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Research Article

Forest-related Knowledge and Transfer Strategies Among Forest-edge Communities in South-Eastern Sierra Leone

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Abstract

Forest-edge communities intrinsically depend on and relate to nearby forests in patterned ways, wherein forest-related knowledge matters because it is both a heritage and valuable asset for healthcare, livelihoods, and meeting wider community needs. Equally, how a forest is understood shapes how it is perceived, valued, and cared for. This study examined the forest-related knowledge and transfer strategies among forest-edge communities in South-eastern Sierra Leone, utilizing a mixed-methods design, incorporating both qualitative and quantitative strategies. Data were collected from adults/household heads, chiefdom/community leaders, and agency staff across the four districts. The study targeted 1,280 respondents (786 male and 494 female), who were interviewed through surveys, Focus Group Discussions (FGDs), and Key Informant Interviews (KIIs). Data were summarised as counts, percentages and words. A chi-square test of independence and logistic regression analyses were used to test the associations between respondent characteristics and outcomes. The study communities demonstrated significant knowledge of their forests, with both formal and informal strategies for knowledge transfer. For local knowledge transfer, the guidance of elders was found to be critical, as they encourage children to "learn by doing" (85.7%), storytelling and proverbs (70.6%), wider cultural practices (62.8), or formal awareness raising (17%). Communities enjoy diverse benefits like shade, food, income, building and craft material, medicinal plants, etc. Change in forest ecosystem was read from the forest itself, with the productivity of wild fruits, and the health and density of trees being the most widely used signs. While some practices by forest-edge communities may degrade forests, the irony for forest-related knowledge is that sustaining it is synonymous with sustaining forest-related practices. Therefore, environment-focused practitioners and institutions should urgently agree on common grounds for local forest-related knowledge and scientific knowledge to be harmonized to sustain the knowledge and ensure long-term forest management strategies.

Keywords

Forests, Forest-related Knowledge, Forest-edge Communities, Sacred Groves, Sierra Leone

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1. Introduction

Natural resources provide the building blocks for human survival, and for forest resources, they shape the way of life and behavior of communities. For forest-edge communities, it is a way of life, that shapes people's attitudes, and profoundly influences how forest resources are used. As Chanza [1] noted, despite the seeming exploitative tendencies of some communities, forest-edge communities perceive forests as their "living relatives" deserving respect and protection, owing to the generous support forests provide to communities. Although the practices of forest-edge communities on forests are context- and place-specific, developing countries in Africa, Asia and Latin America have particularly exhibited attitudes that respect the earth as "mother," and studies justify the need for forests and other natural resources to be treated and utilized as such [2].

The involvement of women in forest resource protection is, however, particularly critical, as they form a significant part of forest resource exploiters. A study in Nigeria [3], for instance, revealed that 71.2% of rural women were involved in harvesting forest resources, including edible leaves, fruits, snails, and medicinal herbs, boosting their income generation potential. Apart from the harvesting of resources, the study further revealed that women play a crucial role in the management of forest resources, which in this sense speaks to the way knowledge is generated and transferred. A related study [4] revealed that, comparably, men dominate forest management structures, but local women are active participants in all tiers of the co-management of forests. This generally points to the need for forest-related knowledge generation and transfer strategies to be cross-cutting, tailored to the needs of both men and women, as they are both active users and beneficiaries of forest resources.

This study examined the forest-related knowledge of forest-edge communities in South-Eastern Sierra Leone and the strategies they employ to transfer such knowledge across generations. The study, therefore, provides answers to the following research questions: How do forest-edge communities perceive and classify forests? What benefits do forest-edge communities derive from forests? How do forest-edge communities predict changes in forest ecosystems? How is forest-related knowledge transferred across generations?

Gauging the forest-related knowledge of forest-edge communities will pinpoint knowledge gaps across communities and serve as a learning experience to enhance knowledge levels for sustainable forest utilization and management. It will also guide the required strategies to safeguard forest-related knowledge and ensure its smooth preservation and transfer across generations.

1.1. Forest-related Knowledge and Forest-edge Community Dynamics

Forests are critical ecosystems supporting environmental, economic, and social systems of the global community. Globally, a profound spiritual and cultural relationship exists between forests and forest-edge communities, which shapes utilization, conservation attitudes and practices of communities. With the global community seeking solutions to the looming Climate Change consequences, forests are noted to provide cost-effective solutions for reducing the accumulation of greenhouse gases (especially CO_2) in the atmosphere [5]. The sustained provision of these support systems largely depends on the sustainability of forests, which in turn depends on community knowledge, practices, and protection systems. Through forest-related knowledge, local communities are able to read seasons, flora and fauna, soil and water systems, and sacred places with agreed rules for sustenance and protection [6, 7].

While some studies often focus on the negative practices that perpetuate forest degradation, some case studies have revealed community beliefs and cultural practices can translate into conservation practices through the establishment of sacred groves, sustained through traditional values, rituals, and taboos [8], with significant biodiversity value [9]. Because of their critical indigenous knowledge of the local environment, active participation by forest-edge communities in forest-related decision-making and management will help develop and implement effective management strategies [10]. Where conservation efforts and resource use are aligned with local cultures, traditions, and beliefs, communities across Africa have exhibited willingness to support forest conservation [8].

In the Global South, the co-production and transfer of forest-related knowledge on governance and conservation are common among local communities [11]. Generally, the actors and interests regarding forest-related knowledge are diverse. Hence, what gets shared and the effects depend on prevailing social and institutional conditions [12, 13]. In West Africa, generally, and Sierra Leone, in particular, the wider belief is that forest loss is rapid, drastic and recent, although this conflicting narrative is partly a matter of definitional diversity [14]. While perceptions about forests vary, safeguarding forest-related knowledge is crucial, as such knowledge is easily lost when land (forest) access, social ties between communities and forests, and intergenerational learning systems are not sustained. This change is particularly pronounced in places with rapid links to outside markets and development, increasing stresses that threaten cultural diversity [15].

The dependence of forest-edge communities on forests has been noted by many studies [6, 7, 16], as well as how their traditional knowledge of the diverse uses of the forest is transferred over generations [6]. Although strategies for transferring and safeguarding forest-related knowledge vary, such knowledge is generally gained through direct involvement with forests, such as gathering, hunting, fishing, and participation in traditional rights [17]. While knowledge remains

contextual, the greatest risk of forest-related knowledge degradation happens where culture and livelihood systems and forest use practices are neglected, risking useful information for community practices and conservation [18]. Sustaining forest-related knowledge is, therefore, synonymous with sustaining activities and practices through which communities gain forest-related knowledge.

