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“Forest is integral to life”: people-forest relations in the lower river region, the Gambia

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Introduction: Forests play a crucial role in the lives of millions of people worldwide by providing material and non-material contributions. Despite forests' paramount importance from ecological, economic, and cultural perspectives, the long-term relationship between forests and local communities living in their proximity is often an undervalued contribution to our understanding of local ecological knowledge systems and forest changes.

Methods: We studied the interrelationships between the Mandinka peoples and forests in an understudied area of West Africa, the Gambia's Lower River Region (LRR). Through 35 semi-structured interviews, we documented the forests' contributions to local Mandinka peoples and their perception of forest changes. We also used geographic information systems (GIS software) for remote sensing satellite imagery to establish a baseline for these complex connections and changes.

Results: This research revealed the crucial importance of the forest's contributions to Mandinka communities and specifically to their psychological well-being. In addition, the interviewees revealed how ongoing socio-economic changes are affecting the human-forest relationship and possibly eroding the local ethnoforestry knowledge in the LRR of the Gambia. The most common forest contributions are those that provide material goods, serving as the driving force in connecting people with the forest, while non-material contributions are eroding due to complex socio-economic changes. Major socio-economic changes are also believed to drive the shift from dense forest to mixed forest and grassland.

Discussion: In line with the state of the art, the knowledge and perception of changes documented in this article underline the quintessential need to include local communities' views in shaping forest management, in order to better fine-tune the strategies to safeguard biocultural diversity across forest areas.

KEYWORDS

community forest management, ethnobiology, ethnoforestry, IPLC, nature contributions to people, West Africa

1. Introduction

Forest ecosystems are among Earth's most important biodiversity hotspots (Kaltenborn et al., 2020). They play a fundamental role in the lives of people with material (e.g., food), non-material (e.g., supporting identities), and regulating contributions (e.g., regulation of climate) (Díaz et al., 2018; Kaltenborn et al., 2020). Worldwide, approximately 350 million people live inside or close to dense forests, and they largely depend on these forests for subsistence and income (Chao, 2012; Htun et al., 2017). However, in several geographical contexts, the growing urbanization rate and development, namely land use change for agriculture, and buildings for human settlements have weakened the connection between the forest and the people (Nuissl and Siedentop, 2021). Nevertheless, traditional forestry knowledge, practices, and beliefs (also named *ethnoforestry*) have been used by indigenous people and local communities with customary rights to their forests to manage and preserve the ecosystems for generations (Chao, 2012; Ritter and Dauksta, 2013; Kaltenborn et al., 2020). The diverse roles that forests have played in human societies and continue to play demonstrate the cruciality of the relationship between humans and forests (Ritter and Dauksta, 2013). Many people's identities and indigenous cultures are shaped by their interactions with the landscape, including forests (Russell et al., 2013; Ryfield et al., 2019). Nevertheless, the relationship between local communities and the forest is dynamic and dependent on several ecological, economic, cultural, and socio-political factors (Huynh et al., 2022).

The impact of major ecological, economic, and socio-political factors on forests is especially evident in Africa, in terms of both their ecological and economic contributions (FAO, 2020). Local communities in the forested areas of the continent rely primarily on food and raw materials, such as non-timber forest products, from the forests, combined with agriculture (Shackleton et al., 2007; Egoh et al., 2012). However, deforestation greatly reduces the connection between the people and the forest (FAO, 2020; Kouassi et al., 2021; Sze et al., 2022). According to the FAO forest resource assessment, Africa had the highest annual rate of net forest loss in 2010–2020, at 3.9 million ha (FAO, 2020). This makes forest-dependent communities vulnerable. Among the West African countries, the Gambia is the smallest and forests occupied 51.3% of its total land area in 1975 (USGS, 2013). They provide fuel wood, food, construction material, tea/herbs, and medicinal plants for local communities (Nget et al., 2012). According to the African Energy Commission, fuel wood, which is derived from the nation's forest resources and accounts for approximately 82% of the biomass, is the Gambia's main energy source (AFREC, 2020). Indeed, due to the expansion in urban areas and the intensification of the use of natural resources, scientists are observing a reduction in the generation of forest contributions to people, which affects agricultural productivity and rural livelihoods in the Gambia (Nget et al., 2012). Considering forest loss and degradation mainly driven by the expansion of agricultural land and aggravated by the impacts of climate change, a large portion of the Gambia's forest ecosystems are vulnerable or on the verge of extinction (LDN, 2018; National Forest Action Plan, 2018).

For this reason, we selected as a case study the Lower River Region (LRR), which is an area of the Gambia characterized by expanding agricultural areas and comprising degraded savannah woodland with dense mangrove belts along the Gambia River (Nget et al., 2012). Ethnoforestry, and more precisely, the relationship

between people and forest, has been partially studied in other regions of the Gambia. For instance, Symington (2015) found that social system changes have altered various forest management practices based on local knowledge in the Gambian West Coast Region. In the same region, Tomaselli et al. (2012) found that the Gambian Forestry Department generally supports communities in forest management, yet various challenges (e.g., illegal activities) still have an impact. Nevertheless, only one document, an FAO report by Thoma and Camara (2005), analyzed the relationship of local communities with their forests in the Lower River Region. Therefore, this study focuses on the interconnection between forests and the local communities of the LRR of the Gambia.

To this end, we:

- Identified the forest's contributions to LRR communities and the frequency of visits to the forest by LRR community members.
- Analyzed the changes in the forest through the perception of LRR communities and QGIS geographical maps.
- Provide insight into the importance of participatory forest management by the local communities.

