These measurements were made using a measuring tape. Using this tape, the diameter is determined by the following relation: D = C / π where D: diameter; C: the circumference measured and π: 3.14

Total tree height was estimated using the logger cross of two straight sticks of the same length (about 20 cm) placed perpendicularly. According to Freytet and Bonnardot [18], the observer was moving until the ends of the vertical stick were in view of the top and base of the tree. The distance between the observer and the base of the tree in this geometric form constitutes an approximation of the height of the tree. However, this is not accurate on steeply inclined terrain and for bent trees.

The taxonomic identification was first performed in the field by the botanist based on morphological characteristics observed in the field, and community guides to select vernacular names. This technique was used by other authors such as [4]. Next, google Lens was used as guidance or pre-identification tools for taxa whose identification was still unknown. The proposals were then compared with floristic references for Guinea, in particular (Couch et al., 2019; Gosline et al., 2023; Magassouba et al., 2007) to verify the nomenclature and taxonomic consistency of registered species.

2.2.3 Data processing and ecological parameters

For all data, the processing consisted first of entering the data collected in an Excel workbook. Then checks and corrections were made [17]. These processed data were used for (i) characterization of recovery and ecological parameters and (ii) characterization of commercial floristic species for local communities.

For the determination of floristic diversity by village, the Shannon index was used. This index (H′) measures the diversity of an ecological community. To do this, it takes into account the number of species present (species richness) and individuals in the ecological community [5].

$H' = - (pi \times \ln pi)$, with $pi = ni / N$

where ni is the number of individuals of species i, N is the total number of individuals, pi = ni/N is the relative abundance of species i, and ln is the natural logarithm.

The comparative interpretation grid used is as follows: diversity was low when $H' < 2$, average when $2 \leq H' \leq 3$, and high when $H' > 3$. This interpretation grid was used in several forest vegetation studies and can be used to compare the relative diversity of the [31] stands studied. Since the index is calculated from natural logarithm (ln), the H′ values are expressed nats [2].

The evenness index of Pielou (J) or (E) evenness measures the distribution of individuals among all species in a community. This index is used in this study to compare populations even if the species richness of populations differs. It is expressed by the ratio of the diversity index of Shannon (H') to the maximum diversity index through the following formula [34]:

$J = H' / Hmax$; $Hmax = \ln(S)$

Its value varies between 0 and 1. When the value is close to or equal to 0, we can qualify the community as a low evenness, i.e. a few dominant species, while when its value is close to or equal to 1, we can qualify as a high equity or equitable distribution of the [36] community.

2.2.4 Useful species, regeneration and disturbance

Regarding the analysis of useful species for the local community, we first used the knowledge of the local guides we worked with during the inventories. The work carried out with these 10 community guides allowed us to collect and record in our database the uses of floristic species.

Subsequently, a literature review was conducted to complete and validate field information. During this literature review, we consulted some studies conducted in Guinea on the use of plants by communities, among which we have (Magassouba et al. 2007; Molmou et al. 2025). For example, the information collected through the above-mentioned guides and studies on useful species in Guinea made it possible to establish a list of useful species for the communities in the study area.

Disturbations observed in plots are marked as stumps, cutting, charcoal production, fire, grazing, clearing, cultivation and tracks. These disturbances may be expressed in terms of presence/absence, number of occurrences or proportion of affected plots. The ecological significance of each of the variables is known prior to analysis.A high richness, diversity, density, basal surface or regeneration is a better condition, while a high frequency of disturbances is an indication of an increase in degradation. But this interpretation is adapted to the type of training. A natural savannah is not judged with the same thresholds as a [27] gallery forest.

In the analysis, individuals with a height of 2 metres or less were considered a natural regeneration.

2.3 Community surveys

The community survey was designed to study the reasons and effects of vegetation degradation in the 10 villages studied in the Boulleré district. It is also supplemented by floral inventories

2.3.1 Design, pre-test and target population

A semi-structured questionnaire was developed in two complementary forms, including a paper version for face-to-face interviews and an electronic version with Microsoft Forms in Microsoft 365. The questionnaire was designed to be consistent and allow people to describe their observations. Prior to the main survey, the questionnaire was pre-tested with a number of 5 participants who were not in the final sample. This pre-test verified the understanding of the questions, the relevance of the response options, the order of the sections in the interview and the duration of the interview. The ambiguous formulations were then corrected. This follows FAO recommendations on the design and pre-test of the [14] questionnaires.

During the survey, temporary visitors and those unable to give informed consent were excluded from the study, and questionnaires that were not complete enough to be analyzed were excluded. The data were collected from 06 to 29/12/2026. The interviews were conducted in Pullar, which is the common language of the study area communities.

2.3.2 Sample size and respondent selection

The required sample size required to estimate a proportion was calculated using the Cochran formula as presented in the [21] studies.

$$n0 = Z^2 p (1 - p) / e^2$$

Where n0 is the required sample size, Z the critical value associated with the confidence level, p the expected proportion and e the margin of error.

The population of Boulleré was estimated at 6,809 at the official census of 2014 [41]. For the Community survey, we selected 200 people in the case of our study, taking into account available resources and conditions on the ground. The maximum margin of error for this sample size was estimated by considering a 95% confidence level, corresponding to a critical value (Z = 1.96), and an expected proportion (p = 0.50). This proportion is chosen in the absence of a prior estimate of the phenomenon studied in the district as it represents the case of the greatest variability in the sample and therefore gives the most conservative estimate of the margin of error [21].

Since the study population was complete, the finite population correction was considered in this analysis as follows:

$$e = Z \times [p (1 - p) / n] \times [(N - n) / (N - 1)]$$

Where e represents the margin of error; Z = 1.96 (95% confidence level); p = 0.50 the expected proportion; n = 200 respondents the sample size; N = 6,809 inhabitants the total reference population.

With 196 valid questionnaires and a finite population of 6,809 inhabitants, the maximum margin of error was approximately ±6.9% at the 95% confidence level, assuming maximum variability (p = 0.50). This precision was considered adequate for an exploratory district-level survey, while village-level estimates were interpreted cautiously because of unequal sample sizes.

Since we do not have the complete nominal household list, we selected the persons to be investigated through a systematic process and a random sampling step. During these investigations, refusals, absences, incomplete questionnaires and possible replacements were recorded to verify the non-response bias. This approach was used by (Dillingham et al., 2020; Maduekwe & De Vries, 2019)

2.3.3 Questionnaire content and data processing

The questionnaire included five sections on the social, environmental and ecological aspects needed to assess the impact of vegetation cover degradation (Table 2).

Table 2: Summary of the questionnaire on the effects of vegetation degradation

No	Section	Main information
1	General information	Gender, age, activity, village, length of residence and household status.
2	Causes of deforestation and degradation	Factors cited, priority factor, justification, location and observation period.
3	Environmental impacts	Perceived effects on vegetation, soils, water, biodiversity, health and well-being.
4	Moyens de subsistance	Economic activities, dependence on natural resources and effects on income or access to resources.
5	Impacts sur la flore	Perceived decrease level, period, species reported as affected and causes advanced.

After collection, the questionnaires were verified and exported to Microsoft Excel. Then the response options were harmonized. In conducting the analyses, the denominator used for the results is based on the percentage of respondents or the percentage of all citations. The category variables were described by the number of respondents, frequency and,... with 95% confidence intervals.

Comparisons between villages were made taking into account the different size of subsamples and the different probability of selection. Responses to changes over the past 10, 20 or 30 years have been assessed by age and length of residence. A respondent was considered to be a witness of a period only if this period was covered by its presence in the village (Cuncil for International Organizations of Medical Sciences (CIOMS, 2016).

Prior to each interview, the objectives of the study, the voluntary nature of participation, the possibility of refusing or ending the interview and the use of data were explained to the participant. Prior to the administration of the questionnaire, free and informed consent was obtained. There were no direct identifiers in the analysis database, and access to the data was restricted to research needs. These provisions are consistent with international standards of consent, confidentiality and voluntary participation (Council for International Organizations of Medical Sciences (CIOMS, 2016).

