# Local perception on the importance of vegetation and Icacina senegalensis in Senegal: Case of Groundnut Basin, Casamance and Eastern Senegal agroecological zones

**Marie Elene Dione**

m.dione20150052@zig.univ.sn

Pan African University Institute of Life and Earth Sciences

**Abiodun Oluwafemi Oluwadare**

University of Ibadan

**Antoine Sambou**

Ziguinchor University

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# Local perception on the importance of vegetation and *Icacina senegalensis* in Senegal: Case of Groundnut Basin, Casamance and Eastern Senegal agroecological zones

**Abstract**

Local communities have alays a strong connection with vegetation. This study aimed to assess local communities' perceptions on the importance of vegetation and *Icacina senegalensis* in three agroecological zones of Senegal. To do that, a semi-structured survey was conducted in local people to gather information on ecosystem services, state and dynamics of vegetation and management strategies using a questionnaire via KoboCollect. The results showed a strong predominance of provisioning services (91.1%), followed by regulating services (8.4%) and cultural services (0.5%). Among provisioning services, human food (33.68%) and animal feed (32.62%) and medicinal use (33.68%) were the most frequently cited and utilised. However, human food (2.5) has a higher use value than medicinal use (1.81) and animal feed (1.1). In total, 70 multi-purpose species were recorded. Among these species, *Icacina senegalensis* (60.39%) was used mainly for medicine (57%). Other species including *Pterocarpus erinaceus*, *Moringa oleifera* and *Faidherbia albida were also usefull*. A moderately abundant (66.8%) and a decline (87.1%) in vegetation were oberved by people. Face to this degradation, reforestation (42.3%), forest protection (17%), conservation (16.49%) and firebreaks (10.3%) were the strategies proposed. *Icacina senegalensis* and several other species were importance sources for food, fodder and medicinal uses. Despite its importance, vegetation was moderately abundant with a general declining trend.

Keywords : vegetation, Icacina senegalensis, importance, use, condition, dynamics

## 1. Introduction

In Africa, vegetation is essential to human life providing a range of ecosystem services that ensure well-being, eradicate hunger and protect the environment (White, 1986). Through its ecosystem services, vegetation provides food, economic benefits and traditional medicine (Ngom et al., 2014) as well as regulatory, supporting and cultural services (MEA, 2005; Camara et al., 2017; Badiane et al., 2019). In Senegal, communities are heavily dependent on natural resources and vegetation which represent a major source of livelihood and resilience (Sarr et al., 2013). Vegetation, particularly woody species, plays essential roles such as ensuring food and energy security for rural households (Nguing et al 2013; Ngom et al., 2014; Sambou et al 2018).

Furthermore, in West Africa, several studies have shown that vegetation degradation is strongly linked to the expansion of agricultural land and the intensification of timber resource exploitation (Brandt et al., 2014). The NDVI and FAPAR time series showed significant greening since the 1980s particularly in the east, south-west and estuary zones, whilst the north and central-west showed signs of recent degradation (Solly et al., 2022; Brandt et al., 2014; Zeng et al., 2023). Furthermore, although there is regreening, this is accompanied by a loss of large trees, a dominance of certain hardy shrubs and a decline in species richness (Dendoncker et al., 2020). However, Sudano-Sahelian ecosystems are characterised by a gradual decline in plant biomass and habitat fragmentation (Herrmann et al., 2005; Fensholt et al., 2009; Gebremedhn et al., 2023). In Casamance and Senegal–Guinea-Bissau border area, the forest initially expanded then retreated after 2010, giving way to fields and bare soil (Cabral and Costa, 2017). Vegetation degradation in these areas results from a combination of anthropogenic and climatic factors. Major causes include agricultural expansion, deforestation linked to the harvesting of wood for energy, overgrazing and bushfires (Ndiaye et al., 2017; Diedhioun et al., 2018), as well as soil salinisation and climatic fluctuations. In Peanut Basin, salinisation promotes the formation of salt marshes and the decline of trees, despite the presence of young saplings (Sambou et al., 2016). Rainfall variability, recurrent droughts and rising temperatures affect the natural regeneration of plant species (Vincke, 2010). This leads to multiple ecological and socio-economic consequences. Vegetation degradation results in biodiversity loss, soil degradation and a reduction in ecosystem services (MEA, 2005) and directly affects the livelihoods of local populations by reducing access to essential plant resources (FAO, 2010).

Face to increasing degradation of vegetation, local communities and institutions have developed various strategies for the sustainable management of natural resources. The conservation of vegetation ressources relies on the establishment of protected areas, the regulation of timber harvesting and the control of bushfires reducing the anthropogenic pressures responsible for land degradation (Traoré et al. 2025), to this are added participatory approaches that integrate local knowledge and community-based natural resource management promoting the sustainable use of multi-purpose plant species (MEA, 2005). Face to increasing degradation, agroforestry also emerges as a key strategy in Sahelian systems, as it helps maintain vegetation cover whilst improving soil fertility and the resilience of production systems to climate change (Reij et al., 2009). Initiatives such as the Great Green Wall are promoting the restoration of tree cover and carbon sequestration, though with mixed results at the local level (Gore et al., 2023). In Senegal, ethnobotanical studies have shown that communities possess in-depth knowledge of plant species and their uses (Nguing et al., 2013). Furthermore, communities living near the Langue de Barbarie National Park recognise a wide variety of plant uses, particularly for food, medicine and livestock (Faye et al., 2023). In Ferlo and Groundnut zones, local perceptions highlight the importance of woody species in providing essential services to communities (Ngom et al., 2014; Ndiaye et al., 2017). These studies showed that perceptions varied according to socio-ecological contexts and strongly influenced natural resource management practices. It is therefore necessary to document local perceptions in order to contribute to better utilisation of vegetal resources and the development of sustainable management strategies adapted to local realities. This present study aimed to improve the level of knowledge regarding the importance, state and dynamics of vegetation and *Icacina senegalensis*.

## 2. Materials and Methods

### *2.1. Study Area Description*

The study was carried in Gouloumbou, Mboure Saly, Samboumba, Coubanack and Medina Boguel located in Eastern Senegal, Groundnut Basin and Casamance respectively (Figure 1).

Eastern Senegal was characterized by a Sudano-Sahelian to Sudano-Guinean climate and a wide variety of soils. The soils were mainly dominated by Lixisols, characterized by a sandy to sandy-ferruginous texture, low fertility, low water retention capacity and low organic matter content (Hernández et al., 2021; Zagre et al., 2024). There were also ferralitic and hydromorphic soils (Hernández et al., 2021). Annual rainfall varied from 600 to 1300 mm depending on latitude and altitude. Average annual temperatures ranged from 24.5°C to 29°C (Gueye et al., 2024). The Groundnut Basin area was characterized by a semi-arid to Sahelo-Sudanese climate. The predominant soils were Lixisols, ferruginous, hydromorphic or ferralitic soils depending on the topography (Malou et al., 2021; Faye et al., 2021; Hernández et al., 2021). Rainfall varied from north to south, ranging from 300 to 800 mm/year, with a tendency towards rising temperatures and high interannual variability in rainfall exceeding 1000 mm (Faye et al., 2024). Casamance had a tropical Sudano-Guinean climate and was characterized by tropical ferruginous, sandy-clay, hydromorphic and acidic or saline soils. The saline soils were poorly suited to agriculture due to salinity and acidity (Diatta et al., 2021). Gouloumbou is located in the department of Tambacounda. Mboure Saly in the department of koungheul, located between longitudes 15°86' W and 14°58' E and latitudes 14°74' N and 13°74' S (Bakhoum et al.,2013), and Samboumba in the department of Nioro du Rip. Coubanack is located in the department of Bignona and Medina Boguel in the department of Kolda (12°53’00’ ‘N, 14°57'00’' W).

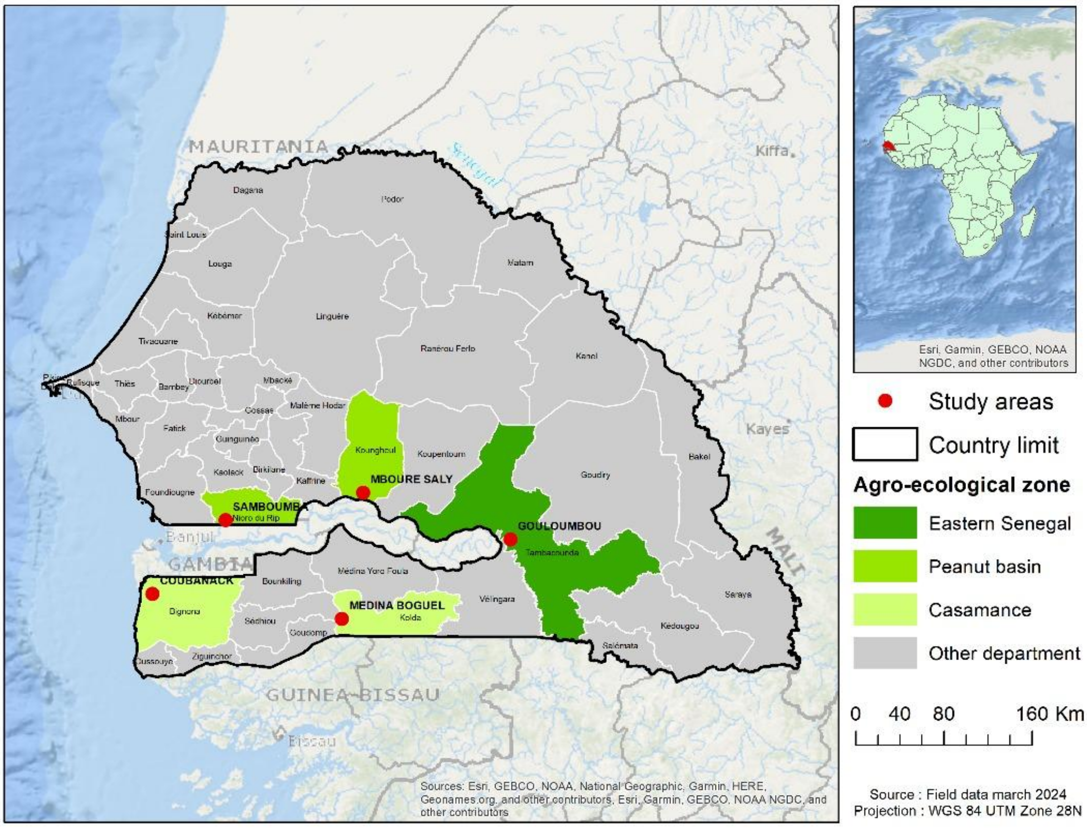


Figure 1: Location of the study area

### *2.2. Data collection*

Socio-economic and ethnobotanical surveys were carried out in three agro-ecological zones (Eastern Senegal, the Peanut Basin and Casamance). The choice of sites to be surveyed was based on the criterion of the presence of *I. senegalensis*. Based this criterion, five sites (Gouloumbou, Samboumba, Saly Mboure, Coubanack and Medina Boguel) were selected randomnly for the surveys (Figure 1). A preliminary survey visit was carried out during which information regarding the total number of households at each site was collected from the village chiefs. Sampling was therefore carried out using Fisher’s formula :