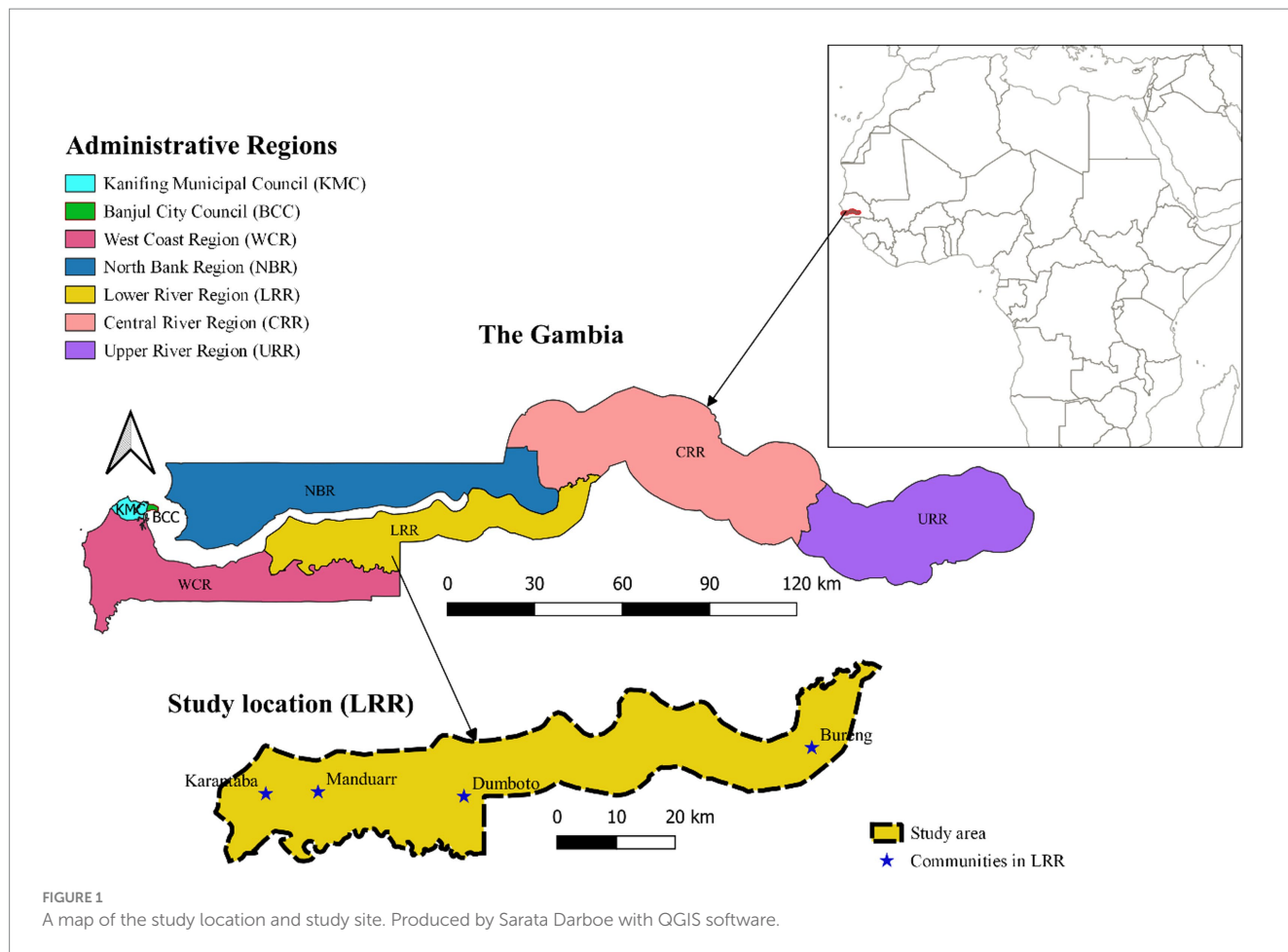
In presenting our results, we rely heavily on our interviewees through extensive citations. We did this to allow the Mandinka people's voices to be explicitly heard and thus go beyond the validation of their contributions.

2. Materials and methods

2.1. Study area

The Gambia is a small country in West Africa (Figure 1). It has a total land area of 11,300 sq. km that extends as a narrow land strip roughly 748 km inland from the Atlantic Ocean and follows the meandering Gambia River. It has a population slightly above 2 million with a density of 432.04 person/km² (Net, 2019). The Gambia is a low-income country due to its high rates of unemployment and poverty, which are over 45 and 35%, respectively (GBoS, 2018; Dampha, 2021). Currently, forest occupies 40% of the country's total land area and is vital in providing basic needs to Gambians (Bojang, 2020; FAO, 2020). The Gambia's forest cover (including Savannah woodland, tree and shrub Savannah, and mangroves) is crucial to the country's environmental and economic growth (Bojang, 2020). However, the fast expansion of human populations, unmanaged bushfires and firewood collection, overgrazing, and expansion of farmland and human habitation are putting forest resources under serious threat and pressure (FAO, 2020).

The LRR is located along the south bank of the river Gambia at the latitude of 13° 24' N and longitude of -15° 42' W. It is predominantly inhabited by the Mandinka and Fula tribes, although other minorities live within the region, such as the Manjakos, Wollofs, Jolas, and Sereres. The analysis covers two sub-regions in the LRR, namely Kiang and Jarra. This rural setting covers an area of 1,495 sq. km (13.2%) out of the 11,300 sq. km total land cover of the Gambia, with a population of 82,361 (GBoS, 2018). The region's land cover consists of forest (66,500 hectares, 44.5% of the total land area of LRR), settlements, grasslands, rivers, and tributaries. Since 1987, the study area has harbored the largest national park in the Gambia (Kiang West



National Park), covering an area of 19,526 hectares (13.1% of the total land area of LRR) of land currently managed by the Department of Parks and Wildlife of the Gambia (Nag, 2019). The forest ecosystem in the LRR has many rare and endangered wildlife species that contribute to the country’s biodiversity, including the Nile crocodile (*Crocodylus niloticus*), clawless otter (*Aonyx capensis*), marsh mongoose (*Antilax paludinosus*), many plant species, leopards (*Panthera pardus*), and West African manatees (*Trichechus senegalensis*) (Jaiteh, 2008).

2.2. Forest governance in the Gambia

The Gambian forests are classified into three main categories, of which one, community forests, is the focus of our study (Gambia Forest Act, 1998).

1. State forests (exclusively managed by the State) which include:

- Forest parks: These are forests that the Gambia’s Department of Forestry manages. Parks are used for producing goods, protecting endangered wildlife and flora species, training forestry workers, and research. They are under the Department of Parks and Wildlife Conservation.
- Forest reserve: any forest under the control of the Forestry Department, except for those in national parks and nature

reserves, which the Department of Parks and Wildlife Conservation oversees.

The population can use these forests only with specific permission. Such limitation undermines the relationship between the people and the forest. Conversely, according to the national forestry law, indigenous peoples and local communities manage the next two typologies (namely community and private forests).