2.4 Cross-analysis of floristic data and perceptions

To verify that the different parameters studied are evolving together, we constructed a correlation matrix based on the average values of the ten villages. We selected 13 parameters: species richness, number of individuals, indices of Shannon and Pielou, density, mean height, number of large trees, proportion of trees, regeneration, and four disturbance indicators. The coefficient of Pearson (r) was calculated for each pair of parameters. There are only 10 villages, and we can only obtain a correlation at the 5% threshold from \ To account for the small sample size, each relationship was also verified using the coefficient of Spearman (ρ).

The species identified by respondents as the most affected, primarily designated by their Poular name, were grouped and associated with scientific names from local names collected from inventories. For each taxon, the number of citations was compared with the number of individuals surveyed, the number of villages where it was encountered, and the use of community guides.

3 RESULTS

3.1 Sampling effort and taxonomic composition

The inventory identified 791 woody individuals from 130 species, 98 genera and 43 families. In general, this community is characterized by Fabaceae and shrubs, which comprise more than four out of five individuals. The diversity is high at the zone scale (Shannon index 4.17 and Pielou evenness 0.86) but is very unevenly distributed in the formations. There are 106 of the 130 species only in the gallery forest, 56 of which have not been found elsewhere. It also has most large trees. By contrast, secondary and degraded forests have poorer flora and a simplified structure, dominated by shrubs less than 10 m high.

In each of the ten villages, the sampling intensity was the same in all plots. A plot marked by four pickets, ten plots and a transect of six stations, with eighteen observation points (Table 1). The total number is 100 plots, 10 transects and 180 transect points. Field surveys provide most of the data (723 individuals, or more than 91% of the total). Itinerant surveys, with 66 individuals, generally provide a floral list of all species absent from plots.

The woody flora of the study area includes 130 species in 98 genera and 43 families (Table 3). The family Fabaceae is the most common family, with 25 species and 219 individuals (more than a quarter of the total number). It is by far followed by the Rubiaceae (10 species), the Moraceae [8], the Phyllanthaceae [20] and a group of 6 families (Apocynaceae, Anacardiaceae, Myrtaceae and Combretaceae). This dominance of the Fabaceae is a classic feature of the Sudan-Guinean formations. It is due both to the richness of the family and to the abundance of some very common species such as *Daniellia oliveri* (33 individuals) and *Dialium guineense* [34].

For genera, *Ficus* is the most diverse genus with five species compared to *Combretum* and *Syzygium* with four. But the majority of genera (76 out of 98) are represented by only one species. This is indicative of a diverse but little redundant flora where each line of taxonomic species is very often represented by a single species. 54 species (approximately 42% of the population) were found only once and 67 are present in only one village. For example, much of the diversity is based on rare or localized species that are particularly affected by habitat loss.

Table 3: Species richness (S), genera, families, number of individuals (N), index of Shannon (H') and Pielou evenness (J) by village and formation

Village / formation	Vegetation formation	S	Genera	Families	N	H' (nats)	J
Bandodj Touguijè	gallery forest	51	43	23	95	3.73	0.95
Boulleré	gallery forest	56	47	26	91	3.74	0.93
Daara	gallery forest	49	40	22	77	3.69	0.95
Boby dantary	Secondary forest	31	28	18	62	3.24	0.94
Lopè	Secondary forest	28	28	16	82	3.07	0.92
M'Body Foulasso	Secondary forest	29	28	18	59	3.05	0.91
Sinthiourou Thiouladji	Secondary forest	32	31	16	92	3.17	0.91
Petoun djiga	Degraded forest	35	34	18	83	3.34	0.94
Sinthiourou Lenguere	Degraded forest	28	25	16	65	3.10	0.93
Thiaghalè	Degraded forest	33	31	18	85	3.25	0.93
gallery forest (3 villages)	--	106	81	39	263	4.33	0.93
Secondary forest (4 villages)	--	55	49	21	295	3.58	0.89
Degraded forest (3 villages)	--	59	52	25	233	3.70	0.91
Ensemble de la zone	--	130	98	43	791	4.17	0.86

Source: Boulleré floristic inventory data, field campaign 2025; author's calculations.

In comparison between villages, there is a clear gradient of wealth (Figure 3a). The three gallery forest villages all have more than 49 species: Boulleré (56), Bandodj Touguijè (51) and Daara (49). The remaining seven villages have between 28 and 35 species.

At the formation level, the gallery forest has 106 species and 39 families, compared with 59 in degraded forest and 55 in secondary forest (Table 3). This result is all the more remarkable since the gallery forest has fewer individuals (263) than the secondary forest (295). Only 36 species are common to all three formations. The gallery forest is rich not only in biodiversity but in diversity.

3.2 Floristic diversity and equity

The Shannon index confirms the hierarchy based on species richness (Table 3, Figure 3b). The villages of the gallery forest have the highest values: Boulleré (3.74), Bandodj Touguijè (3.73) and Daara (3.69). Villages in the secondary forest and degraded forest range from 3.05 in M'Body Foulasso to 3.34 in Petoun djiga. This is a large gap since almost 0.7 nat separates the most diverse village from the least diversified. But it is in fact moderate given the difference in wealth in terms of good distribution of individuals among species.

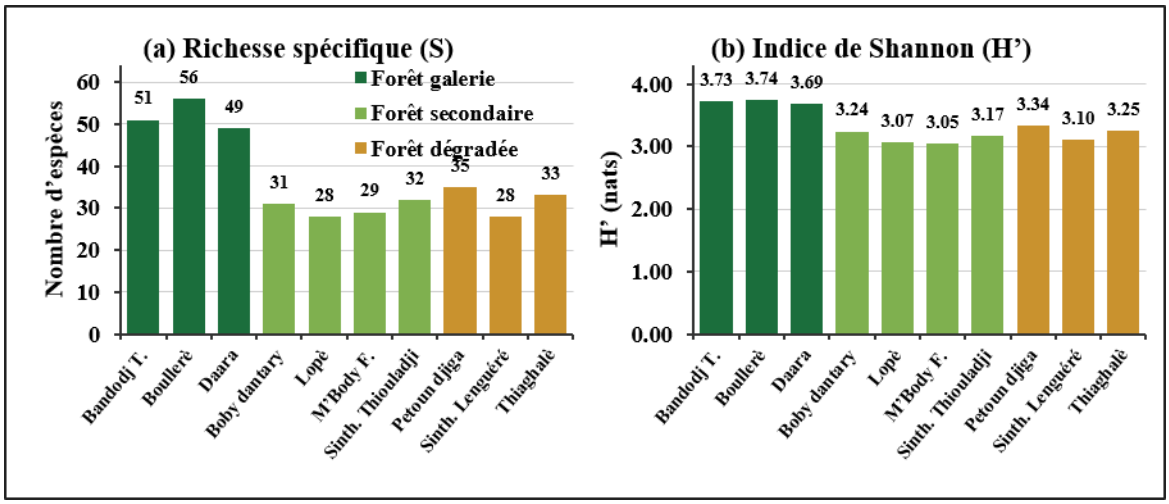

Figure 3: Species richness (a) and index of Shannon (b) by village sit. Source: Boulleré floristic inventory data, 2025 field campaign

The uniformity of Pielou is indeed high and remarkably stable, with an average value ranging from 0.91 to 0.95 depending on the villages (Table 3). The trend curve is almost horizontal. Thus, there is no community dominated by one or two species. This is observed even in the poorest villages, the individuals are evenly distributed among the species present. The degradation occurs primarily because of the loss of species rather than the invasion of the environment by some pioneer species.The results show in Table 3 that the gallery forest has an index of Shannon of 4.33, well above degraded forest (3.70) and secondary forest (3.58). The secondary forest is placed last in the list of trees. This is due to the fact that its four villages all have common species and that their reunification takes longer to develop the wealth than those of other formations. Its uniformity, slightly lower (0.89), is due to the fact that abundant species in these villages are very common, including *Uvaria chamae* (24), *Icacina oliviformis* (17), *Lannea acida* (16) and *Holarrhena floribunda* (15).