While the diversity in local knowledge of forest ecosystems provides a basis for future conservation strategies [18], pressures such as changes in belief systems, shifts in livelihoods, modernization, climate change, and resulting disruptions in social-ecological systems increase risks to safeguarding forest-related knowledge [19-21]. Hence, the need to recognize and respect local cultures, knowledge and livelihood systems is critical because the long-term local rootedness and interaction between communities and forests strengthen their knowledge to identify indicators, drivers, and consequences of forest loss [7]. Generally, community participation as co-managers ensures a functioning forest and that the knowledge intrinsic to communities is protected over generations [22]. It is equally vital for strategies to ensure forest protection measures do not marginalize local communities, erode their cultural systems, impinge on community rights, access, livelihoods, and cultural heritage [22].

A historical account of forest protection in Sierra Leone, especially for sacred groves, is documented by refence [23], highlighting their relevance in sustaining local livelihoods and safeguarding local knowledge. Studies in Sierra Leone have equally noted long-standing strategies for forest-related knowledge transfer, enshrined in community practices, norms, and traditions, and in external agencies and conservation policies [13]. Such diverse traditional knowledge, like observations of species behavior, seasonal changes, soils and resource availability, is crucial but often neglected by formal scientific assessments [24].

The relevance of indigenous forest-related knowledge in Sierra Leone's healthcare has been particularly documented by [25] and [26]. Hence, as customary traditions weaken, forest loss intensifies, and older knowledge-holders are lost, there is a potential for medicinal plant knowledge to disappear, pointing to the urgent need to safeguard such knowledge [26]. For forest-edge communities, this matters because knowledge is viewed both as a heritage and as a valuable asset for healthcare, livelihoods, and wider community needs [25].

1.2. Forest Knowledge Types and Transfer Directions

Forest-related knowledge varies, and the direction of transfer is not unidirectional. For forest-edge communities, forest-related knowledge is usually in two main forms: local ecological knowledge and scientific knowledge. In many ways, forest-edge communities thrive in multiple knowledge systems—with local, indigenous, state, NGO, and scientific knowledge—and such dynamics transcend the existence of knowledge; understanding how it is shared, adapted, and utilized in practice matters [27]. What constitutes scientific knowledge also varies, but for scientific knowledge like that derived from remote sensing, it is common for technical variations of concepts to be accepted, while ignoring ontological or conceptual variations [28]. In this conceptualization, forest and land cover information generation and transfer largely hinges on those who decide and define what the features of interest in datasets are, and why [29]. For land cover, knowledge development strategies should be mindful of assumptions and meanings of the information recorded and classified [28].

The mismatch in understanding geographical data between producers and users has also been documented. This varied perception exists even among users of land cover information from producers, in the process, mis-conceptualization of the meaning and value is apparent [28]. As noted *inter alia* [30], the conceptualization of the world is largely based on available information, which further determines how geographical data are mapped. Even for land cover data, perceptions across stakeholders and agencies vary based on their social constructs and contexts.

Traditional ecological knowledge emerges from a cumulative body of knowledge, practices, and beliefs that communities develop through long-term experience and primarily transfer across generations through informal cultural practices [31]. Such local knowledge includes values, norms, beliefs, views of ecosystem functions and benefits, and constraints shaping how forests are utilized and protected [31, 32].

While strategies employed in traditional knowledge and scientific knowledge vary, the two knowledge systems, however, complement each other. In Sierra Leone, reference [24] noted how strategies for traditional forest-related knowledge unearth critical knowledge often neglected by formal scientific assessments. For forest management, traditional knowledge systems and practices are noted to enhance sustainable management, maintain ecological integrity, and meet community needs [33]. Evidences from the Democratic Republic of Congo [34] and Ethiopia [35-37] have found that traditional ecological knowledge transfer happens informally, oraly, embedded in customary institutions, transmitted through family councils, traditional ceremonies or rituals, songs and riddles.

While intra-community knowledge transfer is widely noted, the role of inter-community interaction and knowledge transfer is equally noteworthy. In this regard, such exchanges provide communities the opportunity to learn from others with similar forest, livelihood, and governance conditions and practices [38]. To ensure sustainability, unidirectional knowledge transfer has no place in forest-related knowledge transfer, as bilateral, or multilateral pathways have proven to be valid and necessary for sustainable management of resources [39]. While diverse strategies are employed to transfer knowledge within and between communities, effective transfer of forest-related knowledge is, however, best achieved

when social ties between the population in question are stronger. Hence, sustaining ties, trust, shared goals, and culture expedite knowledge transfer, especially where collaborative efforts are sustained between communities and external actors [40, 41].

In Sierra Leone, active community involvement in forest management is an effective approach to reduce forest loss and improve rural communities' welfare, as it builds local control, ownership and long-term stewardship [42, 43]. In effect, this proves vital for knowledge transfer as it empowers communities to manage forest resources and build knowledge useful in day-to-day decisions regarding access, protection, and restoration [43].

While traditional knowledge generation and transfer matters, reference [25] have noted forest-related knowledge to be age- and gender specific. Hence, knowledge of certain practices is mainly transferred by elders (e.g., herbal medicine knowledge), or by secret societies, which are often exclusive to men or women. Where effective community participation is encouraged, studies have noted the flexible nature of forest-edge communities in Sierra Leone to accommodate hybrid knowledge systems, where traditional knowledge remains central, but is linked with structured monitoring, sanctuary management, and external technical support [44, 45]. Despite the relevance of local knowledge transfer, it is, however, not always straightforward. A study by [46] in Liberia, for instance found a clear gender differentiation and specialization in the use of medicinal plants for the treatment of illnesses. However, women herbalists were more open and willing to sharing their expert knowledge.

While numerous studies have been done targeting forest-edge communities, the focus and extent have been diverse. Some have focused on knowledge and utilization of wild edible plants [6, 36, 37], others have examined medicinal and wild edible plants [35], or medicinal plant use [26]. Studies that have generally gauged the knowledge of forest-edge communities about their forests, especially how forest-related knowledge is transferred in Sierra Leone, are uncommon. We, therefore, aimed to bridge such a knowledge gap, especially among forest-edge communities in South-eastern Sierra Leone.

2. Materials and Methods

A detailed methodology of this study was given in a related study by reference [7].