2. Community forests:

These are communally owned and maintained forests that provide fundamental needs such as fuel, food, medicine, the production of forest wood, grazing, shelter, and maintenance. Internationally, community forests are managed under governance frameworks in which communities participate fully or partially in decision-making and provide effort and expertise to maintain healthy forests and promote social well-being (Danks and Fortmann, 2004).

3. Private forests:

These are forests that are grown or planted on privately owned or leased property that follows applicable land regulations and whose management is regulated. This includes private natural forests and private plantations.

Community forests and private forests can be used to determine human-forest relations in the Gambia because of their accessibility and management by local people. Rural people in the Gambia were

formerly restricted from accessing specific forest resources because of rigid forest regulations, which made it difficult for them to actively preserve and manage what was once referred to as “their forests” (Sonko and Camera, 2000). However, in the early 1990s, community forests were established and conceived as a partnership between the government and local people at the community level (Heß et al., 2018). Approximately 350 communities established a forest management system in the Gambia from 1995 to 2017 (Heß et al., 2018). This management initiative is called participatory forestry, targeting local people for sustainable forest management to improve livelihoods through sustainable utilization of forest products and services (Jammeh, 2008). Despite the introduction of participatory forest management to transfer 80% of the forest benefits to the community, the State remains the exclusive forest manager (Jammeh, 2008).

In the Gambian context, community forests are characterized by a participatory method of forest management. A community designates a forest within its customary territory for official management by the forestry department and community members (Jammeh, 2008). The land tenure system, established on customary law and acknowledging community land ownership, is vital to community forestry (Jammeh, 2008). Traditional use or ownership rights are complicated by the limitation of state laws, which, combined with population increases, also lead to the unlawful exploitation of forest resources (Sonko and Camera, 2000). The communities are given the right to manage and use the forest and its resources, but the management practices are within the framework of state forest laws (Table 1).

To support the Gambia’s sustainable forest management and development, a comprehensive National Forestry Strategy (2019–2028) was outlined based on social fairness, economic growth, income distribution, and environmental values (National Forest Action Plan, 2018). This forest plan’s primary goals are to address climate change, dryland and wetland conservation, land degradation, drought, and degradation and conserve forest resources across countries’

boundaries (see Gambia Forest Act, 1998; National Forest Action Plan, 2018).

2.3. Data collection and analysis

We collected primary and secondary data through semi-structured interviews and GIS layers from remote sensing data.

2.3.1. Primary data

In total, 30 semi-structured in-depth interviews were conducted in August with local people in the Lower River Region of Gambia based on their experience interacting with the forest in their environment. The number of interviews was decided based on the average number of interviews from several ethnobiological studies. Indeed, in-depth semi-structured interviews allow one to obtain deep knowledge about the selected topic. They also enable the participants to bring additional insights previously unknown to the researchers (Gill et al., 2008). Interviewees were chosen from among those who lived in four communities in the forest enclave, namely, Manduar, Bureng, Dumbuto, and Karantaba, as representatives of the LRR (Figure 1). We adopted a convenient selection based on interviewee availability. Thus, 30 local people from the identified settlements provided information about biocultural diversity concerning the forest and their perspectives on forest functions and values. In addition, five officials of the Gambian Ministry of Forestry (rangers) and community forest heads contributed to knowledge through separate semi-structured interviews about the management aspects and role of forests in the lives of people at the community level in LRR in the Gambia. We followed the International Society of Ethnobiology (ISE) code of ethics, which recognizes local peoples, their various cultures, and control over their lands and languages and links it with the environment which is directly connected to biological diversity (International Society of Ethnobiology, 2006). We gave utmost respect

TABLE 1 Community forest management systems in the Gambia (Jammeh, 2008; National Forest Action Plan, 2018).

| Community forest management types | Characteristics |
|-----------------------------------|--|
| Community forestry | <ul style="list-style-type: none"> • Aims to regulate local communities’ access to forest resources by transferring exclusive forest resource ownership rights from the government to the communities to enhance the local communities’ well-being by incorporating ecologically adapted natural resource management practices • The strategy intends to manage 75% or around 240,000 hectares of the state’s forest cover, with local communities maintaining an estimated 200,000 hectares |
| Joint Park management | <ul style="list-style-type: none"> • Aims to ensure sustainable management of forest resources while meeting the basic needs of rural communities: creating jobs, generating incomes, and improving people’s living conditions • Establishes a long-term leading role in monitoring and analyzing changes in the production, use, and trading of forest products and the resources and services provided by forests • The managing partner is granted long-term access rights to specific forest resources under the terms of the agreement. The management comprises more than 240 villages in the Gambia, predominantly in the Central River Region, and it encompasses 17,300 hectares or 53% of the existing forest park area |
| Community-controlled state forest | <ul style="list-style-type: none"> • Trains communities to manage designated forest areas and conserve their forests, empowering and involving communities |
| Participatory forest management | <ul style="list-style-type: none"> • Promotes sustainable forest management by actively involving the local communities in mitigating forest fires • Enhances livelihoods via the responsible use of forest goods and services • Preserves the genetic diversity of ecosystems of seed trees and populations of essential wood species • Responds to international treaties and conventions • Reduces the financial and technical burden on the State |

to the culture, integrity, and morality of the community members, as, for self-determination, respondents were given the right to speak for themselves, which was acknowledged by asking open questions. Finally, the first author is from the study area; thus, she has prior knowledge about communities' morals, cultures, social norms, and fluency in the language (Mandinka, [mnk]) in which the interview was conducted.

The interview questions were administered to the following age groups: 20–30, 31–40, and ≥ 41 (Table 2). The interviews were conducted in the first language of most of the interviewees, Mandinka, which is widespread in the Gambia. The interviews were conducted in person and recorded with the help of Modou Manneh and Lamin Manneh from the Department of Forestry in the Gambia. As they are part of the community, their contribution to this research was well-received by the local people. The recorded interviews were translated from Mandinka to English. Mandinka is not a written language (Janson, 2013); thus, the authors recognize the uttermost value in presenting the interviewees' voices.

The 35 semi-structured interviews (Table 2 for further details) were transcribed and translated for analysis. The answers to each question were separately organized and analyzed while keeping anonymity. In our analysis, we separated the 30 answers from the local community members from those from the five rangers, which were only qualitatively discussed as they were assumed to have a different attitude toward the forest.