$$Nf = \frac{n}{1 + n/N} X100$$

Where n = 1/d² ; Nf = sample size ; d = margin of error (10%) ; N = total number of households

Nf=100/(1+100/N)

A total of 202 households including 74 in Gouloumbou, 34 in Samboumba, 12 in Saly Mboure, 65 in Coubanack and 17 in Medina Boguel were selected for the survey (Table 2). At each site, the households to be surveyed were selected randomnly. Within each household, the head of household was selected as the survey respondent. The choice of the head of household as the survey unit is justified by the fact that heads of household are best placed to provide the information. However, in some cases, it is the head of household's wife who is interviewed. In order to determine the perception on the importance of the vegetation and *Icacina senegalensis*, semi-structured survey using questionnaire based on Kobocollect was administered to people (Figure 2). The survey document information including ecosystem services provided, state and dynamics of vegetation and Icacina senegalensis, and recommended management strategies for the effective management, protection and conservation. Following the surveys, the species names provided in local languages were identified using the manuals « L'Arbre dans le paysage sénégalais » by Giffard (1974) and « Flore illustrée du Sénégal » (second edition) by Berhaut (1967), as well as certain Fulani names (Aba et al. 2012).

*Table 1: Number of respondants interviewed in each site*

| Sites | Number of households | Sample |
|---|---|---|
| Gouloumbou | 270 | 73 |
| Samboumba | 50 | 33 |
| Saly Mboure | 13 | 12 |
| Coubanack | 190 | 65 |
| Medina Boguel | 21 | 17 |

*Figure 2 : Interview with a household chief*

### *2.3. Processing and analysis of survey data*

The survey data were processed using Excel and analysed with R software. To better understand population's perception on the importance, state and dynamics of vegetation and Icacina senegalensis, citation frequency, fidelity level, use value and informant consensus factor were calculated.

For each category of use, a Citation Frequency (CF) analysis was carried out using the following formula :

$$CF = \frac{\text{Number of Citation of a species for a usage category}}{\text{Total number of respondents}} X100$$

The Fidelity Level of a species in relation to different categories (Cheikhyoussef et al., 2011 ; Gning et al., 2013 ; Sambou et al., 2018), the Fidelity Level (FL) was determined by :

$$FL = \frac{\text{Number of citation of the species for a category}}{\text{Number of records for the species across all categories}} X100$$

For each species listed, a Use Value (UV) as defined by Phillips et al. (1994) was assessed. The Use Value is a way of expressing the relative importance of each species to local communities in terms of uses :

$$UV = \frac{\sum \mathrm{U}}{n}$$

Where U = number of citations per species; n = number of informants

Public consensus on the uses of vegetal resources was also assessed by calculating the (Heinrich et al., 1998). Informant Consensus Factor (ICF) values range from 0 to 1. A high IFC value (closer to 1) is obtained when a single species or a small number of species is cited by a large proportion of informants for a given use category. Conversely, the value is lower (closer to 0) when a wide variety of species are cited for the same use (Ngom et al. 2014).

The IFC is calculated using the following formula :

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where Nur = number of citations for each category, and Nt = number of species in that category.

Principal Component Analysis (PCA) was carried out using R software to identify variations and characteristics relating to respondents, ecosystem services, state, dynamics and conservation strategies.

## 3. Results

### *3.1. Socio-economic characteristics of respondents*

The results of the socio-economic survey showed variations in social characteristics across the different sites (Figure 3). More than half of the respondents (66.33%) were men. The distribution of respondents by gender and age varied across sites. The proportion of men respondents ranges from 0% (Saly Mboure) to 82.35% (Medina Boguel). The age of respondents ranged from 38 years (Saly Mboure) to 53 years (Samboumba). In terms of ethnicity, the results revealed that the respondents are predominantly Fulani (36.13%), followed by Diola (31.18%), Socé (10.89%), Serer (6.43%), Wolof (6.43%) and others (8.91%). A majority of Fulani was recorded in Medina Boguel (94.11%), Samboumba (52.94%) and Gouloumbou (52.70%). Conversely, the Diola made up the majority in Coubanack (96.92%) and the Wolof in Saly Mboure (91.67%). In terms of educational attainment, the survey showed that 31.18% of respondents attended only a koranic school, primary school (29.20%), lower secondary school (18.81%), upper secondary school (7.92%), uneducated (5.94%), higher education (2.47%) and Franco-arab school (2.47%). In Coubanack (27.69%) and Gouloumbou (35.13%), the largest proportion of respondents attended only a Koranic school, whereas primary education was more prevalent in Samboumba (50%), Saly Mboure (58.33%) and Medina Boguel (35.29%). As for marital status, the proportions varied according sites (Figure 4). Thus, 91.6% of those surveyed were married, widowed (4.95%), single (2.48%) and divorced (0.99%).

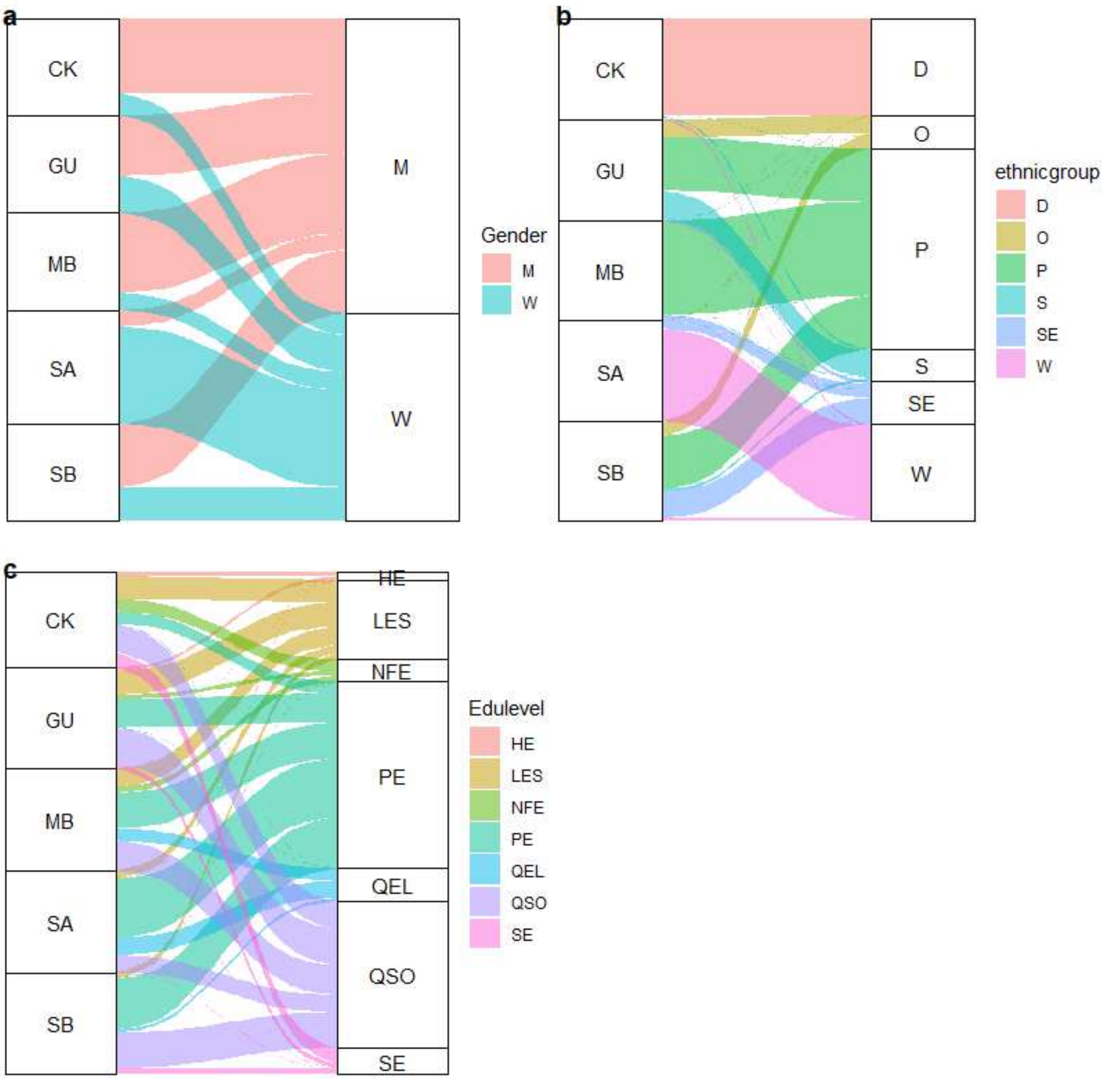


*Figure 3 : gender (a), ethnic group (b) and education level (c) according to the site*