3.3 Stand structure

stand density ranges from 530 stems/ha at M'Body Foulasso to 860 stems/ha at Sinthiourou Thiouladji (Table 4). It does not follow the degradation gradient: Petoun djiga, in a degraded forest, is one of the densest villages (830 stems/ha), while Daara, in a gallery forest, has only 630 stems/ha. The high density of some degraded villages is in fact due to the proliferation of small shrubs, not to the presence of dense treed stands (Table 4).

Table 4: Stem density, height, large trees and natural regeneration (H ≤ 2 m) per village

Village	Density (stems/ha)	Mean height (m)	Maximum height (m)	Large trees (H ≥ 15 m)	Regeneration (ind.)	Regeneration share (%)	Regeneration density (ind./ha)
Bandodj Touguijè	810	7.3	22	17	16	16.8 %	150
Boulleré	820	9.0	34	26	20	22.0 %	190
Daara	630	10.2	29	19	11	14.3 %	110
Boby dantary	620	4.6	20	6	27	43.5 %	270
Lopè	780	6.1	23	10	12	14.6 %	120
M'Body Foulasso	530	7.1	27	9	14	23.7 %	140
Sinthiourou Thiouladji	860	5.4	22	7	26	28.3 %	260
Petoun djiga	830	5.2	21	3	13	15.7 %	130

Sinthiourou Lenguere	590	6.2	32	4	6	9.2 %	60
Thiaghalè	760	4.7	19	1	21	24.7 %	210

Source: Boulleré floristic inventory data, field campaign 2025; author's calculations.

The height of individuals is much more discriminating. The mean height is 8.7 m in the gallery forest, compared with 5.8 m in the secondary forest and 5.3 m in the degraded forest. The distribution by height classes (Figure 4) shows that in these two forests the lower and upper classes are empty. But in the gallery forest, there is a stratified vertical structure: the 15-20 m stratum is well represented and there are even individuals that exceed 20 m. Polynomial trend curves show the difference in shape. Especially in secondary and degraded forests, we have a rapid decline, while in the gallery forest we have a more spreading profile.

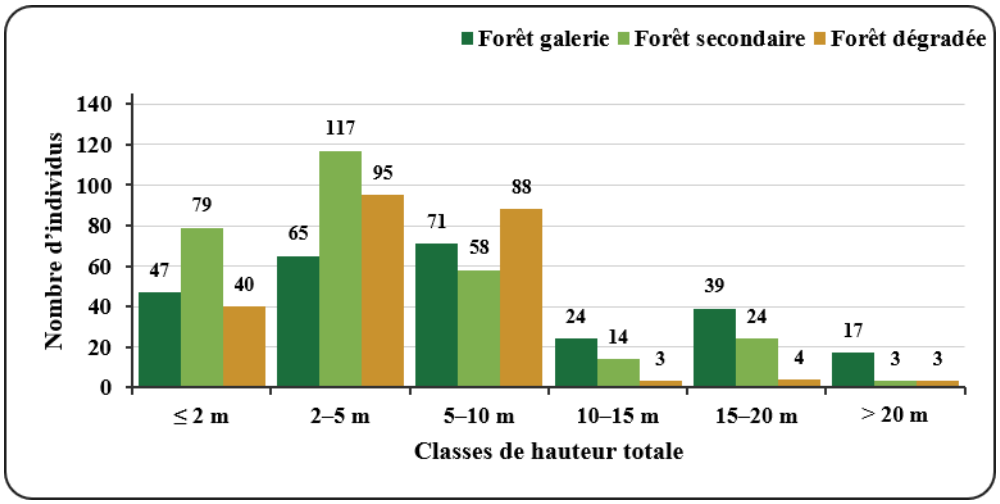

Figure 4: Distribution of individuals by height classes by type of plant formation/ Source: Boulleré floristic inventory data, field campaign 2025

The presence of large trees (height greater than 15 m) sums up this contrast (Table 4). Of the 102 large trees recorded, 62 are in the gallery forest, 32 in the secondary forest and only 8 in the degraded forest. Boulleré (26), Daara (19) and Bandodj Touguijè (17) are the most abundant trees, while Thiaghalè has only one. The rapidly declining trend curve highlights the increasing scarcity of adult populations along the degradation gradient.

3.4 Natural regeneration and disturbance

In the analysis, individuals with a height of 2 metres or less were considered a natural regeneration. 166 individuals meet this criterion, about one in five (Table 4). Regeneration is more common in the secondary forest with nearly 200 individuals per hectare and 27% of the total. It is less significant in the gallery forest (150 individuals per hectare) and degraded forest (133 individuals per hectare). At the village level, Boby Dantary (27 individuals, 270 per hectare) and Sinthiourou Thiouladji (26 individuals, 260 per hectare) are particularly active in regeneration. Sinthiourou Lenguere, where there are only 6 individuals, at the smallest regeneration of the region. This village has a strong agricultural footprint and one of the weakest specific riches.

The distribution of trees and shrubs illuminates this fact. In all cases, shrubs dominate and account for 81% of inventoried individuals. The percentage of trees still stands at 33-37% in the gallery forest, but falls to 5% in Petoun djiga and Thiaghalè. The two trend curves go in different directions, from trees to shrubs, as we move from the gallery forest to the degraded forest. This shift to shrub vegetation is one of the most obvious signs of the degradation of the formations studied.

These disturbances were identified by two sources, first by the degradation index at each survey unit (a total of 10 plots and 6 transect stations (17 per village) and second by georeferenced observations of the degradation transect. The labels were divided into six categories, with one of the observations on each of them falling into the six categories (Table 5).

Table 5: Disruptions observed by village (number of records)

Village	Wood cutting	Bushfires	Land clearing	Agriculture	Pasture	Wood extraction	Other	Total
Bandodj Touguijè	13	4	2	7	0	4	3	33
Boulleré	11	2	2	3	0	0	0	18
Daara	16	5	1	1	0	0	2	25
Boby dantary	17	3	2	7	0	0	1	30
Lopè	6	2	0	2	0	1	1	12
M'Body Foulasso	6	0	0	1	0	0	1	8
Sinthiourou Thiouladji	1	0	0	2	0	0	0	3
Petoun djiga	7	0	1	4	0	0	0	12
Sinthiourou Lenguere	11	0	0	15	0	0	0	26
Thiaghalè	5	0	2	6	0	4	0	17
Total	93	16	10	48	0	9	8	184

Flooding: destruction of cover, deforestation, fallow areas. Agriculture: fields (rice, potato, market garden), cashew plantations, gardens. Wood extraction: coal, carbonization, wood transport, timber. Others: collecting medicinal plants, hamlets, human presence. Source: Boulleré floristic inventory data, field campaign 2025; author's calculations.

Wood cutting is by far the most common disturbance (93 out of 184 records) found in the 10 villages and mainly affects Boby Dantary, Daara, Bandodj Touguijè and Sinthiourou Lenguere (Table 5, Figure 5). Agriculture is in second place (48 mentions), mainly cashew and rice fields. It is the most common in Sinthiourou Lenguere. The bushfiress (16 mentions) mainly affect Daara and Bandodj Touguijè. charcoal production and wood transport are mainly observed in Thiaghalè and Bandodj Touguijè, under the name of "wood extraction". Clearing and fallow land are less frequent and no grazing has been observed.

By collecting all records (Figure 5), Bandodj Touguijè (33), Boby dantary (30), Sinthiourou Lengueré (26) and Daara (25) are the most disturbed sites. The downward trend indicates that pressure is generally higher in the villages of gallery forest than in those of degraded forest, which is consistent with the idea of selective exploitation of the remaining forested areas.