2.1. Study Area/Setting

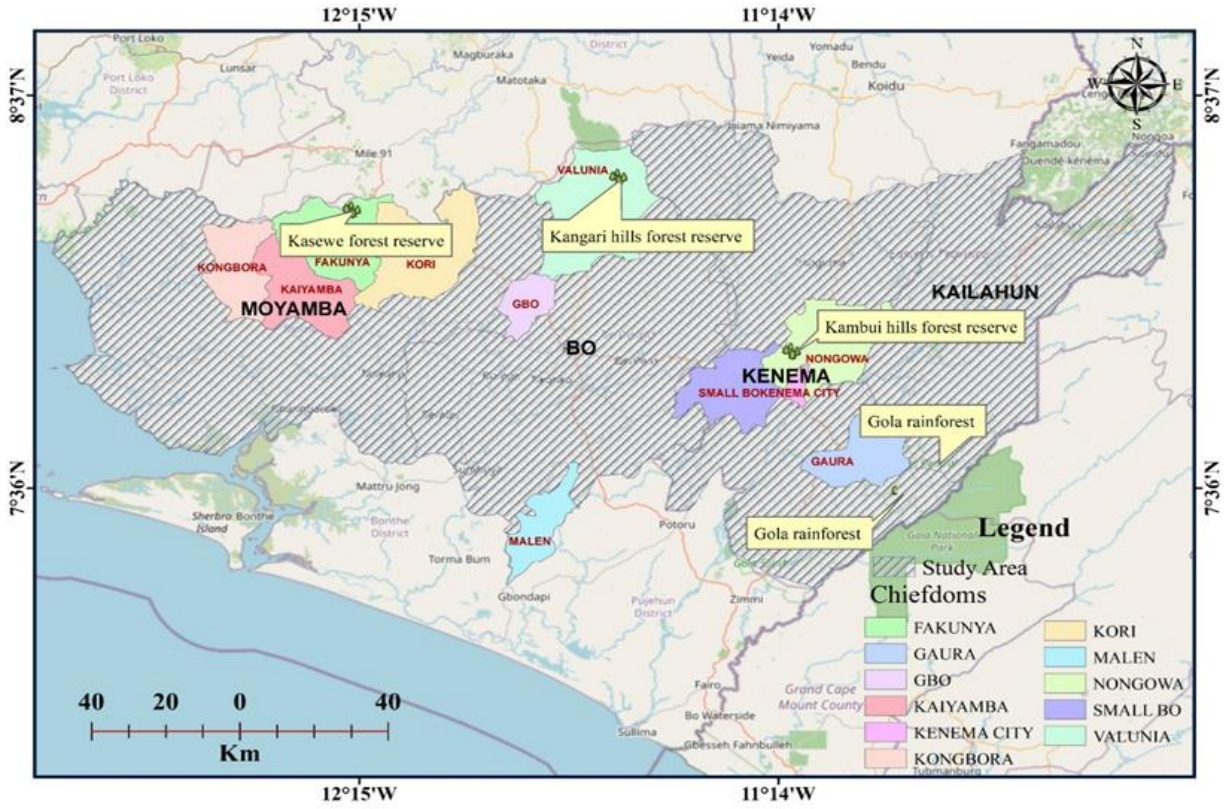

Figure 1. *Location of Chiefdoms containing "forest edge" communities in Southern and Eastern regions of Sierra Leone.*

This study was conducted in selected forest-edge communities in four districts in the southern and eastern regions of Sierra Leone. The Southern Region districts were Bo and Moyamba, while the Eastern Region districts were Kenema and Kailahun. In each district, a reserved forest and its immediate communities were selected for the study. The study-location map is presented in Figure 1.

The topography of the study districts is characterised by a mix of rolling hills, valleys, and lowlands, but three forest reserves (Kawase, Kangari, Kabui) are on prominante and very steep sides hills. Elevation varies, with some areas rising significantly above sea level and providing a variety of microclimates that support different types of vegetation and agricultural activities. Between 1981 and 2018, [47] reported the four districts to have recorded very high mean annual rainfall of 2,766 mm (Moyamba), 2,574 mm (Bo), 2,540 mm (Kenema), and 2,338 mm (Kailahun). The climate of the four districts is generally characterised by distinct dry and rainy seasons. The favourable seasonal rains, together with the warm weather, support the growth of forests and the cultivation of both tree crops and other crops that form a critical part of the local diet. Despite their significant forest landscapes, the study communities, and by extension the districts, are not entirely forested. Hence, the forest landscapes in the study districts contain a rich diversity of flora and fauna, including various species of trees, shrubs, and grasses that provide resources for community livelihoods.

2.2. Socio-economic Environment

According to [48], the study communities across the four districts had a total population of 22,609, comprising 11,419 males and 11,196 females. Projections based on population growth rates, however, indicated that by 2025 the study communities had a total population of 24,878, comprising 12,565 males and 12,313 females. Although the communities host other ethnic groups, such as Temne, Fullah, and Kissi, the Mende are predominant [48]. The study communities are largely characterised by two main religions: Islam and Christianity. The economic activities in the study communities are diverse, ranging from formal to informal activities. This is largely due to the nature of the communities, which range from urban and peri-urban to rural. In peri-urban and rural communities, agricultural activities constitute the majority of livelihood activities [7]. Mining, petty trading (in both food and non-food items), construction, and motorbike taxi riding are other notable economic activities widely practised across the four districts.

2.3. Study Design

This study employed a mixed-methods design that combined quantitative and qualitative strategies and approaches [49]. The use of both strategies provided the researchers with an opportunity to understand the complex realities of the research problems more fully because mixed methods can provide rigorous and deeper interpretations of research outcomes [50]. The design is considered more effective than using a single strategy in conducting research [49, 50]. This study was designed to collect data through surveys, key informant interviews, and focus group discussions to gauge respondents' knowledge about their forests and strategies employed for forest-related knowledge transfer.

2.4. Field Research Instruments

Various research instruments were used according to the type of data collected. Generally, a semi-structured questionnaire was the main instrument for the quantitative component of the study. The questions were structured around the key focus of the study and inputted into KOBO Collect software installed on Android phones used by the enumerators during the survey. Interview guides were equally developed for the Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). For both qualitative and quantitative data collection, mobile phones (e.g., Tecno PAVO Neo) were used to run the KoboCollect software, record interviews, and take photographs, while pens and field notebooks were used to record observations and personal discussions.

2.5. Sampling and Sample Size

The study targeted diverse groups of people; hence, various sampling methods were utilised based on the availability of secondary data and ease of access to the study population. First, purposive sampling was used to identify the targeted forests, particularly public inland forests that provide livelihood opportunities for surrounding communities. A stratified sampling procedure was then used to categorise the various groups of people to be interviewed. The strata into which the study population was categorised included staff of environment- and livelihood-related agencies, environmental officers of district councils, paramount chiefs and community leaders, and adults/heads of households. Depending on ease of access to the identified categories and the possibility of obtaining a representative sample, simple random and accidental sampling were utilised to select respondents. Simple random sampling was conducted by lottery, with respondents/characteristics placed in a sack, rigorously shaken, and selected one at a time until the required number of respondents was achieved. Accidental sampling was also used to reach authorities and agency officials whose duties normally involve frequent movement.