***Legend:*** CK= Coubanack ; GU=Gouloumbou ; MB=Medina Boguel ; SA =SalyMboure; SB=Samboumba ; M=Man ; W =Woman ; D =Diola ; S =Socé;W= Wolof ; P=Peulh ; SE=Serere ; O=Other ; NFE= No formal education; QSO= Koranic school only ; PE= Primary education; LES= Middle school education (ou Lower secondary education) ; SE= Secondary education; HE= Higher education ; QEL= Franco-arab school

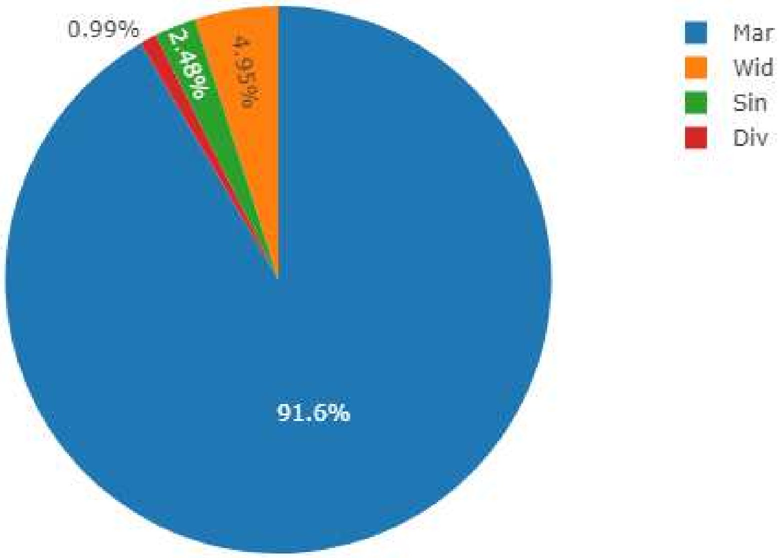


*Figure 4 : Marital status of respondents*

***Legend:*** *Mar = Married ; Sin= Single Div= ; Divorced ; Wid= Widowed*

In economic terms, a wide range of activities were identified (Figure 5). The survey results indicated that agriculture (53.1%) was the main activity of respondents, followed by trade (12.9%), domestic work (9.09%) and other activities (24.91%).

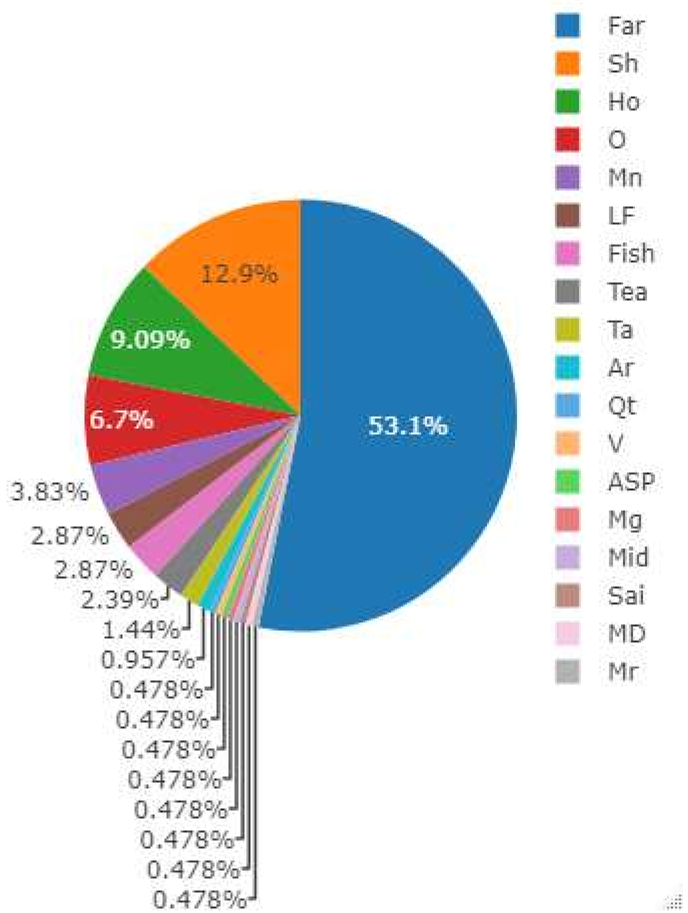


*Figure 5 : Economic activities of respondents*

*Far = Farmer ; Tea=Teacher ; Sh=Shopkeeper ; Ho= Homemaker; LF= Livestock farmer ; V=Visil ; Mg= Market gardener ; ASP= ASP ; Ta=Tailor ; Ar= Arboriculture ; Qt= koranic teacher ; Mr=Metalworker ; Fish = Fisherman ; Mn= Mason ; Mid= Midwife; Sai =Sailor ; MD=Ministry of Defence ; O= Other*

The PCA analysis documented the variability and socio-economic characteristics of the respondents (Figure 6). The analysis revealed four groups. The first group comprising Saly Mboure consisted mainly of women, Wolof speakers, married individuals and farmers. The second group (Gouloumbou) was associated with a higher proportion of widowers, Socé ethnic group, traders and housewives, and those whose education was limited to Koranic school. The third group (Coubanack) was characterised by a higher proportion of Diola speakers, uneducated individuals, tailors and arborists. Finally, the fourth group comprising Samboumba and Medina Boguel was dominated by a higher proportion of herders and Peulh.

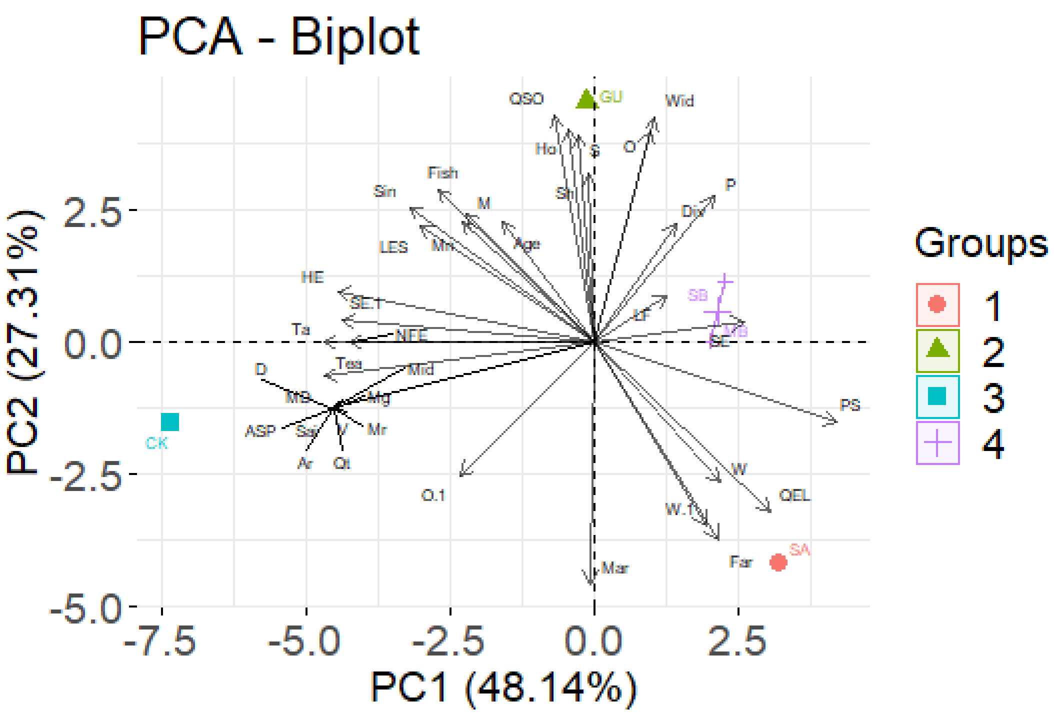


*Figure 6 : Socioeconomic characteristics of respondents*

***Legend:*** *CK= Coubanack ; GU=Gouloumbou ; MB=Medina Boguel ; SA =SalyMboure; SB=Samboumba ; M=Man ; W =Woman ; D =Diola ; S =Socé;W= Wolof ; P=Peulh ; SE=Serere ; O=Other ; NFE= No formal education; QSO= Quranic school only ; PE= Primary education; LES= Middle school education (ou Lower secondary education) ; SE= Secondary education; HE= Higher education ; QEL= Quranic education and literate (ou Quranic school and literacy training) ; Mar = Married ; Sin= Single Div= ; Divorced ; Wid= Widowed ; Far = Farmer; Tea=Teacher ; Sh=Shopkeeper ; Ho= Homemaker; LF= Livestock farmer ; V=Visil ; Mg= Market gardener ; ASP= ASP ; Ta=Tailor ; Ar= Arboriculture ; Qt= Quranic teacher ; Mr=Metalworker ; Fish = Fisherman; Mn= Mason; Mid= Midwife; Sai =Sailor; MD=Ministry of Defence ; O= Other*

### *3.2. Ecosystem services*

The results showed that respondents cited various ecosystem services provided by vegetation (Figure 7). Provisioning services (91.1%) were the most frequently cited by respondents, followed by regulating services (8.4%) and cultural services (0.5%). Provisioning services were characterized by food (33.69%), fodder (32.62%) and medicinal uses (33.69%). For provisioning services, perceptions varied depending on the site (Figure 8). In Coubanack, respondents mentioned food (31.21%), fodder (32.24%) and medicinal uses (31.21%), whilst in Gouloumbou, food (35.97%), fodder (33.87%) and medicinal uses (35,97%). At Medina Boguel, fodder use (9.28%) was the most cited followed by food (8.46%) and medicinal use (8.46%). Among the categories of provisionning services, food (6.34%), fodder (6.55%) and medicine (6.34%) were different uses noticed in Coubanak. In contrast, food consumption (17.98%), animal feed (18.03%) and medicinal use (17.98%) were cited at Samboumba.