2.3.2. Field data analysis

The translated narratives underwent content analysis. The subjects covered by the interviewees were grouped intuitively, and systematically, without the use of any specific software. The similar answers were counted.

2.3.3. Secondary data

Geographic Information System (GIS) layers were obtained from the Google Earth engine with remote sensing data from the Landsat 3, 7, and 8 satellites to generate land use and land cover imagery data for the LRR of the Gambia. The satellite image was extracted using Google Earth. QGIS was used to process and visualize the projection from 1979 to 2021. Land use and land cover classifications (LULC) are classified into eight types (Table 3). These are rivers, wetlands, dense forests, bare land, settlements, grassland/cultivated, mixed forests (trees and shrubs), and farmlands. The generated imagery from the Landsat satellites was processed in GIS software. The area of different classes of LULC was estimated using automated statistic tools in QGIS by multiplying the number of pixels of each LULC class by the pixel size used (30*30)/1,000,000 to obtain an area that was a further percentage. The percentage values of the LULC classes from 1979 were subtracted from 2021 to find the net loss or increase of each LULC type.

3. Results

3.1. The material contribution of forests to Mandinka communities

The interviewees reported material and non-material forest contributions to their livelihoods. Material contributions included the collection of food, e.g., fruits and bush meat; firewood and charcoal,

i.e., energy for cooking and fodder for livestock; building material, e.g., tree branches for fencing poles and roofing; and medicinal remedies from the roots, leaves, and bark of trees. The forest as a food source for sustaining livelihoods appeared across several narratives. A female interviewee stated: "The basic benefit I get from the forest is that it is my main energy source. We used tree branches for cooking, and apart from our agricultural harvest, the forest serves as a second source of food for my family" (N24, female, 20–30 years old). Table 4 gives the main material contributions.

3.2. The non-material contributions of forests to Mandinka communities and psychological experiences in the forest

Forests provide essential non-material contributions that support local identity and culture. According to our interviewees, forests are a crucial element of the identity and cultural expressions of the Mandinka communities. For example, some specific trees have bark and leaves that are used to dress the

TABLE 2 Socio-demographic description of interviewees.

| | Descriptions | Community members participants | Rangers |
|------------------------------|---------------------------------|--------------------------------|---------|
| Gender | Male | 16 | 5 |
| | Female | 14 | 0 |
| Language (Mandinka) | Mother tongue | 27 | 3 |
| | Not mother tongue (Wolof, Fula) | 3 | 2 |
| Age groups | 20–30 | 9 | 2 |
| | 31–40 | 17 | 3 |
| | 41 and above | 4 | 0 |
| Total number of participants | 35 | 30 | 5 |

TABLE 3 Description of land use and land cover classification (LULC) (Dampha, 2021).

| Classes of LULC | Description |
|--------------------------------|---|
| Rivers/wetlands | Rivers, tributaries called "bolongs" in the Gambia, wetlands, and ponds |
| Dense forest | Woodland savanna trees, with 50% or more canopy cover |
| Bare lands | Agricultural lands that are barren, unpaved roads, beaches along the river, plain lands in transition zones between terrestrial and aquatic ecosystems, and football fields |
| Settlements | Houses or buildings |
| Grassland/cultivated/farmlands | Grasslands, orchards (that include mango, orange, and cashew plantations), horticultural gardens, ongoing deforested areas, and newly reforested areas |
| Mixed forest | Shrubs and trees together with grasslands. It can be regarded as an open forest in the Gambia context |

TABLE 4 The main material contributions of forests to Mandinka people and related narratives.

| Collected material | Related narratives |
|---|--|
| Firewood for energy, e.g., cooking, including charcoal | "I am a charcoal seller; I have an oven in the forest where I gather stems and big branches of trees and burn them to produce charcoal" (N13, male, 31–40 years old) |
| (Ripe) fruits, e.g., baobab | "Once upon a time, I went to the nearby forest to collect some baobab tree fruits. I accidentally touched a beehive, and the bees started chasing me and biting all over my head and body. It took me 2 weeks to recover from that incident" (N6, male, 31–40 years old) |
| Nuts | "I collect some fruits and nuts such as palm tree fruits and locust beans for family consumption" (N24, female, 20–30 years old) |
| Herbs (from trees) e.g. "borbori" (including traditional medicine from roots and bark of trees) | "Sometimes I collect useful things like the roots of trees as traditional medicine and leaves of shrubs or trees for tea" (N25, male, 31–40 years old) |
| Tree branches for fencing poles, roofing, and furniture | "In construction, I sometimes used forest tree branches for roofing. It is not frequent, but on a few occasions, I cut branches of trees useful for building houses" (N22, male, 20–30 years old) |
| Fodder and grazing | "My family are cattle rearer; I am responsible for taking the cattle to the bush during the day for grazing and returning them home daily" (N21, male, 20–30 years old) |
| Meat | "I am the traditional hunter of this community. I go to the forest to hunt bush animals like antelopes, big birds, etc., and sell it to village people" (N6, male, 31–40 years old) |
| Honey | "I do a honey collection and sell it to community members" (N8, female, 20–30 years old) |
| Commercial foraging | "I am a vendor; I usually visit the forest to harvest sorrel and fruits for selling" (N9, female, 31–40 years old) |
| Chewing sticks for cleaning teeth | "(...) Sometimes I collect chewing sticks for cleaning my teeth" (N19 female, 20–30 years old) |
| Barks and leaves as part of traditional masquerades | "(...) [for] village festivals we also collect the bark and leaves of trees to dress our traditional masquerades called 'katuranwo' and 'cosewo'" (N24, female, 20–30 years old) |
| Nursery bed for rice | "I go to the forest during the rainy season because our swamp (rice fields) is beside the forest. So, we make our nursery bed for rice within the forest before they are due for transplanting" (N26, male, above 41 years old) |
| Locust beans | "I extract charcoal from and collect" pakiya dico busa" [locust beans from the forest]. I also collect tag grass for covering our houses" (N7, male 31–40 years old) |
| Tag grass | "I can say the most important basic need I collect is tag grass. All my houses are covered with tag grass" (N10, male, above 41) |
| Water | Forests" provide good air and water" (N20, female, 31–40) |

traditional masquerades (as reported in Table 4). Indeed, the forest provides non-material contributions to people as it is deeply embedded in local culture and rituals, as well as in local childhood memories as reflected by the community members in the following quote: "My roots are wood carvers, and I was told by a granny that before they cut any tree in the forest, they make sacrifices and communicate with the devil to allow them to cut that tree. Such places are possessed by the devil. According to her, if you did not do that, the devil can hunt you in yours and disturb your normal life" (N8, female, 20–30 years old).