The sampling frame comprised a total of 16,231 individuals, including 16,171 adults/household heads, 4 environmental officers of district councils, 11 paramount chiefs/representatives, 25 headmen/chiefs, and 20 staff of environment- or livelihood-related agencies. The survey sample size was calculated from the 16,171 adults/household heads using the reference [51] formula, which was employed because of its suitability

for calculating sample sizes when the target population is known [52].

$$n = \frac{N}{1+N(e)^2}$$

where n is the sample size to be determined, N is the total number in the sampling frame (16, 171), and e is the margin of error at the 95% confidence level. Based on this calculation, a sample size of 391 adults/household heads was obtained. However, because of the large area covered by the research and to improve the representativeness and precision of the data, a total of 1,103 respondents were interviewed in the survey through face-to-face interviews. In addition, 13 FGDs were conducted, totalling 149 participants, while the Key Informant Interviews targeted 3 environmental officers of district councils, 4 paramount chiefs/representatives, 16 headmen/town chiefs/chairladies, and 5 staff of environment- or livelihood-related agencies. Overall, the study targeted 1,280 respondents across the survey, KIIs, and FGDs.

2.6. Data Collection and Analysis

2.6.1. Quantitative Data Collection

The quantitative data were collected using semi-structured questionnaires covering the thematic areas of the study. The survey questionnaire was designed in KoBoToolbox and administered through KoBoCollect installed on Android phones (e.g., Tecno PAVO Neo) used by the enumerators during face-to-face interviews.

2.6.2. Qualitative Data Collection

For the qualitative data, Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were conducted using interview guides related to the study themes. Android mobile phones (e.g., Tecno PAVO Neo) were also used to record interviews and take photographs, while pens and field notebooks were used to record observations and personal discussions. The consent of all participants was sought before recording, and the purpose of the study was clearly explained to them.

2.6.3. Quantitative Data Analysis

Data management, statistical testing, and graphics were carried out in the R programming environment. A set of well-established R packages supported the work: the tidyverse family for data handling and charting, janitor for cleaning, gtsummary and flextable for formatted tables, MASS for ordinal regression, psych for scale reliability, and car and broom for model checking and tidy model output. A fixed random seed was set so that the results could be reproduced exactly. Categorical data were summarised using counts and percentages, while questions with a large number of response options allowed respondents to choose more than one answer ('tick all that apply'). For these questions, the percentages reported included all respondents who endorsed each option. A chi-square test of independence was used to test the association between respondent characteristics and outcomes. Where some expected cell counts were small, Fisher's exact test was applied instead. The strength of each association, rather than merely whether it was statistically significant, was measured using Cramér's V, for which larger values indicate a stronger relationship.

Each objective was anchored by a model that considered all predictors together, so that the influence of one characteristic was estimated while the others were held constant. Binary (yes/no) outcomes were modelled using binary logistic regression, and ordered outcomes, such as graded levels of concern, were modelled using ordinal proportional-odds logistic regression. Results were reported as adjusted odds ratios (ORs) with 95 per cent confidence intervals (CIs): a value above 1 means that the characteristic raises the odds of the outcome, while a value below 1 means that it lowers them. The overall fit of the logistic models was summarized using McFadden's pseudo-R^2.

2.6.4. Qualitative Data Analysis

The qualitative data were analysed textually. Data collected from focus group discussions or key informant interviews through audio recordings were transcribed into English and summarised by theme. Data from personal discussions or field observations were recorded in field notebooks and later used in the discussion to triangulate, support, or contrast the quantitative results.

In this study, informed consent was obtained from respondents during this study. Equally, respondents' participation in the research was entirely voluntary, and they had the right to withdraw from the exercise or choose not to answer question(s) at any time during the interview or discussion. This study maintained and observed the ethical principles of informed consent, confidentiality, anonymity, the do no harm principle, and respect.

3. Results

3.1. Definition of "Forest" in Southern and Eastern Districts

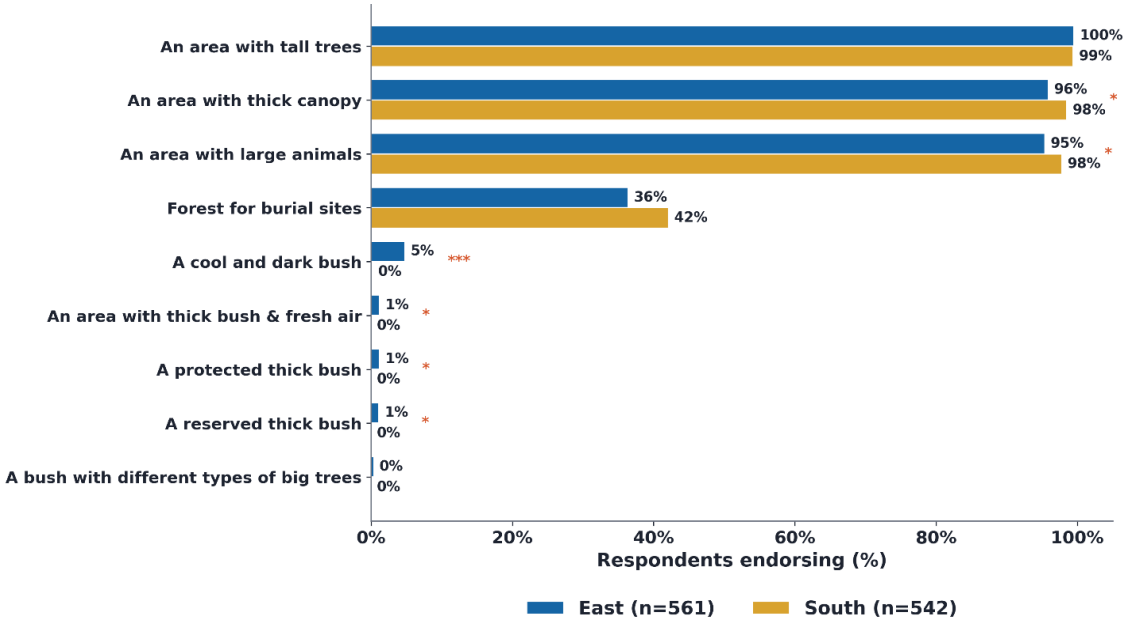

Figure 2. *Definition of "forest" in Southern and Eastern Districts.*

Table 1. *Forest types by region.*

Definition of a forest	East n	East %	South n	South %	Diff (pp)	p	Sig
An area with tall trees	558	99.5	539	99.4	0.0	1.000	ns
An area with thick canopy	538	95.9	534	98.5	-2.6	0.0141	*
An area with large animals	535	95.4	530	97.8	-2.4	0.0415	*
Forest for burial sites	204	36.4	228	42.1	-5.7	0.0604	ns
A cool and dark bush	27	4.8	1	0.2	4.6	<0.001	***
An area with thick bush and fresh air	7	1.2	0	0.0	1.2	0.0258	*
A protected thick bush	7	1.2	0	0.0	1.2	0.0258	*
A reserved thick bush	6	1.1	0	0.0	1.1	0.0450	*
A bush with different types of big trees	2	0.4	0	0.0	0.4	0.4943	ns

Chi-square test of region × endorsement for each item. “Diff” = East % minus South %.
*** p<0.001, ** p<0.01, * p<0.05, ns = not significant.