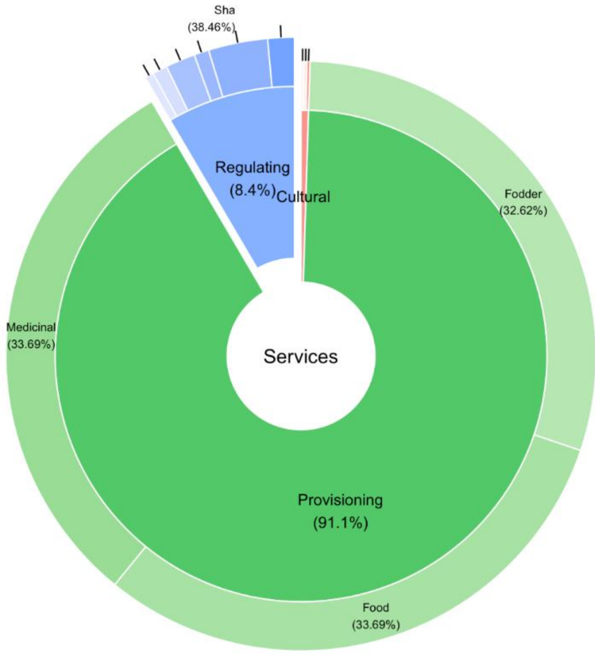


Figure 7 : Ecosystem services

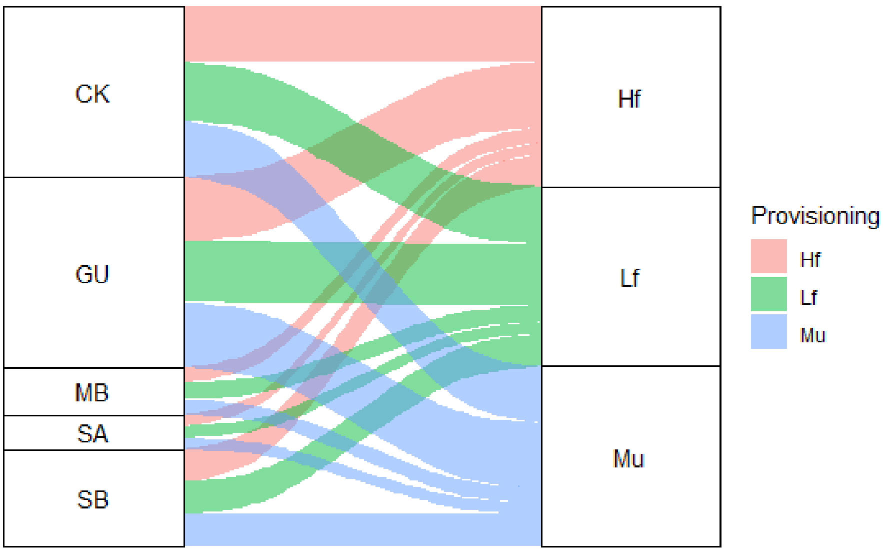


*Figure 8 : Provisioning services*

***Legend:*** *CK = Coubanack ; GU= Gouloumbou ; MB=MedinaBoguel ; SA= SalyMboure; SB=Samboumba ; Hf =Human food; Lf=Livestock feed ; Mu= Medicinal use*

The cultural services were withering (33.33%), spiritual protection (33.33%) and mystical (33.33%). There was considerable variation in people's perceptions of cultural services provided by vegetation (Figure 9).


Figure 9 : Cultural services according to sites

***Legend:*** *CK= Coubanack ; GU=Gouloumbou ; MB =Medina Boguel ; SA= SalyMboure; SB =Samboumba ; Tal=Talisment ; Bew =Bewitched; Bp=Body protection*

The main regulating services identified by local people were shade (40.81%), windbreaks (18.36%), protective hedges (6.12%), soil protection (4.08%), pesticides (10.20%) and fertilisation (10.20%). Perceptions on regulating services varied according location (Figure 9). The shading effect was cited by 100% of respondents in Medina Boguel and Saly Mboure ; services such as windbreaks (30.7%), shading effect (19.23%), fertilisation (19.23%), pesticides (11.53%), defensive hedges (7.69%), dust mitigation (3.84%) and oxygen production (3.84%) were noted in Coubanack. In Gouloumbou, respondents highlighted the shading effect (54.54%), pesticides (18.18%), windbreaks (9.09%), defensive hedges (9.09%) and agriculture (9.09%). In Samboumba, soil protection (22.22%), rainfall (11.11%) and shading (66.67%) were the most frequently cited regulating services (Figure 10).

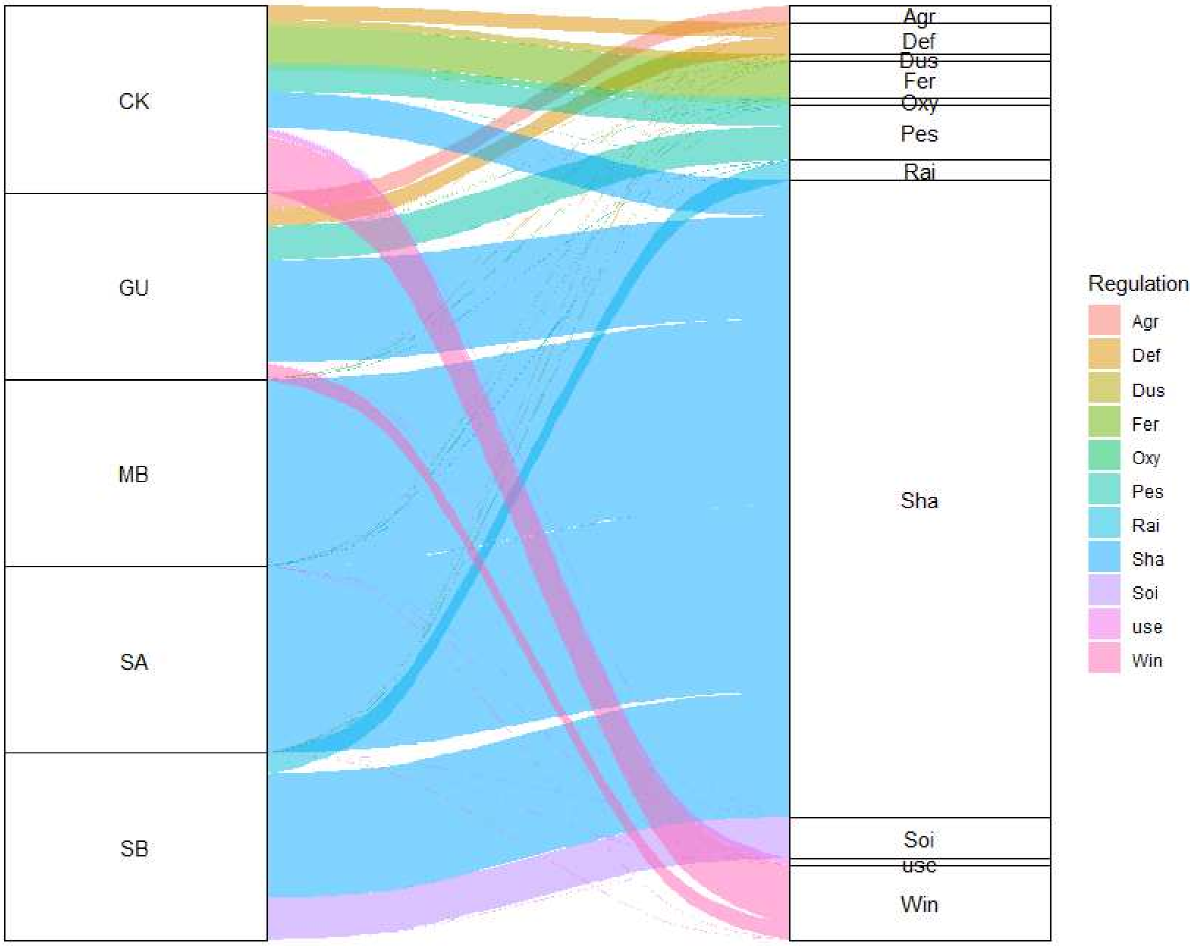


*Figure 10 : Regulation services*

*Legend: CK= Coubanack ; GU=Gouloumbou ; MB =Medina Boguel ; SA= SalyMboure; SB =Samboumba ; Fer= Fertilization; Sha=Shading ; Win = Windbreak; Dus= Dust suppression ; Pes=Pesticides ; Def= Defensive hedge ; Oxy= Oxygen production ; use= use VETO ; Agr= Agriculture ; Soi = Soil protection ; Rai= Rain retention*

The distribution of ecosystem service parameters across sites revealed distinct spatial patterns, with the first two dimensions of the PCA explaining 82.87% of the total variance (PC1 : 56.76% ; PC2 : 26.11%). The PCA highlighted differences in perceptions on ecosystem services between sites (Figure 11). The analysis identified three groups. The first group represented by Coubanack focused on regulatory and cultural services such as fertilisation, windbreak, dust suppression, oxygen production and drainage. The second group comprising Gouloumbou was distinguished by higher citation frequencies for spiritual protection and agricultural services. The third group comprising Samboumba and Medina Boguel, is characterised by the ecosystem services of maraboutage, soil protection, rainfall provision and shading.