Peacefulness and happiness are some of the emotions the forest provokes. Some interviewees reported contrasting moods. For example, a male interviewee added, "I feel happy whenever I am in the forest. As I said before, it is a place of meditation for me. Some specific parts of the forest serve as a place of reflection because it always reminds me of my late parents. I always remember them teaching me trees that can be used for human consumption, forbidden fruits, and materials that can be used from the forest for medicinal purposes. Those reflections serve as an education that I can also pass on to my children" (N4, male, 31–40 years old). However, interviewees also noted feeling scared, especially in link to the devil. Eight interviewees noted the devil and referred to specific place as a frightening area. The following quote summarizes being scared in certain places or alone: "Sometimes I feel good

being opportune to live next to the forest, which I think is a blessing. But also, in some parts of the forest, I feel scared because we believe that the devil possesses those areas. Such an environment, sometimes even the entire forest, is hot, but that place is always cold. So, we did not frequently visit that area unless we needed something around that area that you must pass beside the area regarded as a spiritual area" (N5, male, 20–30 years old).

Besides the psychological experiences, the forest is also a place of rituals. However, the interviewees express a change in those processes. "We used to have rigid cultures, and they are observed in the forest, but these places are now too open. Sometimes you can be working there, but if you know that before they are cultural places, you will not even know. Those cultures are disappearing because many people no longer believe in them and did not observe them because of education and modernization" (N8, female, 20–30 years old).

3.3. Forest" integral to [Mandinka] life": regulating contributions of forests

Interviewees shared numerous inputs on the forest's contribution to regulating the ecosystem (Table 5). For example, a male interviewee notes: "Forest serves to maintain the soil's nutrient balance. My family has different farmlands, around the forest, and

TABLE 5 Perceived regulating contributions of forests by Mandinka communities.

| Ecosystem function (interviewees) | Supporting quote |
|---|---|
| Prevents the damage from windstorms/thunderstorms (mentioned by 13 interviewees) | “As we all know, Gambia is always a victim of windstorms, some big strong trees are found in the forest for example, mahogany trees serve as windbreaks thereby preventing our structures and houses from collapsing during intense winds” (N1, female 31–40 years old) |
| Fresh air (mentioned by 10 interviewees) | “Forest helps in providing good and fresh air to the community” (N4, male, 31–40 years old) |
| Limits erosion, reduces flood risk, and used for building dikes “tesito” (mentioned by 10 interviewees) | “It reduces the risks of floods because if you observe around, areas with large gullies are deforested areas, but where there are so many trees, those areas are unaffected by erosion” (N2, male, above 41 years old) |
| Soil fertility (mentioned by 6 interviewees) | “(…) The leaf litter in the forest improves the soil fertility. It serves a long way to maintaining the nutrient capacity of the soil, and it also helps the forest’s regenerative capacity as bushfires in the region are recurring every year.” (N5, male, 31–40 years old) |
| Regulates temperature (mentioned by 5 interviewees) | “The forest is like a seal in terms of preventing us from windstorms, and it regulates the temperature in this settlement” (N9, female 31–40 years old) |

the crop grows better” (N6, male, 31–40 years old). Protection from flooding and windstorms was repeatedly highlighted. The most widespread narrative was about forest protection against the damage from windstorms and heavy thunderstorms and the contribution of forests to fresh air and limiting flood risks.

A male interviewee (20–30 years old) noted the following: “From the training as a forest committee member conducted by the Department of Forestry of the Gambia, I understand forest not only prevent flooding and windstorm but also this extremely excessive heat.” The interviewees repeatedly focused on good air and temperature regulation. The following quote supports this: “It provides good air. Trees increase the occurrence of rainfall in this settlement” (N27, female, 31–40 years old).

When describing the natural contribution of the forest toward flooding, the interviewees explained the spatial component, as reflected in the following quote: “This community is not far from the river, but the forest is between the settlement and the river. So, the community is not flooded by river inundation due to the forest acting as a barrier. So, this settlement is not experiencing flooding like other settlements in the Gambia” (N13, male, 31–40 years old). An interviewee (N14, male, 31–40 years old) adds: “Before my parents said that the community had lots of trees, they were not suffering from wind. Now, because our forest is deforested, every wind damages lots of houses in our community.” Such an explanation shows how the ongoing forest transformation affects the local communities.

3.4. Changes across the forest ecosystem and its impact on the local community

The land use maps and insights from the interviewees revealed major changes across the forest. Interviewees’ narratives about changes can be categorized into morphological changes in forest cover and changes in people’s socioeconomic and cultural life, respectively.