Understanding how forest-edge communities define and classify forests is vital for assessing their knowledge of what they consider a forest, and for gauging how they relate to and exploit forest ecosystems. Figure 2 and Table 1 present, respectively, the distribution and the Chi-squared results of how forests are defined in the two study regions. Respondents drew on both ecological indicators, such as canopy, tall trees, and wildlife, and cultural categories, such as secret-society forests, sacred and burial groves, and traditional-rights forests, when defining and naming forests. Almost everyone in both regions described a forest in basic ecological terms: an area with tall trees (about 99% in each District), and large majorities also named thick canopy and large animals. These last two were slightly more common in the South, and although the gaps are

small, they are statistically significant. The more descriptive definitions were rare but revealing: calling a forest "a cool and dark bush" was reported almost only in the East (4.8% against 0.2%, p<0.001). Cultural or sacred classification was somewhat more common in the South (56%) than in the East (46%).

3.2. How Respondents Name the Various Forest Types in Their Communities

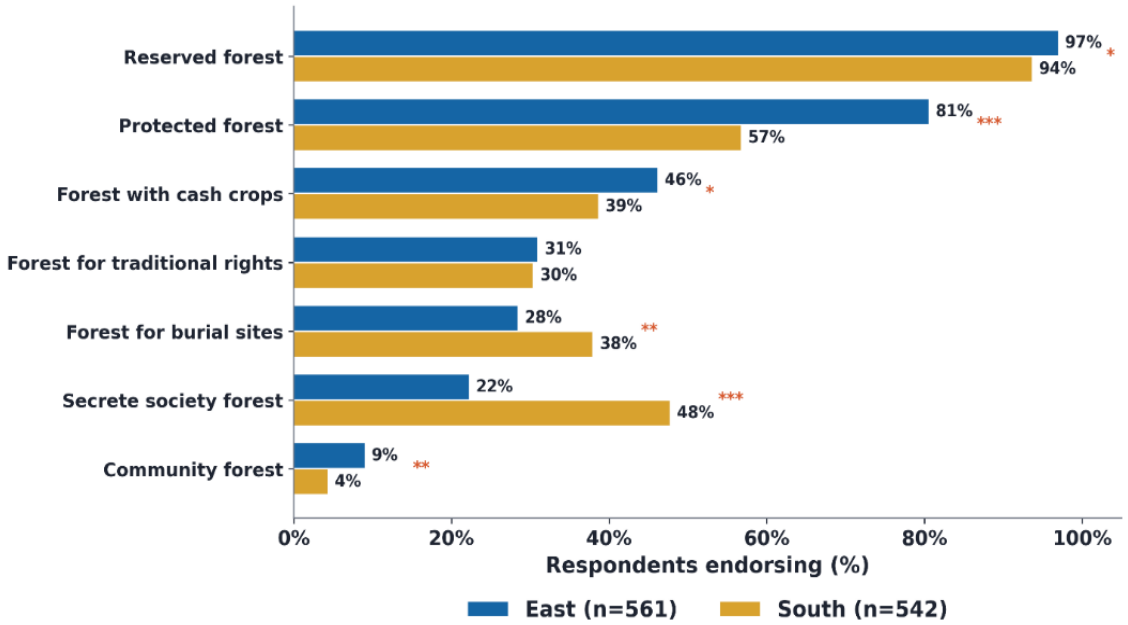

Figure 3. *How communities classify forest types in the two regions (East vs South).*

Table 2. *Forest types by region.*

Named forest type	East n	East %	South n	South %	Diff (pp)	p	Sig
Reserved forest	544	97.0	508	93.7	3.2	0.0155	*
Protected forest	452	80.6	308	56.8	23.7	<0.001	***
Forest with cash crops	259	46.2	210	38.7	7.4	0.0150	*
Forest for traditional rights	174	31.0	165	30.4	0.6	0.8879	ns
Forest for burial sites	160	28.5	206	38.0	-9.5	0.0010	**
Secret-society forests	125	22.3	259	47.8	-25.5	<0.001	***
Community forest	51	9.1	24	4.4	4.7	0.0031	**

Chi-square test of region × endorsement for each item. *** p<0.001, ** p<0.01, * p<0.05, ns = not significant.

Figure 3 and Table 2 present the distribution and Chi-squared results of the forest types named in the two regions. Beyond the ecological and cultural features, forest-edge communities are able to classify forests by extent, function, and ownership. These names matter, because they signal how communities recognize the governance and authority that control access to and use of forest resources. Clear regional differences emerged in the forest types people named. Reserved and protected forests were recognized by most respondents, but protected forests were far more familiar in the East (80.6% against 56.8%, p<0.001). The sharpest contrast was for secret-society forests, named more than twice as often in the South (47.8% against 22.3%, p<0.001), while burial-site forests were also more common in the South.