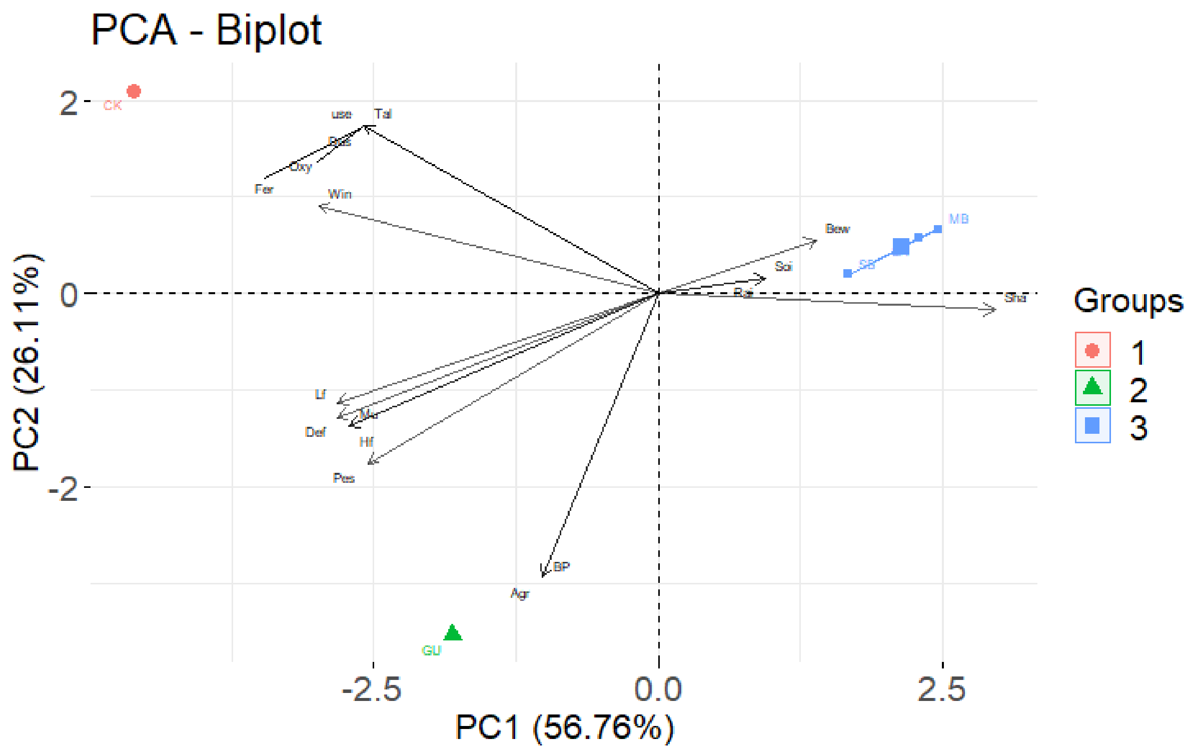


*Figure 11 : Caracteristic of ecosystem services according to sites*

***Legend:*** *CK= Coubanack ; GU=Gouloumbou ; MB =Medina Boguel ; SA= SalyMboure; SB =Samboumba ; Fer= Fertilization; Sha=Shading ; Win = Windbreak; Dus= Dust suppression ; Pes=Pesticides ; Def= Defensive hedge ; Oxy= Oxygen production ; use= use VETO ; Agr= Agriculture ; Soi = Soil protection ; Rai= Rain retention ; Tal=Talisment ; Bew =Bewitched; Bp=Body protection ; Hf =Human food ; Lf=Livestock feed ; Mu= Medicinal use*

### *3.3. Use of species*

Local people considered food (2.5) to be the most important use provided by the vegetation (Table 2), followed by medicinal use (1.82) and fodder (1.104). The consensus factors among informants ranged from 87% to 92%. The highest FCI values were recorded for fodder (92%) and food (91%). In total, 70 species were used for provisioning ecosystem services. Of these species, 49 were used for food, 19 for fodder and 50 for medicinal uses. Among these species, 11 had the highest use values. *Icacina senegalensis* (1.31) was cited in all three categories with a higher level of fidelity (45.86%) in medicinal use (60.39%). *Pterocarpus erinaceus* (0.5) was frequently cited for fodder (43.56%) with a fidelity level of 87.12%. *Cordyla pinnata* (0.34) was mentioned more frequently for food (22.27%) with a fidelity level of 64.28%. The use of *Moringa oleifera* (0.34) was dominated by food (24.75%) with fidelity level (72.46%). *Faidherbia albida* (0.26) was used for fodder (23.27%) and medicinal purposes (3.46%). *Mangifera indica* (0.24), *Adansonia digitata* (0.22), *Saba senegalensis* (0.18) and *Parkia biglobosa* (0.17) were used primarily for food, but also for medicinal purposes and as fodder.

*Guiera senegalensis* (0.15) and *Senna sieberiana* (0.11) were cited only for medicinal use (15.84% and 11.88%) with higher fidelity level (100%).

*Tableau 2 : Usage value, citation frequency and fidelity level of each species*

| Species | VU | USE | Food | | Fodder | | Medicinal | |
|---|---|---|---|---|---|---|---|---|
| | | | CF(%) | NF(%) | CF(%) | FL (%) | CF(%) | FL (%) |
| *Parkia biglobosa* | 0,173 | Hf,Lf | 16,832 | 97,143 | 0,495 | 2,857 | 0 | 0 |
| *Combretum micranthum* | 0,054 | Hf, Mu | 3,465 | 63,636 | 0 | 0 | 1,980 | 36,364 |
| *Nauclea latifolia* | 0,005 | Hf | 0,495 | 100 | 0 | 0 | 0 | 0 |
| *Erythrina senegalensis* | 0,015 | Hf | 1,485 | 100 | 0 | 0 | 0 | 0 |
| *Moringa olifeira* | 0,341 | Hf,Lf,Mu | 24,752 | 72,464 | 2,475 | 7,246 | 6,931 | 20,290 |
| *Sansevieria senegambica* | 0,005 | Hf | 0,495 | 100 | 0 | 0 | 0 | 0 |
| *Afzelia africana* | 0,015 | Hf,Mu | 0,495 | 33,333 | 0 | 0 | 0,990 | 66,667 |
| *Anacardium occidentale* | 0,054 | Hf,Lf,Mu | 3,960 | 72,727 | 0,990 | 18,182 | 0,495 | 9,091 |
| *Mangifera indica* | 0,242 | Hf,Lf,Mu | 14,356 | 59,184 | 2,970 | 12,245 | 6,931 | 28,571 |
| *Citrus limon* | 0,094 | Hf,Mu | 5,941 | 63,158 | 0 | 0 | 3,465 | 36,842 |
| *Tamarindus indica* | 0,040 | Hf,Mu | 3,465 | 87,500 | 0 | 0 | 0,495 | 12,500 |
| *Lophira alata* | 0,005 | Hf | 0,495 | 100 | 0 | 0 | 0 | 0 |
| *Adansonia digitata* | 0,228 | Hf,Lf,Mu | 18,317 | 80,435 | 1,980 | 8,696 | 2,475 | 10,870 |
| *Landolphia heudelotii* | 0,050 | Hf,Mu | 3,960 | 80 | 0 | 0 | 0,990 | 20 |
| *Saba senegalensis* | 0,188 | Hf,Mu | 15,842 | 84,211 | 0 | 0 | 2,970 | 15,789 |
| *Elaeis guineensis* | 0,030 | Hf,Mu | 2,475 | 83,333 | 0 | 0 | 0,495 | 16,667 |
| *Justicia adhatodoides* | 0,015 | Hf,Mu | 0,495 | 33,333 | 0 | 0 | 0,990 | 66,667 |
| *Citrus sinensis* | 0,050 | Hf | 4,950 | 100 | 0 | 0 | 0 | 0 |
| *Detarium senegalensis* | 0,069 | Hf,Lf,Mu | 5,446 | 78,571 | 0,495 | 7,143 | 0,990 | 14,286 |
| *Annona senegalensis* | 0,035 | Hf,Mu | 2,475 | 71,429 | 0 | 0 | 0,990 | 28,571 |
| *Dialium guineense* | 0,050 | Hf,Mu | 3,960 | 80 | 0 | 0 | 0,990 | 20 |
| *Zizphis mauritania* | 0,079 | Hf,Mu | 4,950 | 62,500 | 0 | 0 | 2,970 | 37,500 |
| *Cola cordifolia* | 0,059 | Hf | 5,941 | 100 | 0 | 0 | 0 | 0 |
| *Senna tora* | 0,030 | Hf,Lf,Mu | 0,990 | 33,333 | 0,495 | 16,667 | 1,485 | 50 |
| *Ficus basarensis* | 0,010 | Hf,Mu | 0,495 | 50 | 0 | 0 | 0,495 | 50 |
| *Uvaria chamae* | 0,010 | Hf,Mu | 0,495 | 50 | 0 | 0 | 0,495 | 50 |
| *Cordyla pinnata* | 0,347 | Hf,Lf,Mu | 22,277 | 64,286 | 7,426 | 21,429 | 4,950 | 14,286 |
| *Acacia macrostachya* | 0,005 | Hf | 0,495 | 100 | 0 | 0 | 0 | 0 |
| *Securinega virosa* | 0,015 | Hf,Mu | 0,495 | 33,333 | 0 | 0 | 0,990 | 66,667 |
| *Vernonia amygdalina* | 0,020 | Hf,Lf | 1,485 | 75,000 | 0,495 | 25,000 | 0 | 0 |
| *Leptadaenia hastata* | 0,010 | Hf | 0,990 | 100 | 0 | 0 | 0 | 0 |
| *Holarrhena floribunda (G. Don.)* | 0,005 | Hf | 0,495 | 100 | 0 | 0 | 0 | 0 |
| *Hexalobus monopetalus* | 0,010 | Hf | 0,990 | 100 | 0 | 0 | 0 | 0 |
| *Ficus dicranostyla* | 0,025 | Hf | 2,475 | 100 | 0 | 0 | 0 | 0 |
| *Vitex doniana* | 0,035 | Hf,Lf | 2,475 | 71,429 | 0,990 | 28,571 | 0 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Ficus spp* | 0,015 | Hf,Lf,Mu | 0,495 | 33,333 | 0,495 | 33,333 | 0,495 | 33,333 |
| *Strychnos spinosa* | 0,015 | Hf,Mu | 0,990 | 66,667 | 0 | 0 | 0,495 | 33,333 |
| *Lannea microcarpa* | 0,015 | Hf | 1,485 | 100 | 0 | 0 | 0 | 0 |
| *Pompo Ndogo* | 0,005 | Hf | 0,495 | 100 | 0 | 0 | 0 | 0 |
| *Neocarya macrophylla* | 0,030 | Hf,Mu | 2,475 | 83,333 | 0 | 0 | 0,495 | 16,667 |
| *Prosopis africana* | 0,010 | Hf,Mu | 0,495 | 50 | 0 | 0 | 0,495 | 50 |
| *Ficus capensis* | 0,074 | Hf,Lf | 0,495 | 6,667 | 6,931 | 93,333 | 0 | 0 |
| *Poupartia birrea* | 0,020 | Hf,Mu | 0,990 | 50 | 0 | 0 | 0,990 | 50 |
| *Abrus precatorius* | 0,015 | Hf,Mu | 0,495 | 33,333 | 0 | 0 | 0,990 | 66,667 |
| *Diospyros mespiliformis* | 0,020 | Hf | 1,980 | 100 | 0 | 0 | 0 | 0 |
| *Icacina senegalensis* | 1,317 | Hf,Lf,Mu | 59,406 | 45,113 | 11,881 | 9,023 | 60,396 | 45,865 |
| *Detarium microcarpum* | 0,010 | Hf | 0,990 | 100 | 0 | 0 | 0 | 0 |
| *Faidherbia albida* | 0,267 | Lf,Mu | 0 | 0 | 23,267 | 87,037 | 3,465 | 12,963 |
| *Pterocarpus erinaceus* | 0,500 | Lf,Mu | 0 | 0 | 43,564 | 87,129 | 6,436 | 12,871 |
| *Azadirachta indica* | 0,045 | Lf,Mu | 0 | 0 | 3,960 | 88,889 | 0,495 | 11,111 |
| *Ceiba pentandra* | 0,010 | Lf,Mu | 0 | 0 | 0,495 | 50 | 0,495 | 50 |
| *Guiera senegalensis* | 0,158 | Mu | 0 | 0 | 0 | 0 | 15,842 | 100 |
| *Terminalia macrop tera* | 0,020 | Lf,Mu | 0 | 0 | 0,495 | 25,000 | 1,485 | 75,000 |
| *Grewia bicolor* | 0,005 | Lf | 0 | 0 | 0,495 | 100 | 0 | 0 |
| *Khaya senegalensis* | 0,064 | Mu | 0 | 0 | 0 | 0 | 6,436 | 100 |
| *Senna occidentalis* | 0,084 | Mu | 0 | 0 | 0 | 0 | 8,416 | 100 |
| *Calotropis procera* | 0,020 | Mu | 0 | 0 | 0 | 0 | 1,980 | 100 |
| *Daniellia oliveri* | 0,010 | Mu | 0 | 0 | 0 | 0 | 0,990 | 100 |
| *Carapa procera* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Morinda geminata* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Euphorbia* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Piliostigma reticulatum* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Balanites aegyptiaca* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Cassia sieberiana DC.* | 0,119 | Mu | 0 | 0 | 0 | 0 | 11,881 | 100 |
| *Piliostigma thonningii* | 0,025 | Mu | 0 | 0 | 0 | 0 | 2,475 | 100 |
| *Eucalyptus alba* | 0,025 | Mu | 0 | 0 | 0 | 0 | 2,475 | 100 |
| *Bambusa arundinacea* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Combretum glutinosum* | 0,064 | Mu | 0 | 0 | 0 | 0 | 6,436 | 100 |
| *Terminalia avicennoides* | 0,005 | Mu | 0 | 0 | 0 | 0 | 0,495 | 100 |
| *Ficus iteophylla* | 0,010 | Mu | 0 | 0 | 0 | 0 | 0,990 | 100 |