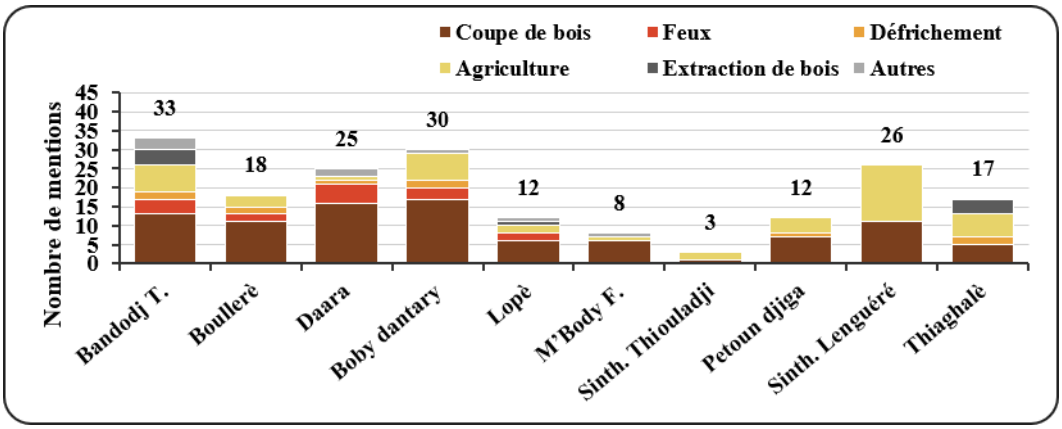

Figure 5: Disruptions observed by village by type (number of records)

Source: Boulleré floristic inventory data, 2025 field campaign

3.5 Useful plant species

Of the 130 species listed, 27 are mentioned as having been declared for use by Community guides, for a total of 189 citations (Table 6). The species are presented with their names in Poular, an indicator of their local knowledge: Siilla for *Icacina oliviformis*, Guobi for *Carapa procera*, *Doundukè* for *Sarcocephalus latifolus* or Sindja for *Cassia fistula*.

Table 6: Useful species, scientific names, families, Poular names, use categories and citation frequencies

Species	**Family**	**Pular name**	**Usage (s)**	**Citations**	***Species***	**Family**	**Pular name**	**Usage(s)**	**Citations**
Icacina oliviformis	Icacinaceae	Siilla	Food	27	*Anisophyllea laurina*	Anisophylleaceae	Kansi	Construction	2
Carapa procera	Meliaceae	Guobi	Medicine	24	*Cassia grandis*	Fabaceae	Sindja	Medicine	2
Sarcocephalus latifolius	Rubiaceae	Doundukè	Medicine	23	*Eucalyptus robusta*	Myrtaceae	Boullè	Medicine	2
Cassia fistula	Fabaceae	Sindja	Medicine	22	*Afzelia xylocarpa*	Fabaceae	Bouppè	Construction	1
Lophira lanceolata	Ochnaceae	Manlaga	Medicine	16	*Bridelia ferruginea*	Phyllanthaceae	Baniballè	Food	1
Vitex madiensis	Lamiaceae	Capped	Medicine	15	*Combretum collinum*	Combretaceae	Dooki	Medicine	1
Spondias mombin	Anacardiaceae	Thyalè	Food	9	*Combretum indicum*	Combretaceae	Dooki	Medicine	1
Elaeis guineensis	Arecaceae	Tougui	Food	8	*Dialium guineense*	Fabaceae	Meko	Food	1
Combretum micranthum	Combretaceae	Kankaliba	Medicine	6	*Parkia biglobosa*	Fabaceae	Nètè	Food	1
Newbouldia laevis	Bignoniaceae	Soukounden	Medicine	6	*Robinia pseudoacacia*	Fabaceae	N'Boyla	Medicine	1
Anthocleista grandiflora	Gentianaceae	Boom	Medicine	5	*Smilax laurifolia*	Smilacaceae	Ballè betè	Wood energy	1
Combretum glutinosum	Combretaceae	Kamafassa	Medicine	5	*Xylopia aethiopica*	Annonaceae	Guile	Medicine	1
Anacardium occidentale	Anacardiaceae	Yalagè porto	Food	4	*Xylopia aromatica*	Annonaceae	Broubrou	Medicine	1
Cassia sieberiana	Fabaceae	Djégou	Medicine	3	*Total: 27 species*				189

Source: Boulleré floristic inventory data, field campaign 2025; author's calculations.

Traditional medicine is the primary use (Figure 6) and covers 17 species and 134 citations, representing more than 70% of the total. Next comes the feeding with 7 species and 51 citations, followed by construction wood (2 species) and firewood (1 species), which are in retreat. No reference was made to fodder. The low presence of firewood in the declarations contrasts with the importance of coal cutting and production observed on the ground. This suggests that this use, although real, is less spontaneously associated with a particular species by informants.

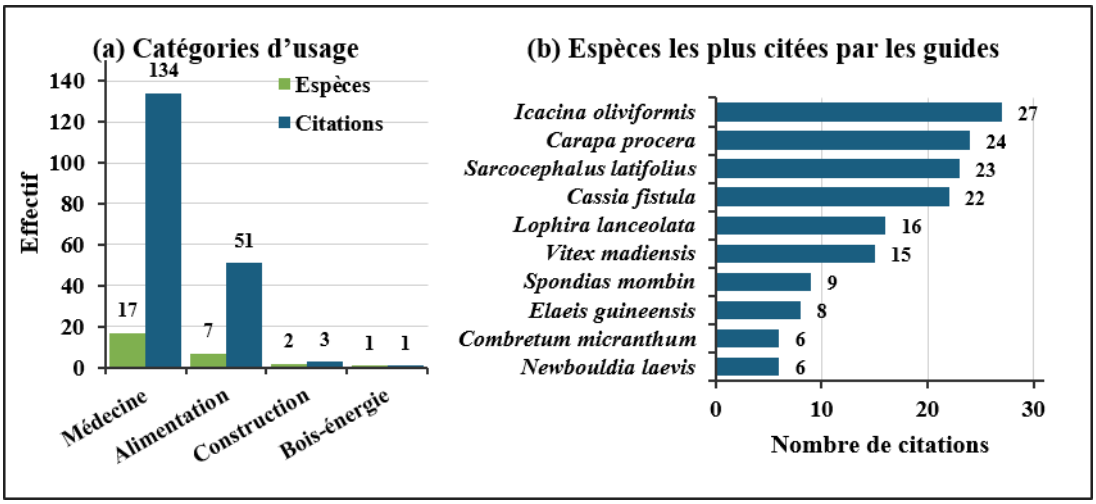

Figure 6: Useful species cited by Community guides: (a) distribution by use category; (b) the most cited species. Source: Boulleré floristic inventory data, 2025 field campaign

3.6 Floristic synthesis and relationships between parameters

Table 7: Synthetic classification of villages (value and rank in parentheses)

Village	Vegetation formation	Richness S	Shannon H'	Density (stems/ha)	Regeneration	Disturbances	Mean rank
Boulleré	gallery forest	56 (1)	3,74 (1)	820 (3)	20 (4)	18 (6)	3.0
Sinthiourou Thiouladji	Secondary forest	32 (6)	3,17 (7)	860 (1)	26 (2)	3 (1)	3.4
Petoun djiga	Degraded forest	35 (4)	3,34 (4)	830 (2)	13 (7)	12 (3)	4.0
Bandodj Touguijè	gallery forest	51 (2)	3,73 (2)	810 (4)	16 (5)	33 (10)	4.6
Thiaghalè	Degraded forest	33 (5)	3,25 (5)	760 (6)	21 (3)	17 (5)	4.8
Daara	gallery forest	49 (3)	3,69 (3)	630 (7)	11 (9)	25 (7)	5.8
Boby dantary	Secondary forest	31 (7)	3,24 (6)	620 (8)	27 (1)	30 (9)	6.2
Lopè	Secondary forest	28 (9)	3,07 (9)	780 (5)	12 (8)	12 (3)	6.8
M'Body Foulasso	Secondary forest	29 (8)	3,05 (10)	530 (10)	14 (6)	8 (2)	7.2
Sinthiourou Lenguere	Degraded forest	28 (9)	3,10 (8)	590 (9)	6 (10)	26 (8)	8.8

Source: Boulleré floristic inventory data, field campaign 2025; author's calculations.