3.3. Binary Logistic Regression: Cultural/Sacred Classification of Forests

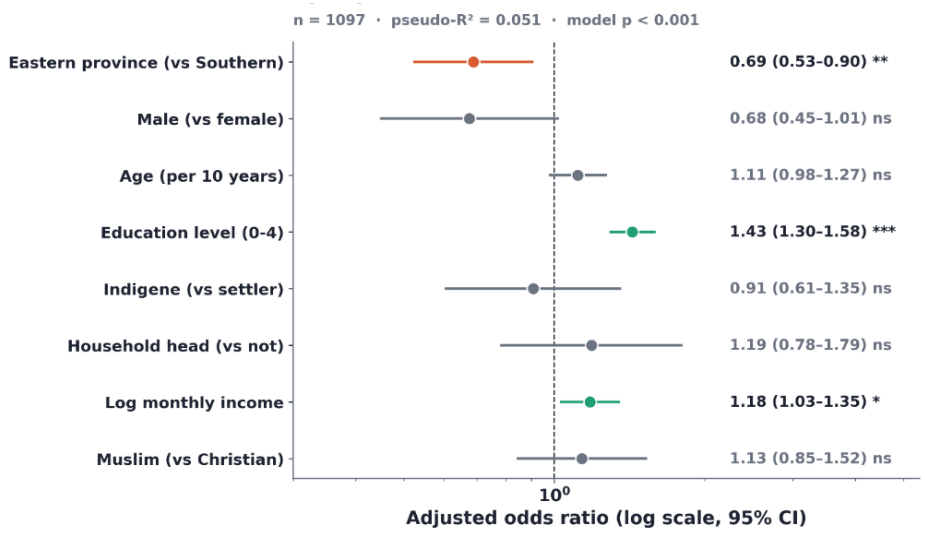

Figure 4. *Adjusted predictors of forest classification.*

Table 3. *Binary logistic regression - classification of sacred forest.*

Variable	OR	95% CI (lower)	95% CI (upper)	p	Sig
Eastern province (vs Southern)	0.688	0.525	0.903	0.007	**
Male (vs female)	0.676	0.451	1.015	0.059	ns
Age (per 10 years)	1.114	0.981	1.266	0.097	ns
Education level (0–4)	1.432	1.295	1.584	<0.001	***
Indigene (vs settler)	0.907	0.608	1.353	0.632	ns
Household head (vs not)	1.186	0.784	1.794	0.418	ns
Log monthly income	1.179	1.032	1.346	0.015	*
Muslim (vs Christian)	1.135	0.845	1.523	0.401	ns

OR > 1 raises the odds of cultural/sacred classification; OR < 1 lowers it. Model pseudo-R ²= 0.05.
*** p<0.001, ** p<0.01, * p<0.05, ns = not significant.

To understand what drives the classification of forests by forest-edge communities, a binary logistic regression was run in which key respondent characteristics were examined. The results are presented in Figure 4 and Table 3. Holding background characteristics constant, two findings stood out. Education was the strongest predictor of classifying forests in cultural or sacred terms, with each step up the education ladder raising the odds substantially (OR = 1.43, p<0.001), and higher income was a modest but significant predictor (OR = 1.18, p<0.05).

3.4. The Main Benefits Communities Derive From Their Forests

Table 4. *Perceived benefits of community forests.*

Benefits	n	Percent
Provides shade	942	85.4

Benefits	n	Percent
Provides food and income	926	84.0
Reduces erosion and maintains soil fertility	660	59.8
Provides medicinal plants	511	46.3
Provides wood for construction, furniture and energy	488	44.2
Serves as sacred places for traditional practices and ceremonies	310	28.1
Serves as homes for many plants and animals	268	24.3
Provides scholarship opportunities and income	7	0.6
Provides safe drinking water	3	0.3

Percentages exceed 100 because respondents could select several benefits.

Forest-edge communities maintain an intrinsic relationship with nearby forests, though the extent and nature of the benefits they enjoy vary from place to place. Table 4 presents the multiple benefits communities enjoy from their forests. Communities described the forest mainly in practical, everyday terms. The most widely recognized benefits were shade (85.4%) and food and income (84.0%), followed by the forest's role in reducing erosion and maintaining soil fertility (59.8%). Medicinal plants (46.3%) and wood for construction and energy (44.2%) were also commonly named, while cultural and ecological values such as sacred or ceremonial use (28.1%) and the forest as a home for plants and animals (24.3%) were mentioned less often.

3.5. The Relationship Existing Between Forest-edge Communities and Forests

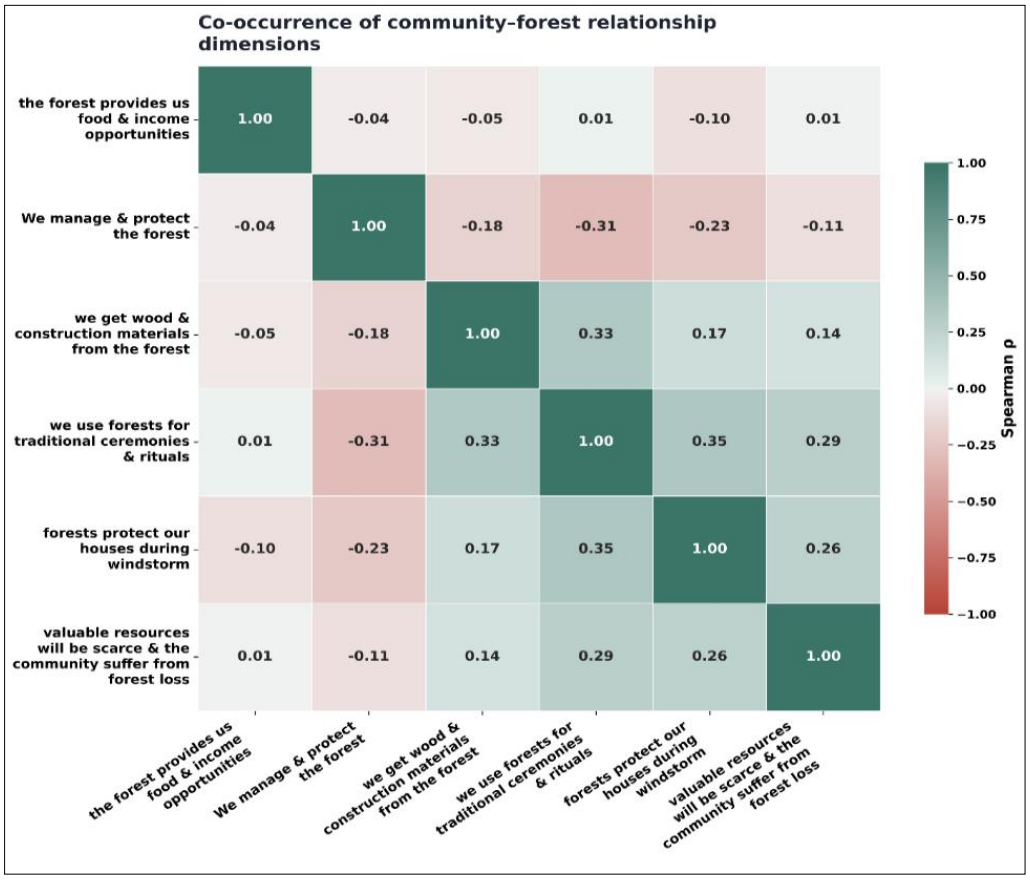

Figure 5. *Co-occurrence (correlation) between community-forest relationships.*

Forest-edge communities depend intrinsically on nearby forests, and the ways they relate to those forests tend to occur together in patterned ways. Figure 5 presents the co-occurrence of the different relationship dimensions. The study revealed that cultural and protective relationships tend to cluster. Using forests for traditional ceremonies was positively associated with drawing wood and construction materials ($\rho = 0.33$) and with the belief that forests shield houses during storms ($\rho = 0.35$).