***Legend:*** *Hf =Human food; Lf=Livestock feed ; Mu= Medicinal use ; CF= Citation frequency ; NF= Fidelity Level ; UV=Usage value*

The results regarding different uses showed that Icacina senegalensis was used for food (43%) and medicinal purposes (57%) by local communities (Figure 12). In terms of consumption, *Icacina senegalensis* was used for food (83.33%) and fodder (16.67%). For medicinal purposes, Icacina senegalensis was used to treat yellow fever (30.41%), stomach ache (15.98%), reproductive issues (14.43%), muscle pain (7.22%), incubators for premature babies (7.22%), malaria (5.67%) and others (19.07%). The other uses included poisoning, burns, deworming, constipation, diabetes, diarrhoea, eye pain and swelling.

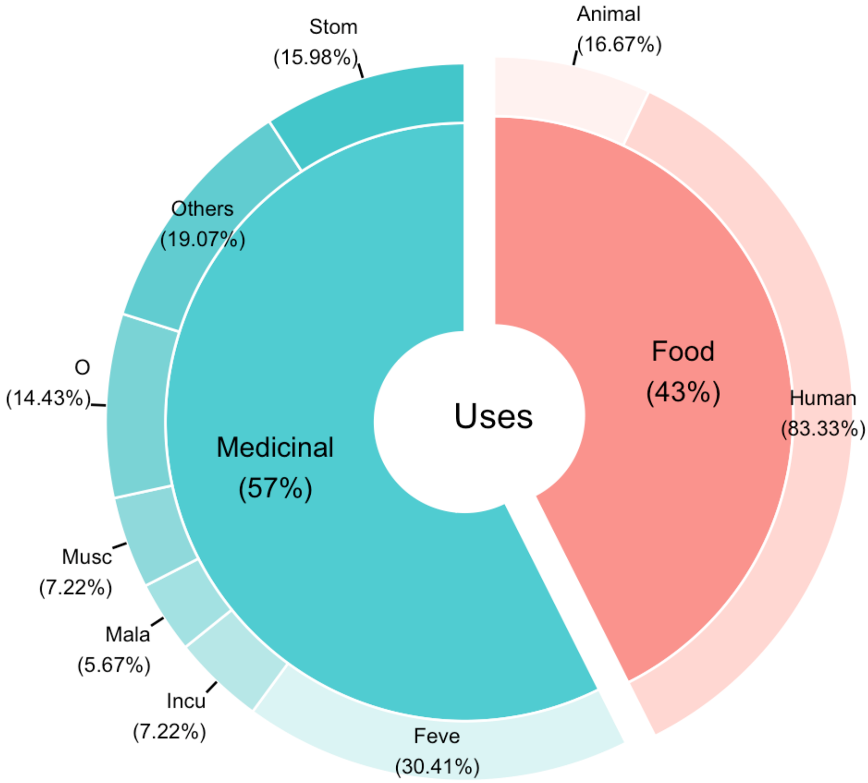


Figure 12 : Use of *Icacina senegalensis*

***Legend:*** *Mala = Malaria ; Feve= Fever ; Musc= Muscle pain ; Stom= Stomach ache ; Pois= Poisoning ; Incu=Incubators for premature babies ; Burn=Burn ; Dewo= Dewormer ; Maln= Malnutrition ; Cons=Constipation ; Eyes= Eyes ; Diab = Diabetes; Diar= Diarrhea; Inju = Injury; Swel= Swelling; O=Other*

### *3.4. Vegetation status and dynamics*

Analysis of community perceptions regarding to state and dynamics of vegetation and *Icacina senegalensis* at the revealed different patterns (Figure 13). Survey data on vegetation indicated that vegetation was moderately abundant (66.8%), rare (20.3%) and abundant (12.9%). *Icacina senegalensis* was moderately abundant (58.9%), abundant (27.2%) and scarce (13.9%). The survey revealed a decrease (87.1%), stability (2%) and an increase (10.9%) in vegetation. The stand of Icacina senegalensis has decreased (90%) compared with an increase (8%) and stable (2%).