Table 7 shows that Boulleré has the best average ranking among villages (3.0) with the region's greatest richness and diversity, good density and moderate disturbance. It is followed by Sinthiourou Thiouladji (3.4) who manages to resist with the highest density of the region, the highest rates of regeneration and the least reported disturbance despite its relatively low richness. Petoun djiga (4.0) is in third place due to its high density, better diversity than other degraded

forest villages, and low disturbance. Bandodj Touguijè and Daara are the richest and most diverse villages, but the highest pressure they encounter (cut, fire and regeneration), and for Daara, a lower degree of regeneration. At the other end, the least favourable situations are Sinthiourou Lenguere (8.8), M'Body Foulasso (7.2) and Lopè (6.8). Sinthiourou Lenguere has low wealth, lower regeneration in the region and strong agricultural influence. It therefore seems to be the most problematic site. M'Body Foulasso has a low density and diversity. Lopè is among the weakest in wealth and regeneration.

The most obvious relationship (Figure 7) is between species richness and the Shannon index (r = 0.98; ρ = 0.95). This confirms that diversity in such equitable communities depends primarily on the number of species. Similarly, density is very closely related to the number of individuals (r = 0.93). This is expected since the study area is the same in all villages. The most interesting result is how diversity is linked to the vertical structure of communities. For example, species richness increases as large trees are added (r = 0.87), the proportion of trees increases (r = 0.76) and the mean height is increased (r = 0.74). The Shannon index follows the same trend. These three structural parameters are also strongly correlated (r = 0.85 to 0.88) and are significant with the coefficient of Spearman (ρ = 0.83 to 0.94). Thus, the villages that have retained a population of high and dense trees are also the richest in terms of species.

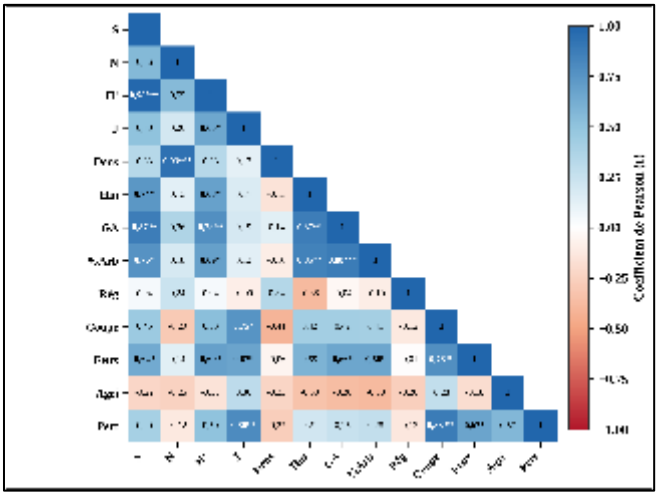

Figure 7: Pearson correlation matrix (r) between the floristic parameters of the ten village sites

* p < 0.05; ** p < 0.01; *** p < 0.001 (n = 10). S: richness; N: individuals; H': Shannon; J: Pielou; Dens: density; Hm: mean height; GA: large trees; %Arb: proportion of trees; Reg: regeneration; Cut, Fire, Agri: mentions; Pert: total disturbance

However, the correlation between diversity and structure loses meaning with the coefficient of Spearman (ρ = 0.4). They depend in fact on the distance between the three gallery forest villages and the other seven rather than on the evolution of the villages from one village to another. They therefore mainly reflect the effect of plant formation. Regeneration, however, has no significant relationship with other parameters. In fact, it tends to decrease with mean height (r = -0.38 and ρ = -0.50) and young individuals benefit more from open environments than closed communities with less ground light. Disruption indicators, too, can lead to a paradoxical conclusion. bushfiress were positively correlated with richness (r = 0.64), diversity (r = 0.69), number of large trees (r = 0.66) and proportion of trees (r = 0.66).

Wood cutting and total disturbance are positively associated with equity (r = 0.75 and 0.80). These relationships do not mean that the disturbance is good for diversity. Rather, they suggest that human pressure is still exerted on forested and rich areas where wood and resources are available. Fires and cuts are also closely related (r = 0.78), suggesting that they are in line with each other in recovery. On the other hand, agriculture was negatively related to the number of large trees (r = -0.36) and the proportion of trees (r = -0.38). These correlations are not very significant, but they indicate the replacement of trees in these villages with crops. That is why we take their correlation with caution. In only ten villages, we use disturbance indicators on three of them and they are not causal relationships.

3.7 Respondent Profile

community surveys were conducted in the ten villages of the study. Two hundred questionnaires were administered, 196 of which are usable (98.0%). The four untapped results were rejected. Therefore, the analyses are based on 196 valid responses (Table 8). For multiple-choice questions, one respondent could choose from several options; Thus, the sum of the percentages may exceed 100%.

Most respondents are men (58.9 per cent men and 41.1 per cent women) and they are predominantly community (95.3 per cent). Almost half (49.5%) have been living in the community for more than 30 years and less than one in ten (8.8%)

for less than 10 years (Table 8). Their testimony about the evolution of the environment is rooted in the time they have spent in the community. The questionnaire did not ask for age, however the length of residence is used here as an indicator of experience with the territory.

Table 8: Distribution and characteristics of respondents by village (population)

Village	Vegetation formation	Respondents	%	Men	Women	Residence > 30 years	Agriculture	Livestock
Bandodj Touguijè	gallery forest	12	6.1	8	3	5	8	2
Boulleré	gallery forest	64	32.7	38	25	33	61	53
Daara	gallery forest	11	5.6	4	6	8	11	11
Boby dantary	Secondary forest	11	5.6	9	2	8	11	11
Lopè	Secondary forest	18	9.2	12	6	13	17	17
M'Body Foulasso	Secondary forest	17	8.7	6	11	6	17	17
Sinthiourou Thiouladji	Secondary forest	16	8.2	9	7	3	16	16
Petoun djiga	Degraded forest	18	9.2	10	7	1	18	17
Sinthiourou Lenguere	Degraded forest	13	6.6	9	4	5	13	13
Thiaghalè	Degraded forest	16	8.2	8	8	8	14	7
Total exploitable	--	196	100.0	113 (59 %)	79 (41 %)	90 (49 %)	186 (96 %)	164 (85 %)

Source: community surveys, Boulleré district; author's calculations.

3.8 Perceived causes and temporality of degradation

The main causes of deforestation in mining areas are composed, with 194 respondents reporting an average of 5.9 causes (Figure 8a). Mining is most frequently cited (94.8% of respondents), followed by charcoal production (82.5%) and logging (82.0%). Clearing for mining infrastructure is also cited by most respondents (72.7%).

Perceived causes are dominated by mining, charcoal production, forestry and mining infrastructure. These results describe the factors that communities highlight and do not in themselves demonstrate direct causality.

The comparison of villages shows a broad consensus on the role of mines in more than 80% of respondents everywhere. The differences are more marked by other factors: agriculture is mainly promoted in Boby dantary (82%) and much less in Bandodj Touguijè (25%); charcoal production is less mentioned in Lopè (53%) than in other villages.

The respondents' concerns were first mines (69.4%) (Figure 8b), then charcoal (55.2 %) and wood cutting (41.0%). Amongst which we have mines dominate in 7 villages, charcoal in Bandodj Touguijè, Boby dantary and wood cutting in Sinthiourou Lenguere.