3.6. How Communities Predict or Detect Changes in Forest Ecosystems

Table 5. *Method of detecting forest ecosystem change.*

Sign used to detect change	East n	East %	South n	South %	Diff (pp)	p	Sig
Monitor the productivity of wild fruits	425	75.8	413	76.2	-0.4	0.9194	ns
Monitor the health and density of trees	339	60.4	368	67.9	-7.5	0.0117	*
Monitor water-level changes in nearby wetlands	316	56.3	238	43.9	12.4	<0.001	***
Observe availability of certain animals	269	48.0	281	51.8	-3.9	0.2175	ns
Observe soil colour and moisture	239	42.6	330	60.9	-18.3	<0.001	***
Level of forest protection	10	1.8	0	0.0	1.8	<0.001	***
Loss of forest thickness	5	0.9	2	0.4	0.5	0.033	*
Loss of natural resources	2	0.4	0	0.0	0.4	<0.001	***

Chi-square test of region × endorsement for each item. *** p<0.001, ** p<0.01, * p<0.05, ns = not significant.

Due to their direct dependence and interaction with their nearby forests, communities tend to be observant of changes to the forest ecosystems and resources. Results on how respondents predict or detect changes in their forests, and a Chi-squared test run across the two regions, are presented in Table 5. Communities in both regions read ecosystem change mainly from the forest itself, with the productivity of wild fruits and the health and density of trees being the most widely used signs. The regional differences lie in the secondary cues: Eastern respondents were more likely to watch water levels in nearby wetlands (56.3% against 43.9%, p<0.001), whereas Southern respondents leaned more on soil colour and moisture (60.9% against 42.6%, p<0.001).

3.7. How Communities Transfer Forest-related Knowledge Across Generations

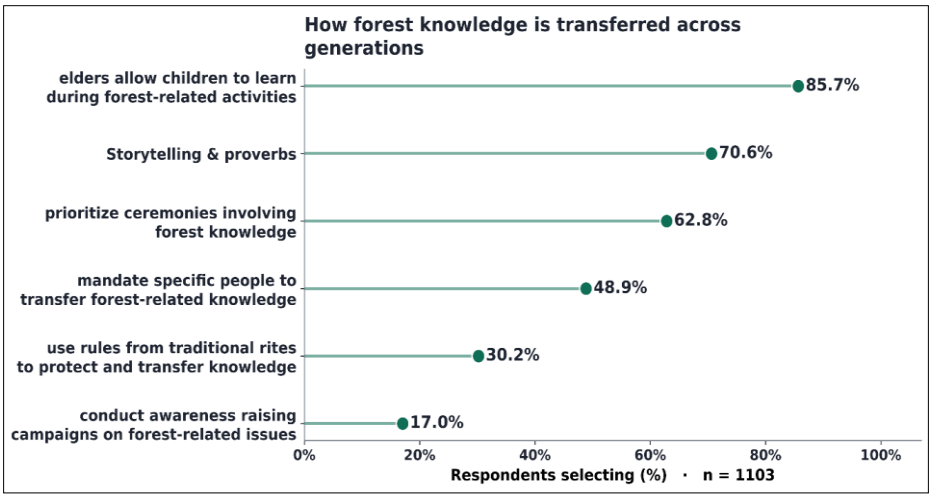

Figure 6. *How forest-related knowledge is transferred across generations.*

The sustainability of forests depends in part on the knowledge and practices of nearby communities, and passing that knowledge on requires deliberate systems and strategies. Figure 6 presents how forest-related knowledge is transferred across generations in the study communities. The results point to planned, structured arrangements for passing on forest knowledge. Elders with long-term experience play a central role in guiding and allowing children to learn about forests during forest-related rituals (85.7%), through storytelling and proverbs (70.6%), and by prioritizing ceremonies in which forest knowledge is transferred (62.8%). A smaller share mandated specific people to carry out this transfer (48.9%), while relatively few communities reported awareness-raising campaigns on forest issues (17.0%).

4. Discussions

This study highlights the dynamic and complex nature of forest-related knowledge generation and transfer strategies in South-eastern Sierra Leone. As presented in Figure 2 and Table 1, the two provinces do share a common core understanding of what a forest is and differ only at the margins. These patterns confirm what the literature leads one to expect. Indigenous knowledge is, by definition, generated through long interaction with a particular territory and encoded in shared systems of classification [53, 54], and [2] note that sustained contact with ecosystems allows communities to build detailed classification systems for flora and fauna. The blending of ecological and cultural categories seen here reflects the sophisticated traditional ecological knowledge systems that reference [2, 6] describe, in which practical resource classification sits alongside spiritual and cultural meanings such as sacred forests and groves. The stronger cultural framing in the South also fits the comparative evidence that sacred groves and culturally protected forests are a well-established feature of forest classification in many regions [8, 21, 55, 56]. This classification matters because how a forest is understood shapes how it is perceived, valued, and cared for.

This classification is consistent even among other community members and staff of protection agencies during Key Informant Interviews (KII) and Focus Group Discussions (FGD). A community leader in Lalehun Gola, Kenema District viewed "*a forest as a dense area with big trees, wild animals, provides shade/thick old bush*"; while a community leader in Takpoima, Kailahun District viewed it as "*a protected/reserved place full of shades, wild animals, tall trees*". A community leader in Moyambawo Fakunya, Moyamba District, viewed "*a forest as a place with wild animals, big trees, and contains many plantations and fruits*". During a FGD of female members in Kambuiwabu, Kenema District, the most prominent responses were that a forest is "*a place with big trees/old bush, wild animals, sacred place, and provides shade*". These local definitions and classification of forests generally imply communities' judgement of their locality hinges on their everyday interactions and observations of their surrounding ecosystems.

The patterns presented in Figure 3 and Table 2 suggest that cultural and sacred forest categories are more prominent in the Southern province, whereas formal protection categories are more familiar in the East [21]. The eastern pattern probably reflects the strict protection systems of the Gola Rainforest, while communities in the South were found to hold a number of areas designated specifically for traditional and cultural practices, such as forests for burial sites (38.0%) and secret-society forests (47.8%). The prominence of secret-society and burial forests in the South is consistent with the wider literature on cultural landscapes, in which community beliefs and practices are expressed through sacred forests and groves that are sustained by traditional values, rituals, and taboos [8, 14], and in which trees in sacred forests are maintained and protected for ritual purposes [9, 57]. The stronger recognition of formal categories in the East, by contrast, illustrates how an externally enforced protection regime such as the Gola Rainforest Conservation programme becomes embedded in the way nearby communities name and understand their forests.