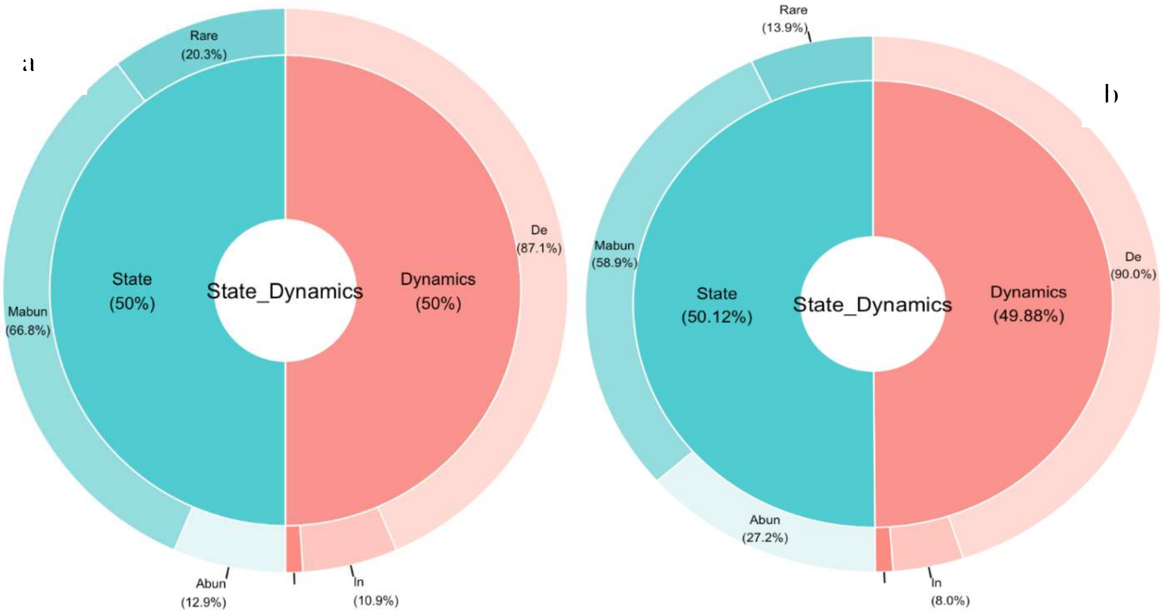


*Figure 13 : State and dynamics of vegetation(a) and Icacina senegalensis(b)*

***Legend:*** *Abun = Abundant ; Rare=Rare ; Mabun= Moderately abundant ; In=Increase; De=Decrease ; Sta=Stable*

Perceptions on state and dynamics of vegetation varied depending on the site (Figure 14). The results indicated a moderate abundant ranging from 58.33% to 70.58% depending on the site. In Coubanack, respondents found that vegetation was abundant (13.84%), sparse (21.53%) and moderately abundant (64.61%). In Samboumba, people considered vegetation as abundant (11.76%), sparse (23.52%) and moderately abundant (64.70%). In Saly Mboure, the state of the vegetation was characterised as abundant (16.67%), rare (25%) and moderately abundant (58.33%). Vegetation was judged to be abundant (23.52%), rare and moderately abundant (70.58%) in Medina Boguel. In Gouloumbou, local residents considered the vegetation to be abundant (9.45%), scarce (20.27%) and moderately abundant (70.27%). In terms of dynamics, an increase (16.92%), a decrease (81.53%) and stability (1.53%) were noted in Coubanack. In Samboumba and Saly Mboure, 100% of respondents reported a decrease. In Medina Boguel, vegetation has decreased (82.35%) and remained stable (17.64%). In contrast, vegetation has seen a slight increase (14.86%) compared to a decrease (85.13%) in Gouloumbou.

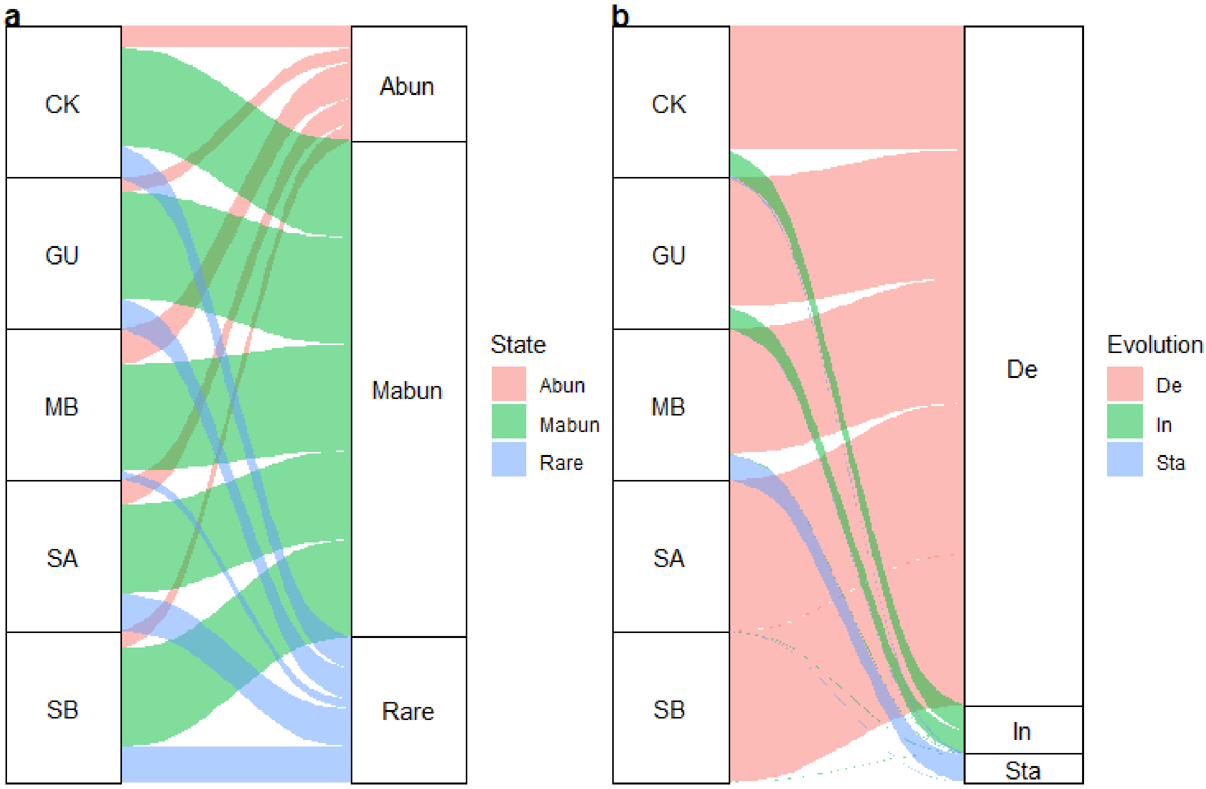


*Figure 14 : State (a) and dynamics (b) of vegetation according to sites*

***Legend:*** *CK = Coubanack ; Gouloumbou=GU ;MedinaBoguel=MB ;SalyMboure=SA ; Samboumba=SB ; Abundant=Abun ; Rare=Rare ; Moderately abundant = Mabun ;Increase= In ; Decrease=De ; Stable= Sta*

### *3.5. Vegetation Conservation Strategies*

To address the decline in vegetation, local communities have proposed several strategies to protect, conserve and restore vegetation (Figure 15). Reforestation (42.3%) was the most frequently cited strategy followed by protection (17%), firebreaks (10.3%), maintenance (5.67%), monitoring (4.12%), awareness (4.12%) and others (16.49%). The other strategies included creating community reserves and classified forests, prohibiting the felling and burning of trees, practising assisted natural regeneration, traditional practices and rational use.

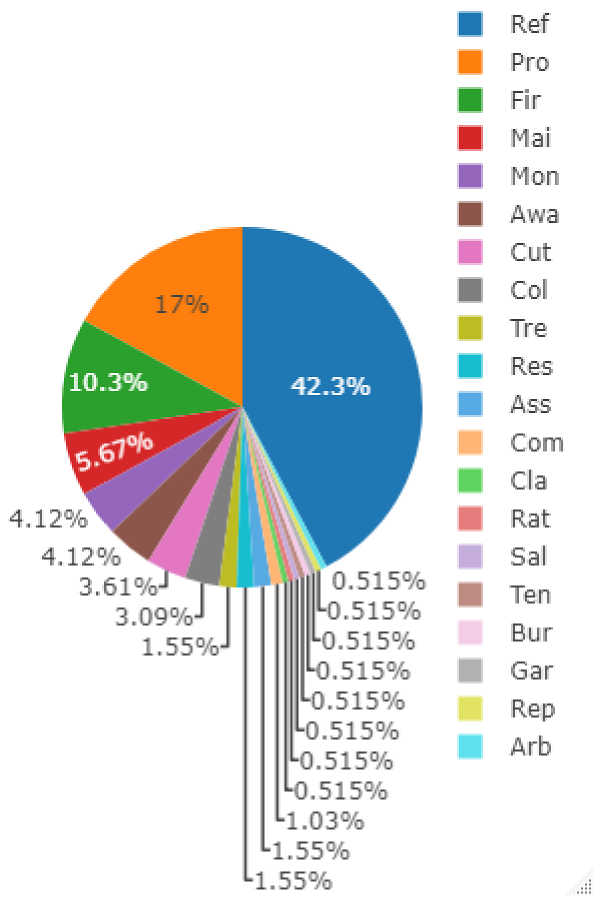


*Figure 15 : Vegetation Conservation Strategy*

***Legend:*** *Ref = Reforestation ; Awa= Awareness-raising ; Bur= Burning bans ; Com= Community reserve ; Cut=Cutting bans ; Ten=Tents ; Fir= Firebreaks ; Cla=Classified forest ; Pro =Protection ; Mon= Monitoring ; Ass= Assisted natural regeneration ; Mai= Maintenance ; Rat = Rational use ; Sal= Salinization control ; Tre= Tree nursery ; Res=Restoration ; Col=Collaboration with the Water and Forestry Department ; Gar=Garden ; Rep= Reporting to the village chief ; Arb=Arboriculture*

### *3.6. Typology of the state, dynamics and conservation strategies of sites*

The PCA revealed variations in people's perceptions on state, dynamics and strategies depending on the site (Figure 16). The PCA explained 70.75% of the total variance (PC1 : 37.8% ; PC2 : 32.95%) across four clusters. The Saly Mboure and Samboumba group was represented by a declining in vegetation and a shift towards defensive measures such as arboriculture, denunciation and collaboration. The Coubanack group was characterised by strategies based on reforestation, classified forests and community reserves, vegetation restoration, ban on forest burning, combating salinisation, and rational use. The Gouloumbou group was associated with moderately abundant and strategies based firebreaks, awareness and protection. The fourth group including Medina Boguel was characterized by stable and abundant vegetation.