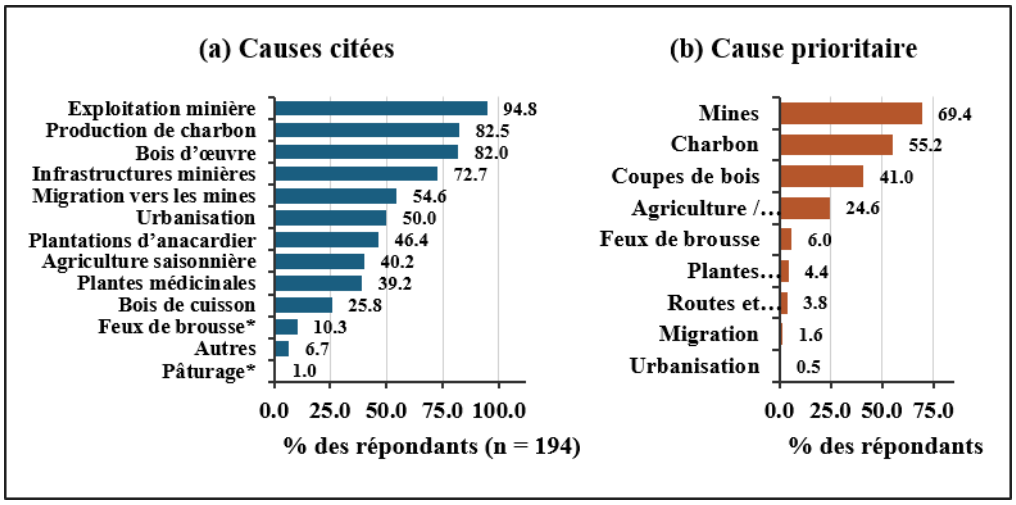

Figure 8: Causes of degradation cited by respondents (a) and cause considered most of concern (b). * spontaneously quoted in the comments. Source: community surveys, Boulleré

The intersection with the length of residence is a good answer. Residents who have lived for less than 10 years place almost all deforestation in the last decade (92%), which makes sense given their length of stay. But among those who have lived for more than 30 years, a large proportion go back 20 years (46%) or 30 years (16%). The perception of a recent acceleration is therefore shared, but the oldest residents bear witness to a deterioration that began earlier.

3.9 Perceived environmental and socio-economic impacts

Deforestation is associated with some commonly shared environmental effects (Figure 9a). Most respondents cited loss of arable land (97.4%) and loss of biodiversity (95.3%) as the greatest concerns, followed by water and air pollution, hydrological changes and depletion of natural resources.

Comments indicate the nature of these impacts are composed of sedimentation and drainage of streams, reduced precipitation, heat and dust. These observations, mentioned spontaneously, align with the hydrological changes proposed in the questionnaire.

The problem is widespread (Table 9): 92.5% of respondents believe that deforestation impacts the health and well-being of the community, and 89.6% say they are very worried about the future. Wildlife is very negatively affected by 79.3% of respondents, and the impact on plant diversity is high for 59.3% of respondents.

Table 9: Perception of the magnitude of impacts on health, fauna and flora

Question	Answer	Count	%	Question	Answer	Count	%
Impact on health and welfare	Yes	161	92.5		Positively	1	0.5
	No	5	2.9		Very Positive	3	1.6
	Does not know	8	4.6		Does not know	19	9.8
Concern for the future	Yes, very concerned	173	89.6	Plant diversity allocation level	High	108	59.3
	Yes, somewhat concerned	12	6.2		Moyennement	22	12.1
	No, not really worried.	8	4.1		Faible	12	6.6
Effet sur la vie sauvage	Very negative	153	79.3		Very low	22	12.1
	Negatively	17	8.8		Does not know	18	9.9

Source: community surveys, Boulleré district; author's calculations.

The most significant effect is the decline in agricultural yields (97.8%), followed by the loss of livestock and pasture (80.1%) and arable land (77.9%) (Figure 9b). The reduction of forest products and pharmacopoeia is also a concern for 61.3% of respondents. Details on the decrease in harvests (10 bags of seed reduced to 3 bags of seed), shortages of water and feed for livestock, theft and livestock accidents due to the opening of mining roads, and dust on crops are also discussed. Disposable wood and income are not mentioned in the comments (9 references to loss of income).

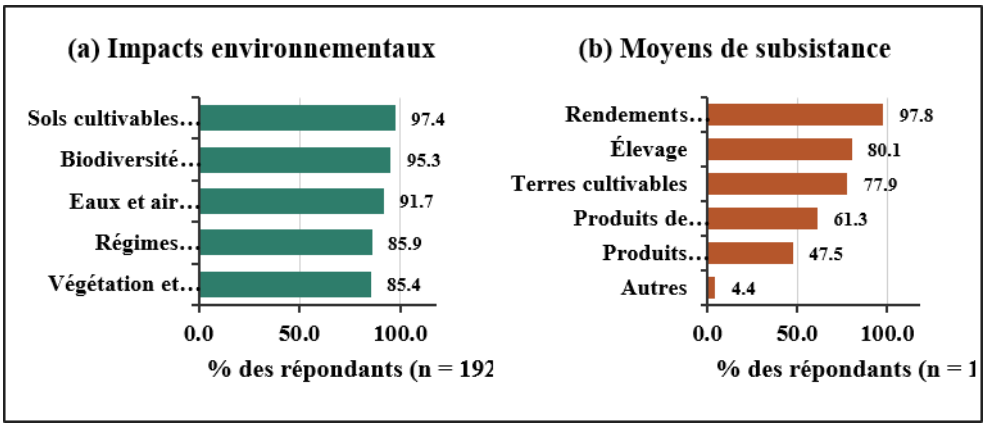

Figure 9: Environmental impacts (a) and livelihood effects (b) reported by respondents. Source: community surveys, Boulleré

3.10 Useful species perceived as affected and presence in inventories

On the question of which plant species are most affected by deforestation, 169 respondents identified species, mainly under their respective local names in Poular. These names were grouped together and associated with scientific names based on local names listed in floristic inventories (Table 10). 26 species or groups of species were located.

Table 10: Plant species reported as most affected and correspondence with floristic inventories

Local name	Scientific name (correspondence)	Citations	% of respondents	Villages (survey)	Individuals inventoried	Villages (inventory)	Use
Lengué	*Afzelia africana*	73	43.2	9	8	6	--
Bani	*Pterocarpus erinaceus*	64	37.9	10	18	6	--
Nètè (néré)	*Parkia biglobosa*	64	37.9	10	19	9	Food
Koura	*Parinari excelsa*	57	33.7	10	7	6	--
Thièwè	*Daniellia oliveri*	56	33.1	10	33	7	--
Kahi (Caïlcedrat)	*Khaya spp.*	44	26.0	9	1	1	--
Meko	*Dialium guineense*	44	26.0	9	31	10	Food
Thimmé	*Milicia excelsa / M. regia*	35	20.7	9	2	2	--
Téli	*Erythrophleum suaveolens*	30	17.8	10	4	3	--
Malanga	*Lophira lanceolata*	20	11.8	8	16	7	Medicine
Bantan (fromager)	*Ceiba pentandra*	19	11.2	8	1	1	--
Kansi	*Anisophyllea laurina*	15	8.9	6	13	3	Construction
Bottled	*Uvaria chamae*	10	5.9	5	50	10	--

Porrè (rubber liane)	*Landolphia spp.*	8	4.7	6	23	8	--
Loukoun	*Unidentified with certainty*	8	4.7	6	absent	--	--
Doundukè	*Sarcocephalus latifolius*	6	3.6	4	23	7	Medicine
Siilla	*Icacina oliviformis*	5	3.0	2	27	8	Food
Endhanma	*Holarrhena floribunda*	3	1.8	3	30	7	--
Barkè	*Piliostigma thonningii*	2	1.2	2	11	7	--
sTougui (palmier)	*Elaeis guineensis*	2	1.2	2	8	2	Food
Kollè yala	*Allophylus africanus*	2	1.2	2	23	8	--
Yalagè tiangol	*Uapaca spp.*	2	1.2	1	3	2	--
Boto	*Detarium senegalense*	2	1.2	2	3	3	--
Nongo (figuier)	*Ficus spp.*	1	0.6	1	16	7	--
Maronaye	*Albizia zygia*	1	0.6	1	14	8	--
Kankaliba	*Combretum micranthum*	1	0.6	1	7	6	Medicine

n = 169 respondents who cited at least one species. Correspondances based on local names of the floristic inventory; Kahi = cailcedrat (*Khaya senegalensis* cited, *K. grandifoliola* inventoried); to be validated with a botanist. The issue did not distinguish rare, declining or difficult to access species. "Not present" = species not found in plots and itinerant surveys. Use: use indicated by Community guides.