Figure 4 and Table 3 indicate regional gap held in the adjusted model, with Eastern respondents significantly less likely than Southern ones to use cultural or sacred classifications (OR = 0.69, $p<0.01$). The model explained only a small share of the variation (pseudo-R^2 = 0.05), so while these are real influences, they are partial ones. The education effect is consistent with reference [58], who reported that education shapes conservation-related knowledge, attitudes, and perceptions in forest-edge communities. It is worth noting, however, that education associated with more cultural and sacred framing, runs against a simple reading of [59], who described a decline in traditional forest knowledge among younger, and often more schooled Africans. One way to reconcile the two is that formal education may sharpen people's ability to articulate and label cultural categories even where the depth of inherited practice is thinning, a distinction the present cross-sectional model cannot fully resolve.

Results in Table 4 suggests that provisioning and protective services are more front-of-mind for these communities than biodiversity or heritage values. The pattern matches the wider literature on the goods and services forests provide to nearby communities, which spans shade, food, income, soil stabilization, energy, medicines, and construction materials [16, 60, 61]. In the four-part framing used by [62], respondents leaned heavily towards provisioning and regulating services and gave less prominence to cultural and supporting ones. The strong showing of medicinal plants is notable and consistent with reference [16], who found that almost all respondents in their Sierra Leonean study relied on medicinal plants for treating common ailments, and with [26], who described herbal medicine as central to the customs of forest-edge communities. The limited number who reported forests provide safe drinking water (0.3%) does not in any way imply it is less important.

The data collection period (done during the rainy season- in August- when there was abundant water) may have swayed respondents to prioritize other benefits derived from the forests. That everyday provisioning services dominate perception, while heritage and biodiversity values are named less often, is itself an important signal for how communities are likely to weigh protection against use.

In Figure 5, seeing oneself as an active manager and protector of the forest, by contrast, sat slightly apart from these everyday uses. The clustering of ritual, material, and protective ties support the view, expressed by [1], that forest-edge communities regard forests as "living relatives" deserving respect and protection, and it reflects the way traditional ecological knowledge in these settings binds practical resource use to spiritual and cultural meaning [63].

Results in Table 5 imply people everywhere monitor the same forest but read somewhat different indicators of its health. This capacity to notice and interpret change is exactly what the literature attributes to communities in long contact with their ecosystems. Reference [2] describe how sustained interaction lets communities track ecological change over time, and [63] further argued that this ability to observe and recognize changing patterns effectively preceded modern conservation movements. The detailed, indicator-based monitoring reported here confirms that forest-edge communities in South-eastern Sierra Leone are knowledgeable observers of their environment, a knowledge base that is valuable both for forest health and for the livelihoods that depend on it.

Results in Figure 6 show that the communities value the sustainability of both forest knowledge and forest resources. This reliance on oral, ceremonial, and story-based transmission is precisely what the literature describes. Indigenous knowledge among forest-edge communities is transmitted orally through storytelling, myths, songs, cultural events, and local classification systems, while modern management systems lean on digital platforms [53, 64]. The very low uptake of awareness campaigns here mirrors that contrast, and the thinness of such modern channels lends weight to the concern raised by [59] about the gradual erosion of traditional forest knowledge among younger generations, particularly where inherited and modern modes of transfer are not bridged. The findings are equally consistent with KII done across the study communities. A community leader in Lalehun Gola said, "*we sit them down and explain to them the importance of forest, educating them about the advantages of having a forest*"; while a community leader in Takpoima, Kailahun District, pointed out that "*we usually explain the history of the forest and educate the children on the importance of the forest*". A female community member in Kambuiwabu, Kenema District revealed: "*we transfer forest-related knowledge through storytelling and explanations about the forest to children*".

A more comprehensive explanation was provided by a local authority in Ngodama Ndowehun, Moyamba District, who reported that "*we have many activities and practices for transferring forest-related knowledge to our children. We educate the children about the historical background and importance of the forest, and involve them when pouring libations to the ancestors in the forest before the start of every farming season. That is a practice that we met our forefathers practicing and we have since maintained it. During that occasion, we go into the caves of the forest and perform rituals. The knowledge about the forest is, however, transferred by age and by the level of responsibility and leadership qualities we identify in our children. Apart from the knowledge we transfer from general community rituals, knowledge about the forest is also transferred by gender- men provide forest-related knowledge to men, and women do the same to young girls and other women through their secret societies*.

While local knowledge transfer is apparent, forest-related knowledge is equally transferred using formal structures. A Forest Ranger at Taiama (along the Gola Rain Forest) in Malema chiefdom, Kailahun District, revealed, "*We educate the children about the relevance of the forest, the existing formal laws against the illegal activities in the forest*."

Future research should focus on the use of modern information and communication technology (ICT) in safeguarding forest-related knowledge among forest-edge communities. Equally, a comparative study gauging the knowledge transfer strategies between inland forest-edge communities and coastal (mangrove) communities is vital to understand the diversity in strategies between the two ecosystems. In addition, a nationwide study gauging the knowledge of communities across all forest types is vital to ensure a comprehensive national account of knowledge types and transfer strategies across

5. Conclusion

This study examined the forest-related knowledge and transfer strategies among forest-edge communities in South-eastern Sierra Leone. We established that the targeted forest-edge communities have demonstrated significant knowledge of their forests, in terms of types and complexity. While informal forest knowledge transfer prevails in the study communities, scientific and formal knowledge transfer strategies are equally vital. Hence, sustaining forest-related knowledge and transfer among forest-edge communities would be contingent on a dual approach- the recognition and protection of local knowledge, and the use of scientific knowledge to advance and sustain knowledge generation and transfer mechanisms. Such strategies should be context-specific if they aim to enhance effectiveness among forest-edge communities in knowledge generation, transfer, and wider forest management.

Abbreviations

FGDs	Focus Group Discussions
KIIs	Key Informant Interviews
NGO	Non-Governmental Organization

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Author Contributions

Alpha Sesay: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Resources, Writing – original draft, Writing – review & editing

Victor Tamba Simbay Kabba: Supervision, Writing – review & editing

Aiah Lebbie: Supervision, Writing – review & editing

Richard Allen Wadsworth: Supervision, Writing – review & editing

Data Availability Statement

The data for this study are available to the corresponding author upon a special and reasonable request

Conflicts of Interest

The authors declare no conflicts of interest.

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