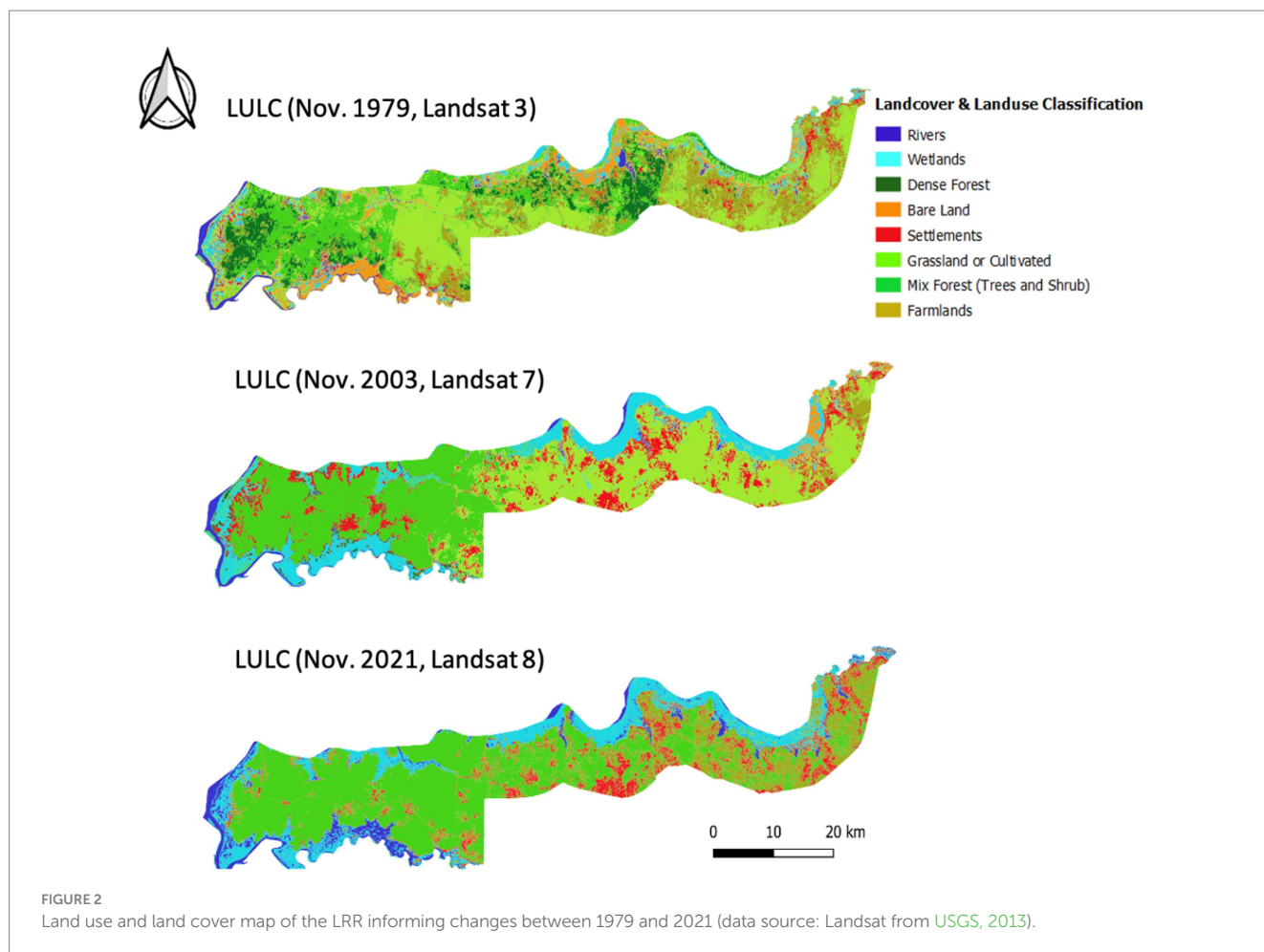
Changes in forest cover concerning the physical structure of the forest and related to the disappearances of trees and wild fauna were reported as one of the driving forces that reduced the interviewees’ involvement with the forest. A female interviewee (N1, 31–40 years old) expressed that “There are changes in the overall ecosystem, such as the disappearance of some trees and animals due to occurrences of

bushfires every year during the dry season. The forest is no longer dense. In the 1970s, this part used to have thick forests. Even if you go to the forest, you used to be scared because of darkness, but now Jarra East is the most deforested area in the Lower River Region. Some trees and animals are gone. Also, cutting down big trees for charcoal production led to the extinction of our traditional trees. As the saying goes, the forest belongs to everyone in the community. Some of these human activities make the forest lose its cultural value. But now the government is helping us reduce that indiscriminate tree felling for energy production.”

The Landsat data of the forest cover in the LRR of the Gambia showed a significant change in land use and land cover between 1979 and 2021 (Figure 2). In 1979, 32% of the total area of LRR was covered by forest, but the entire green space, including grassland, was 60%.

The analysis shows a net decrease of 6% in forest area in 2003 and of 17% for the net change composition of relative land cover description and percentage values from 1979 to 2021. In 1979, the western part (Kiang) and central part (Jarra) had some dense forest, which eventually disappeared by 2003 and 2021 to a mixed forest of shrubs and trees (Figure 2). On the contrary, settlements and bare lands increased by 3% from 1979 to 2003 and 4% from 1979 to 2021. The land use and land cover map indicates that settlements and developments are more concentrated in the central part toward the east in the LRR. River encroachment and wetland increased by 15% from 1979 to 2021.

The interviewees named several drivers of change, including natural phenomena and anthropogenic pressures. A male interviewee (N16, 31–40 years old) summarized the drivers of change as follows: “There are changes to the forest. The forest size and thickness have reduced and are changing because of two main things. First, bushfires are consuming our forests every year. Old trees die, and new trees replacing the old ones can easily be burnt by bushfires. We, the livestock farmers, find it so difficult to feed our animals, especially during the dry season. Second, many trees are cut by people either for timber, firewood, or charcoal production. These activities have a great impact on our forest cover.” The rangers also noticed the change in the diversity of the surroundings, which was reflected by one of the interviewees: “Sometimes I feel sad for local people because deforestation is hitting the sub-region so much, and they are vulnerable because they depend on the forest for their livelihood” (Ranger 1).



An additional aspect of change was notable among the comments linked to the cultural transformations of the community's lives. The following quote demonstrates the apparent change: "In the past, there was one big tree in the forest where the community performed initiation of male children into adulthood. In yearly initiation events, male children were circumcised and stay in the bush (forest) for 1–2 months, when they get educated about communities' cultures, how to respect elders, and how to become responsible in the future. Elders communicate to the kids in rituals and irony. Also, when the villages faced some natural hazards (too little or too much rain, wind, flooding), the elders gathered in the forest under the tree to supplicate according to our traditional beliefs to stop the hazard. Now that tree fell, it symbolized culture and peace for our community. But now, because of modernization and formal education, Islamic religious beliefs, villages take their male children to the doctors for circumcision, that culture is no longer practiced here" (N14, male, 31–40 years old). An interviewee adds: "(...) but now those things are not happening, also during the rainy season, when so many days have passed without rain, the elders of the community used to go the forest to do some cultural rituals for the rain to come" (N6, male, 31–40 years old). Besides the change in local rituals, the interviewees named "Kafo" (in the Mandinka language), a social age group that joins the

community forest members for tree planting to recover the damage to the forest.

Nevertheless, with the introduction of technological appliances, many stay indoors, spending more time watching television programs, and typically depend on other community members for forest products by purchasing firewood as a source of energy for cooking. Notably, the idea of change was recognized and discussed by the interviewees." In the present generation, life has changed, some cultural activities are becoming a thing of the past, and people think they should embrace modern lifestyles to fit into modern society. This is leading to the disconnection of people from the forest" (N9, female, 31–40 years old).