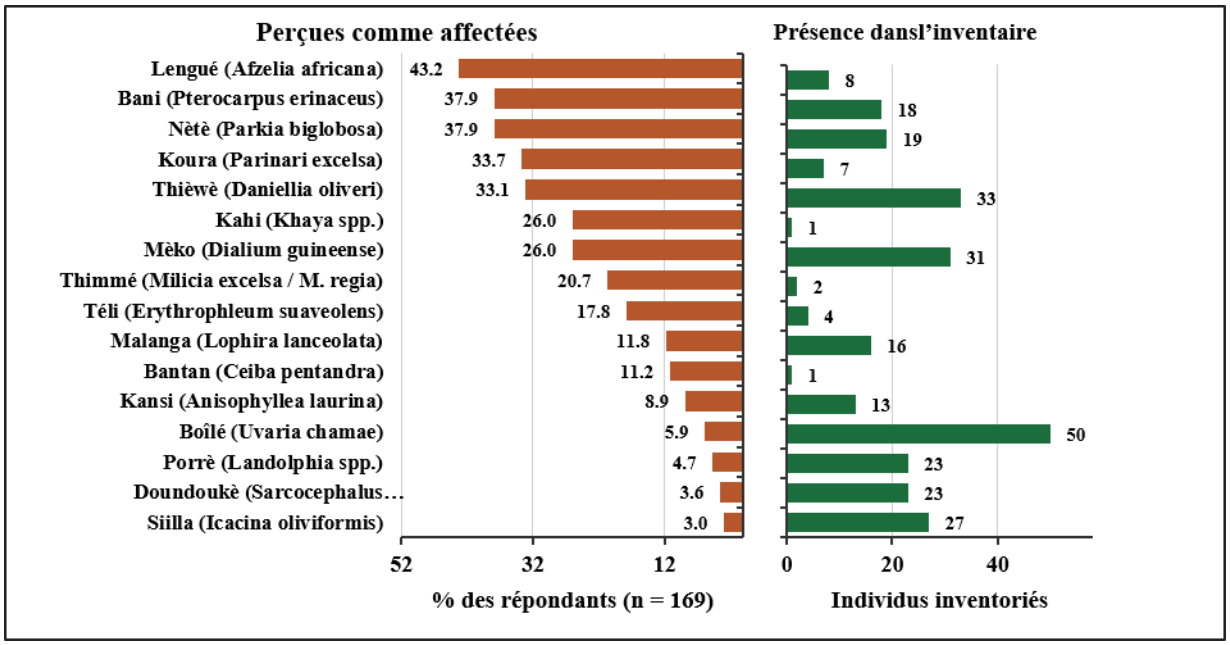

Figure 10: Species most cited as affected by deforestation and number of individuals surveyed. Source: community surveys (n = 169 respondents) and floristic inventory, Boulleré

The most cited species (Figure 10) are high-value trees such as lengué (*Afzelia africana*, 43.2%), bani (*Pterocarpus erinaceus*, 37.9%), Néré or nètè (*Parkia biglobosa*, 37.9%), koura (*Parinari excelsa*) and Thièwè (*Daniellia oliveri*). These

species are both sought for wood and useful for feeding, pharmacopoeia or forage. Thimmé (iroko), teli, kahi (cailcedrat) and malanga complete the list. Several respondents pointed out that "large trees are already threatened."

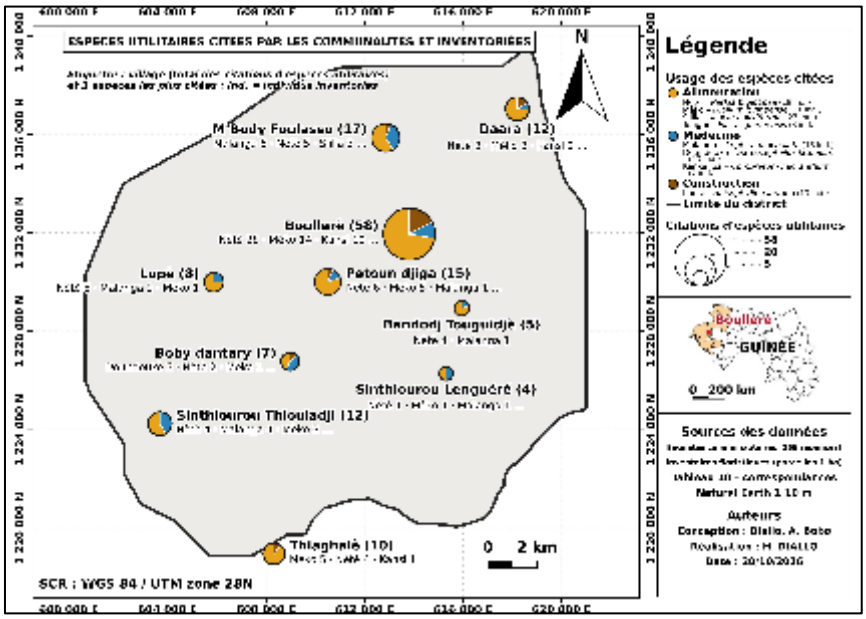

Figure 11: Distribution map of the useful species inventoried and cited in the Boulleré district

Comparisons between inventory species (Table 10) and those cited (rare) by communities show that 25 of the 26 species listed were found in the field. Some of the species mentioned are even abundant in inventories (Thièwè, *Daniellia oliver*i, 33 individuals) or meko (*Dialium guineense*, 31 individuals). Rarity of large, exploitable specimens is more likely the reason, rather than the disappearance of such species. In other cases, some of the highly discussed species are not well represented in inventories (Lengé, Koura, Kahi (cailcedrat), Thimmé, Téli, Bantan (fromager), etc.) and the rarity is very clear. This is particularly true for *Afzelia africana* (Lengué), who is vulnerable and mentioned by 43.2% of respondents but has only 8 individuals in the inventories.

Most uses are related to feeding with Nètè or nérée, Meko, Siilla and Tougui. There are three species associated with traditional medicine: Malanga, Doundukè and Kankaliba. Kansi is known for its construction. Nètè is the most useful species with 64 records, while Mèko has the largest number of records (44) and the widest distribution since it was inventoried in the ten villages. Several profiles can be distinguished with this comparison. Nètè has a high declared importance with a fairly small field presence. Mèko combines community importance, abundance and wide distribution. Siilla and Doundukè are abundant, but few mentioned in the surveys.

The profiles can be used to classify the species to be studied. Those that are often mentioned but rarely observed should receive special attention, and those that are useful, abundant and widely distributed can be key resources for communities.

For useful species, 169 respondents identified 26 particularly affected species or groups of plants. The most cited are Lengué, Bani, Néré, Koura and Thièwè. Twenty-five of them are in floristic inventories but some of them are very rare and few in the field. The results therefore indicate that the degradation of vegetation cover is seen as an ecological, economic and social process.

4 DISCUSSIONS

The results are based on two independent sources: inventories using the same methodology at ten village sites and a survey of 196 respondents. They show an increase in floristic and structural degradation, pressure on forested formations and community perceptions that converge towards rarity of large useful species. The observation mechanism (ten sites, dry season campaign, retrospective perceptions) allows the formation of coherent associations but no causal relationships.

4.1 Gallery forests as reservoirs of diversity and useful species

The three gallery forests contain 106 of the 130 species surveyed and 56 that were not found elsewhere, with indices of Shannon ranging from 3.69 to 3.74 nats, and 62 of the 102 large trees. Secondary forest and degraded forest villages

each have 28-35 species and secondary forest has more individuals (295) than gallery forest (263) [33]. This contrast shows the refuge role of the riparian formations already described in the bauxite zone of Sangarédi where the gallery forest integrity is very intact and very degraded. This also reflects the situation in other Sudan and Guinean formations where the wealth and structure of populations are destroyed with the intensity of use. Fabaceae (25 species, 219 individuals) dominated these formations. For useful species, this concentration has a direct effect. Much of the diversity depends on rare or localized species: 54 species were found in a single village and 67 in a single village. Of the 27 useful species mentioned by the guides, *Cassia grandis*, *Anthocleista grandiflora*, *Combretum indum* and *Combretum collinum* were found only in gallery-forest villages. Their availability therefore depends on the survival of some wooded fragments. The loss or fragmentation of these formations would affect both the floral diversity and the plant resources that villages need (Arouna et al., 2017; Fousséni, 2023; Kombate et al., 2020).