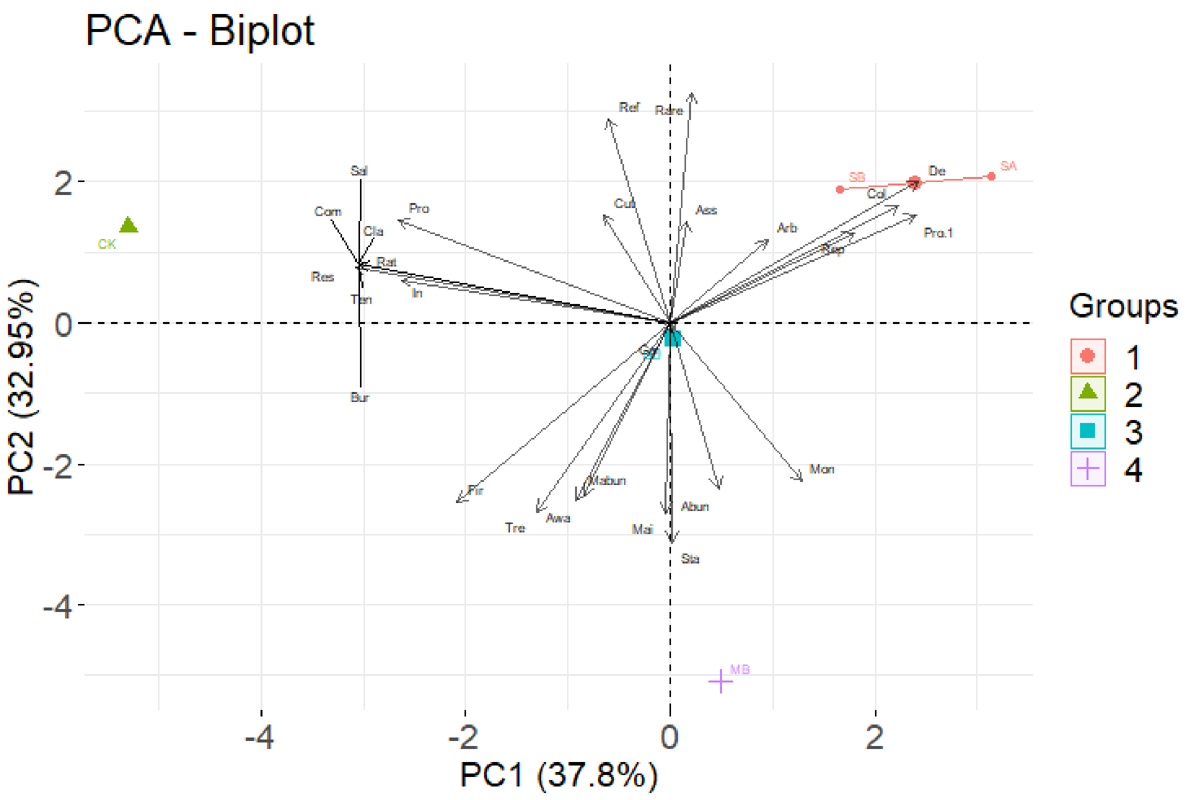


*Figure16 : Caracteristic ofstate, dynamics and conservation strategy according to sites*

***Legend:*** *CK = Coubanack; Gouloumbou=GU ;MedinaBoguel=MB ;SalyMboure=SA ; Samboumba=SB ; Abundant=Abun ; Rare=Rare ; Moderately abundant = Mabun ;Increase= In ; Decrease=De ; Stable= Sta ; Ref = Reforestation; Awa= Awareness-raising ; Bur= Burning bans; Com= Community reserve ; Cut=Cutting bans ; Ten=Tents ; Fir= Firebreaks ; Cla=Classified forest ; Pro =Protection; Mon= Monitoring ; Ass= Assisted natural regeneration ; Mai= Maintenance ; Rat = Rational use; Sal= Salinization control ;Tre= Tree nursery; Res=Restoration ; Col=Collaboration with the Water and Forestry Department ; Gar=Garden ; Rep= Reporting to the village chief ; Arb=Arboriculture*

## 4. Discussion

### *4.1. The importance of vegetation*

70 species of which 49 for food, 19 for fodder and 50 for medicinal purposes were reported in the study area. This floristic richness highlighted the importance of vegetation in the three agroecological zones. 91.1% of respondents stated that the tree provides provisioning services; 8.4% cited regulatory services and 0.5% cultural services. This may be explained by the importance of the tree in rural human life (MEA, 2005; Ngom et al., 2014; Camara et al., 2017; Badiane et al., 2019). The citation frequencies were distributed in a similar manner, reflecting their knowledge and use across several essential functions : such as food, fodder and traditional medicine. The overall use value was highest for food, followed by medicinal use, which reflected the fact that people were more interested in species used for food and their well-being.

High level of consensus ranging from 86.61% to 91.89% highlighted the agreement and the importance these species for local populations. Vegetation had an important socio-economic value in Malinké communities (Ngning et al., 2013)

Of the species listed, eleven proved to be the most useful with the highest usage values and citation frequencies. They were used either for food, fodder and medicinal purposes. *Cordyla pinnata; Moringa oleifera; Adansonia digitata; Saba senegalensis*; *Parkia biglobosa* and *Mangifera indica* were the species with the highest levels of consistency in food use, explaining why these species are most commonly used for food. *Pterocarpus erinaceus* and *Faidherbia albida* showed high levels of consistency in fodder use. *Guiera senegalensis*, *Senna sieberiana* and *Icacina senegalensis* were mainly used for medicine. These species were cited in one of the three uses (Lykke et al 2004; Ngom et al., 2014; Ndiaye et al 2017; Sarr et al 2013).

Information on the importance of *Icacina senegalensis* showed that 57% of respondents stated that the species was used for medicinal purposes to treat illnesses including yellow fever, stomach ache, muscle pain, poisoning, burns, deworming, constipation, diabetes, diarrhoea, eye pain and swelling. Extracts of the plant have shown antimalarial activity (Sarr et al.,2011 ; Essien et al.,2014 ; Akuodor et al, 2017a ; Diatta et al,2019)), making it a potential candidate for the development of antimalarial, analgesic, anti-inflammatory (David-Oku et al.,2016), antimicrobial (Akuodor et al., 2017b), broad-spectrum antibacterial according to David-Oku et al (2017), antidiabetic and hypolipidemic drugs (Manga et al 2013 ; Akuodor et al., 2014). Icacina senegalensis was used as food. Tuber and seed of *Icacina senegalensis* transformed into powder can be used in the formulation of manufacture of cattle feed (Niayale et al.,2021) in particular monogastric animals (Ansah and Aboagye,2011; Alhassan et al.,2019; Niayale et al.,2023) contented of the expensive cereals such as maize and the leaves could be consumed by ruminants according to Ansah (2014). Tuber and seed flour contained nutritional values such as crude energy, essential amino acids, detergent fibre starch, dry matter (DM), crude protein (CP) and minerals (Dei et al., 2011; Alhassan et al., 2019). Leaves were also rich in nutritional values according to Ansah (2014).

***4.2. Vegetation status and dynamics***

The majority of those surveyed considered the vegetation to be moderately abundant. This may be explained by the fact that vegetation cover was present but under pressure. Such a perception was frequently observed in West African agro-ecological landscapes, where natural systems were heavily influenced by human activities, notably extensive agriculture, firewood collection and livestock farming (Vogt et al. 2019). As for vegetation dynamics, these were perceived in a distinctly negative light, with 87.1% of respondents indicating a decline in plant resources. This trend was consistent with regional observations regarding the degradation of Sudano-Sahelian ecosystems, characterised by a gradual reduction in plant biomass and habitat fragmentation (Herrmann et al., 2005 ; Fensholt et al., 2009 ; Gebremedhn et al., 2023). In West Africa, several studies have shown that vegetation degradation is strongly linked to the expansion of agricultural land and the intensification of timber resource exploitation (Brandt et al., 2014). However, the NDVI and FAPAR time series show significant regreening since the 1980s, particularly in the east, south-west and estuarine areas, whilst the north and centre-west show signs of recent degradation (Solly et al., 2022 ; Brandt et al., 2014 ; Zeng et al., 2023), even though there has been a loss of large trees, the dominance of certain hardy shrubs and a decline in species richness (Dendoncker et al., 2020). At all sites, the majority of respondents perceive vegetation as moderately abundant, confirming a general trend of moderate availability. In contrast, Saly Mboure and Samboumba show clear signs of degradation, with a high proportion of responses indicating a scarcity of vegetation and a trend towards decline. This situation is consistent with the results of research conducted in Senegal's groundnut-growing region, where the conversion of land to intensive agriculture has led to a significant reduction in natural vegetation cover (Tappan et al., 2004).

*Icacina senegalensis* was perceived as moderately abundant by a majority of respondents, its trend was declining.

### *4.3. Vegetation conservation strategies*

The strong support for reforestation reflected public awareness of the importance of restoring degraded vegetation cover and ensuring the future availability of plant resources. This approach is widely promoted in environmental policies in West Africa, although its effectiveness depends heavily on the choice of species and implementation conditions for example, the Great Green Wall supports the restoration of tree cover and carbon storage, but with mixed results at the local level (Gore et al., 2023). Protective measures such as the creation of community reserves and bans on tree felling, form part of a sustainable resource management approach. These practices align with the principles of community-based natural resource management, which have proven effective in several African contexts (Agrawal and Gibson, 1999). Furthermore, strategies such as the establishment of firebreaks and public awareness campaigns aim to prevent disturbances, particularly bushfires, which are a major cause of ecosystem degradation. However, the limited attention given to forest monitoring and maintenance suggests a lack of institutional and organisational resources, which could limit the effectiveness of the actions undertaken.

## 5. Conclusion

The vegetation play an important rule by providing provisioning, regulating and cultral services. The most cited ecosystem services was provisioning followed by regulating services. The vegetation was rich in plant species used for food, fodder and traditional medicine. *Icacina senegalensis* and other key species were essential for food security and well-being of local communities. Despite its importance, vegetation was moderately abundant and declining indicating human pressure on plant resources. Face to this degradation, conservation strategies based on reforestation, protection and awareness have been recommended but their effectiveness depended on institutional support and coordinated sustainable management.

## Declarations

### Funding

This research was supported by the African Union Commission (AUC) through the Pan African University scholarship programme.

### Ethics approval

Ethical approval for this study was obtained from the Pan African University Life and Earth Sciences Institute (including Health and Agriculture) (PAULESI), University of Ibadan, Nigeria. Prior informed consent was obtained from all participants before data collection.

### Consent to participate

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

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

### Clinical trial number

Not applicable.

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