4. Discussion

Our results reveal four main findings. First, material and partially non-material forest contributions are still fundamental to most of the members of local communities in the LRR, affecting the frequency with which they visit the forest. Second, the forest supports psychological well-being, yet some forest areas are generally considered hazardous. Third, major socio-ecological changes are affecting the relationship between the LRR communities and forests. Fourth, such changes contribute to the erosion of traditional forestry knowledge, resulting in changes in community forest management.

4.1. The fundamentality of the forest contributions to Mandinka

The first result indicates that material and non-material forest contributions are substantial and integral to the lives of local people in the LRR of the Gambia. Most respondents did not differentiate between the contributions because of their interdependency and connectedness.

We found that the specific forest contributions to the local people determine their frequency of visiting the forest and their activities in the forest. How often they undertake those activities also depends on their needs, moods, feelings, and perceptions about a particular section of the forest. According to Häggström (2019), human and ecological perceptions of “seeing” and “being in” the forest are interwoven. Material forest contributions to people, especially food and medicines, benefit human well-being, quality of life, food security, and social cohesion (Pullanikkatil and Shackleton, 2019; Constant and Taylor, 2020).

The forest holds cultural and spiritual values for the interviewed Mandinka people, and such forests are regarded as sacred forests. The forest is paramount in the identity of the communities because they perform(ed) rituals or traditional ceremonies that promote peace, harmony, and happiness among local people. These findings align with Constant and Taylor (2020), who state that ritual ceremonies are also conducted to facilitate important social interactions with clan members and cultivate traditional forms of respect. Interviewees indicated that doing traditional prayers of supplication in the forest is a form of communicating to their spiritual gods that illustrates their spiritual beliefs (mostly to prevent natural disasters). This is common to other cultures in forested habitats [e.g., the blessing of medicinal plants among indigenous peoples of Amazonia (Custódio et al., 2019)]. For the interviewees, such connectedness to the forest was difficult to express in modern terms because of the *tacitness* (*sensu* Polanyi, 1966) of their bodily experience. They feel they have communicated to gods if natural disasters have stopped because they feel that their prayers have been answered.

4.2. The contribution of forests to psychological well-being

The second finding reveals that being in the forest is geared toward human well-being. This aligns with other research that people visit the forest because it makes them feel good for primarily two reasons: identifying and appreciating a particular forest activity and enjoying the advantages of the serenity of the forest (Häggström, 2019). Others who visit the forest are resting and recharging their brains following the experiences they formerly had there (Stålhammar and Pedersen, 2017). In this study, the “recharging of the brain” is an arbitrary term that describes people’s indifferent ways of reflecting or pondering past activities in the forest. However, not all community members are physically involved in the activities mentioned earlier happening in the forest. Instead, they depend on other community members for forest goods because they have the purchasing power due to improvements in their economic gains. According to another research study, the amount of forest products gathered and utilized, which is larger in middle-income families, fluctuates as people’s or

households’ earnings rise (Talpä et al., 2022). It is interesting to see how people’s feelings and relations to the forest are underlying factors for their life with the forest if it is experienced as an outdoor activities of being-in-the-forest. Individuals’ moods in the forest depend on their bodily interaction with the forest environment, shaped by spiritual and cultural beliefs that guide their thoughts about the forest. This determines rural people’s attachment to the forest or detachment from some sections of the forest. Such bodily interaction entails people’s life experiences in the forest. Häggström (2019) highlights that the phenomenological approach and cultural connections in human-nature relationships have showcased the intertwined and complex internal and external experiences of being in the forest. Participants used bodily language to communicate their feelings of being in the forest, such as mood changes to happy, peaceful, or scared feelings that shape their understanding of reality or their perception of the forest. Häggström (2019) demonstrates that feeling good in the forest is a sense of connectedness that infers a feeling of thoughts that indicates the forest as a peaceful environment. Tuan (1977) found that feelings and thoughts construct our understanding of reality, and hence, these pauses for reflection may play a crucial role in the lived experience of being in the forest. Our interviewees stressed that their life experiences in the forest are a true manifestation of the past cultural activities of their communities, and they felt that those cultures are their identity, which is shaped by the forest. Some held spiritual and cultural beliefs that they passed to the younger generation by teaching them ethics during initiation ceremonies in the forest. Konczal (2013) suggests that understanding the relationship between people and forests may be crucial to appreciating a society’s identity. In addition, the study finds that individual life experience of being in the forest is about their childhood experience where the community’s initiation ceremonies are held, and such memories are lifelong memories (Konczal, 2013).

4.3. Socio-ecological changes affect the human-forest relationship

The third result relates to the major socio-ecological changes affecting the relationship between the LRR communities and their forests. People reported having stronger spiritual beliefs and cultural bondage to the forest in the past (Roux et al., 2022). The present generation mainly considers material forest contributions because they are more instrumental to their well-being than non-material forest contributions. This is especially true for fuel wood because the forest is no longer a primary source of food or medicine for people in the LRR communities, as most of them depend on food and medicine that is imported into the country. Therefore, local communities perceive that traditional forestry knowledge, practices and beliefs related to either forests’ material and immaterial contributions are increasingly eroding.

The analysis of land use indicates an overall decrease of 17% in forest cover from 1979 to 2021 (43 years), resulting in deforestation or a change in the forest ecosystem in the LRR. Since 1946, human activities and climate change impacts have destroyed nearly 50% of the Gambia’s forest cover according to 2019 estimates (Dampha, 2021). Conversely, from the land use and cover map results, the dense forest has completely disappeared and grassland increased from 3% in 1979 to 7% by 2021. Such ecological succession has allowed grazing and

unsustainable agriculture (for example, abandoning lands after exhausting soil fertility, leading to infertile barren lands that are susceptible to erosion and deforestation). Grasslands that are regarded as open access are being converted to farmlands and after several years of exhausting the soil nutrients, the fields are abandoned as barren land that is susceptible to many forms of land degradation. This can be confirmed by the land use and cover classification as bare land and settlements increased exponentially from 2003 to 2021. Similar studies in the southwestern region found that open-access forests under community management are highly susceptible to human-induced activities, causing irreparable environmental damage and non-substitutable loss of critical natural capital (Dampah, 2021).