4.2 Degradation marked by loss of species and large trees

Evenness is high and stable (J = 0.91 to 0.95): no village is dominated by one or two pioneer species. Rather, degradation is manifested by loss of species and simplification of vertical structure. The mean height decreased from 8.7 m in the gallery forest to 5.3 m in the degraded forest, the proportion of trees decreased from 33-37 % in the galleries to 5 % in Petoun djiga and Thiaghalè, and Thiaghalè had only one large tree. Correlation with wealth, large trees, proportion of trees and mean height (r = 0.74 to 0.88) suggests that the villages that maintained a population of high trees are also the richest. However, they mainly reflect the difference between the three galleries and the seven other sites. The density does not follow this gradient: the density of some degraded villages is high because shrubs grow. Density alone is not a good indicator of the state of formation and ecological integrity. Structures, composition and number of large trees are important for assessing degradation and ecological integrity. The decline of large trees is a particular problem as they provide ecological functions and resources that young individuals only replace a few decades later [21]. At Boulleré, the focus is on wood and multi-use species, and these are the ones communities report to have been most affected. The regeneration (H ≤ 2 m) has no impact on the other parameters. More abundant in secondary forests, including Boby dantary and Sinthiourou Thiouladji, it tends to decrease with mean height. This is consistent with the recolonization due to the opening of the canopy. In wood used for charcoal, stem discharges and young stems are also abundant, but with no guarantee of reappearance of [22] species. The very low regeneration of Sinthiourou Lenguere (60 individuals/ha), which is associated with the highest agricultural footprint (15 records), indicates a site where repeated clearing limits recolonization.

4.3 Selective pressure on wooded formations and valuable species

Wood cutting is the most frequent disturbance (93 of 184 records), and several of the most disturbed sites are gallery forests (Bandodj Touguijè, Daara). Positive correlations between fires or cuts and richness, diversity or evenness do not mean that disturbance promotes diversity. They indicate that sampling is concentrated where trees and resources remain. This selective exploitation scheme is documented for charcoal production, which first targets large individuals of hardwood species and reduces their basal area [22]. It is consistent with the evidence: charcoal production (82.5%) and lumber mining (82.0 %) are cited almost as often as mining.

The species most mentioned as affected are precisely timber species of high value. *Pterocarpus erinaceus* (bani), cited by 37.9% of respondents, is classified as Endangered on the IUCN Red List; Illegal logging has become its main threat and African populations of this kind are listed in CITES Annex II (OECD, 2016). *Afzelia africana* (Lengué), the most cited (43.2%), has only 8 individuals in the inventory; This threatened multi-use species undergoes sampling and fire in other West African savannahs [3]. *Khaya* spp., *Milicia* spp. and *Ceiba pentadra*, cited by 11-26% of respondents, are represented by only one or two individuals. For these species, the convergence between perception of rarefaction and low presence in plots is greatest.

4.4 Local knowledge and inventories: complementary sources

Twenty-five of the 26 taxa cited by respondents were found in the inventory, which means that local knowledge is correct for species in the region. However, the comparison revealed three profiles. The first group includes species often mentioned but rarely found in plots (Lengué, koura, kahi, thimmé, téli, bantan): perception and observation converge. The second group includes listed but abundant species, such as thièwè (*Daniellia oliveri*, 33 individuals) or mèko (*Dialium guineense*, 31 individuals in the ten villages): the rarity is more likely due to large exploitable individuals and not to the species itself. The third group concerns abundant and useful species but rarely mentioned as affected (*Icacina oliviformis*, *Sarcocephalus latifolus*, *Uvaria chamae*), shrubs or small trees that can survive in an open environment. This is consistent with the results in the Sahel, where many people report that species with high socio-economic value lose their place and those that grow are often exotic [44]. The presence of *Eucalyptus robusta* in the ten villages and the expansion of cashew plantations are also consistent with this hypothesis. The difference is also consistent with the ecological apparency hypothesis hypothesis that large, visible, long-lived plants are more frequently cited and valued [19]. One example is the Néré (*Parkia biglobosa*), where 37.9% of respondents reported it as affected but only once by the inventory guides. The two sources do not measure the same. The guides describe the uses of the plants found in the

plots, and respondents report a loss across the region. Similarly, the small number of firewood records (one species) is less important than cutting and coal in the field, which are omnipresent but rarely attributed to a species. These results recommend the combination of local knowledge and plant resource inventories in the [24] monitoring.

4.5 Perceived causes and impacts on land and livelihoods

Mining is the most frequently cited cause (94.8%) and of greatest concern (69.4%) in plots, although no direct mining disruption was found in plots where logging and agriculture are the dominant activities. The reason is the observation scale. The plots are planted in plant formations, and respondents are concerned about the land because it denuds the plateaus, opens up tracks and infrastructure that alter access to land and resources. The socio-environmental effects of bauxite extraction in the Boké region, such as loss of agricultural land, pollution and habitat destruction, are well documented [12], and mining is one of the major threats to biodiversity in Guinea [11]. The mine also indirectly influences the populations of this region (54.6% of respondents mentioned migration to mines) and the need for wood and charcoal [39]. Perceptions therefore reflect a set of mutually reinforcing pressures. Impacts on productive bases are significant: loss of arable land (97.4% of respondents) and agricultural yields (97.8% of respondents) and livestock (80.1%). The reduction in pharmacopoeia products reported by 61.3% of respondents links the degradation of the cover to useful species: traditional medicine is cited more than 70% of the time in the guides. In a country where 95.9% of respondents are engaged in agriculture, the lack of medicinal and food species has a negative impact on local resources essential to food health and security, as demonstrated by other studies in Guinea and Côte d'Ivoire [28]. These impacts are still reported: they are people's experiences and need to be verified by performance, availability of people's resources and income.

4.6 Management implications and limitations of the study

The results have three different directions. The first is to protect the remaining gallery forests and their large trees, which concentrate diversity and some useful species, by limiting cuts and fires in these formations. The second is to establish a list of priority species based on the profile. Species that are commonly cited but rare (*Afzelia africana*, *Pterocarpus erinaceus*, *Khaya* spp., *Milicia* spp., *Parinari excelsa*, *Erythrophleum suaveolens*) should be monitored and prioritized in the rehabilitation of mining sites and ecological restoration rather than exotic species [16]. The third is to engage communities in monitoring because their knowledge is not always reflected in occasional inventories. The inventories are based on ten plots and only one dry season [44]. This reduces the statistical power (only large effects can reach statistical significance with n = 10) and the identification of taxa that require reproductive organs to be determined. Names that have been identified by application are checked with reference to Guinean flora but the validity of herbarium specimens is still desired. The survey is not balanced between villages (64 respondents to Boulleré, 11 to Daara and Boby dantary) and we did not check the age of respondents but the memories.

CONCLUSIONS

This study combined floristic inventories at ten village sites with a survey of 196 respondents to analyze the effect of vegetation degradation on useful species in the Boulleré district. Woody flora has 130 species but is very unevenly distributed: gallery forest has 106 species and the majority of large trees, while secondary and degraded forests have poorer flora and shrub-dominated structure. Degradation results in loss of species and large trees rather than dominance of some species. Community guides mentioned 27 species of useful species, mainly medicinal and food. Degradation is associated with mining, charcoal production and logging, and people can feel it on land, agricultural productivity and pharmacopoeia. Twenty-five of the 26 species they consider to be a problem are on the ground, and several high-value species such as *Afzelia africana*, *Pterocarpus erinaceus, Khaya spp*., and Milicia spp. are frequently mentioned and rare in plots. The main management strategies are gallery forest conservation, participatory monitoring of priority species and integration of degraded and mining sites. Regular monitoring of populations of these species would help to better understand the effect of degradation on community plant resources.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest

Statement of informed consent

Informed consent was obtained from all participants before the interviews.

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