From the findings, the primary drivers of change or degradation of forest cover in the LRR are bushfires, land use change by converting forest or grasslands into farmlands and settlement, illegal timber logging by exploiting hardwood forests, charcoal production, and firewood collection for domestic use. The collected firewood and charcoal are transported to urban cities to meet their energy needs for cooking. Similar studies have been done in the southwestern region of the Gambia (West Coast, Kanifing municipality) stating that the drivers of deforestation in that region are climate change (drought resulting in bushfire), illegal timber production, and large-scale firewood collection for domestic use (Heß et al., 2018; Dampah, 2021).

Consequently, these changes move local people's socioeconomic and cultural life away from the forest. For example, introducing formal school education in English and lessening the value of the Mandinka language is one of the drivers for disconnecting local people from the forest. Local languages better adhere to specific socio-ecological contexts and could crucially contribute to biocultural diversity (Soldal et al., 2023). For instance, informal education in Mandinka, which used to be conducted during initiation, was replaced by formal education in English. Religious studies are integrated into the formal education curriculum, teaching the younger generation Western cultures, beliefs, and social life, portraying spiritual beliefs and cultural activities that used to happen in the forest as redundant. Such teachings are not in support of some spiritual beliefs and cultural rituals. As reported by our interviewees, many local people no longer rely on traditional cultural and spiritual beliefs. They practice the ethics of religions instead of traditional or "soninke" beliefs. The forest esthetic value serving cultural ethics has been gradually fading away, and it is losing its role as a place for cultural performances. In addition, with the introduction of hospitals in 1843 by British colonial masters and the extension of clinics in the communities, the forest's value as a source of traditional medicines is diminishing among locals.

Similarly, because of modern health facilities, people prefer taking their male children to be circumcised in the hospital instead of taking them to the bush or forest for initiation ceremonies. Cultural performances remained in the past. Nevertheless, another social and economic life transformation preventing people from spending more time in the forest or outdoor nature is people spending more time playing games and watching movies or television programs. This reduces outdoor activities, and community members spend less time together in the forest collecting food. This change in socio-economic life has reduced people's connections with the forest and the social bonds among community members. Miller (2005) suggests that direct nature experiences have become progressively unavailable to new generations; this creates an ever-narrowing spectrum of nature experiences due to sedentary activities. Nevertheless, another driver

of change in people's relationship with the forest is urbanization and rural-urban migration. This result is well documented in the literature, along with the expansion and development of urban cities in terms of infrastructures, social amenities, and modern technological facilities such as roads, electrification in urban cities, schools, hospitals, and job opportunities. This also reduces rural people's interaction with their local environment (Mattalia et al., 2022; Plieninger et al., 2023).

4.4. Erosion of local knowledge affects forest management

The fourth finding indicates that the erosion of traditional forestry knowledge results in changes in community forest management. Except for natural occurrences such as bushfires, some cultural trees or animals in the forest are tabooed by traditional customary laws not to be felled or killed by anyone due to the spiritual and cultural value attached to those species in the forest. This was a form of conservative practice to maintain the forest by local communities in the past, incumbent upon every community member to be respected and observed. Similar studies have shown that cultural practices protect and maintain sacred forests for biodiversity protection but also allow mechanisms for local people to connect spiritually with the land, ancestral spirits, and God (Constant and Taylor, 2020). However, the results suggest that the present community forest management system used a top-down approach where the guiding principle for maintaining the forest is formulated by the legislative councils held by forestry officials instead of traditional customary laws. With a decentralized management system, community forest committees are responsible for implementing the forest laws with an agenda of "benefit from what belongs to you." The system gives 85% benefit to communities, while before, the community was in total control and benefited 100% from what belonged to them. Nevertheless, local people are satisfied with recent participatory forest management because of the cooperation between different stakeholders. This cooperation benefits them in multiple ways, such as training local people in new conservation practices, forest product marketing strategies, and decentralized management systems.

Community forestry is the first step in the ecological, economic, and social transition needed to restore a historically unstable system and achieve sustainable forest management (Sonko and Camera, 2000). Community or participatory forest management systems have realistic objectives to involve local people in managing the forest that belongs to their community. However, the system creates some problems by promoting widespread illegal timber logging by people disguising themselves as community members. Also, the system presents a conflict of interest between communities and the state as the Gambian National Forest Action Plan 2019–2028 advocates for a steady reduction in charcoal production to conserve the already degraded forests while the local people's only source of energy for cooking is firewood or charcoal. This creates a concern in their communities that they are responsible for protecting the forest because, in turn, they are protecting the source of their primary benefits.

Such conflicts are common in biodiversity conservation and call for context-based strategies co-designed by local communities, stakeholders, and policymakers respectful of/ shaped by the local

knowledge, cultural values, beliefs, and practices related to the communities' ethnicities and religious faith.

In this research, we tackled the relationship between forests and local Mandinka communities, mainly through the contributions of forests to people. Nevertheless, we are aware of the crucial importance of human contributions to forests for their maintenance through community forest management systems, especially considering the importance of this biome in the identity of the studied communities. The findings show that involving various stakeholders in forest management systems by integrating both traditional and state forest management systems will be instrumental in the maintenance of forests in the long term.

Through the ongoing collaboration with local communities, this study contributes to valorizing the role of the local knowledge held by Mandinka peoples in maintaining their forests. Moreover, the results obtained from this study could serve as a yardstick for the government in formulating culturally informed forest policies.

5. Conclusion

This research reveals the crucial importance of the contribution of forests to Mandinka communities, specifically to their psychological well-being. In addition, our interviewees show how ongoing social changes affect the human-forest relationship and erode local ethnoforestry knowledge in the LRR in the Gambia.

The perception of the local communities about the various contributions of forests to local communities is based on their individual needs, creating preferences as to which services are more beneficial to the person. Moreover, the results reveal that human influences on forests resulted in changes in forest cover due to land use and land cover change for short-term benefits.

In line with other scholars, the findings of this study underline the quintessential need to include the views of local communities in shaping forest management to better fine-tune conservation strategies and also ultimately contribute to community well-being. This confirms, therefore, that other studies during the past decade clearly showed how the paradigm of forest management has to shift from an aseptic "organizing" to more of a "caring" attitude. Given the tremendous ecological importance of forests in the current debate on climate change, this change in perspective is more needed than ever.

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Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

GM, BP, SD, and RS conceptualized and designed the study. SD and LM conducted the study in the local community. SD drafted the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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