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Traditional taboos: informal and invisible protection of remaining patches of forest in Vhembe District in Limpopo, South Africa

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Introduction: Since 1990, there has been a global decline in forest areas. Between 2010 and 2020, the greatest annual net loss of forests was on the African continent. Despite South African indigenous forests and trees being protected under the National Forests Act of 1998 (Act No. 84 of 1998), the country has also shown an increased annual net loss of forests. Although the Vhembe District Municipality in South Africa has lost forest owing to human-induced deforestation and other land use activities, sacred forests have not been affected. According to traditional beliefs, exploitation of such indigenous patches of sacred forests is taboo. This study aims to explore the role of taboos in the protection of the remaining patches of sacred forest.

Methods: The study relies on data collected between December 2022 and December 2023. Semi-structured interviews were conducted with key informants (n = 61) and local communities in Tshidzivhe and Duthuni villages (n = 60). Observations were used as a further data collection tool. The interview questions were prepared to assess the role of taboos in the protection and management of sacred forests. Data collected through interviews were analysed using thematic content analysis, while field observations helped to corroborate the results from the interviews.

Results and discussion: The study identified two main taboos – one that restricts entry into the sacred forests (i.e. preventing entry into the sacred forests, and harvesting, hunting and hiking in these areas), and another that prohibits noise or activities that disrespect sacred forests. The study found that believers and non-believers alike, for fear of retribution by the spirits, still obey these taboos and their related myths. This has allowed these areas to develop dense stands of closed-canopy evergreen forest that support more diverse flora and fauna than found in surrounding areas. Although sacred forests are not meant for biodiversity conservation, they offer opportunities to be integrated into global conservation targets of "30x30" and "Half-Earth" by 2030. They also offer the opportunity of serving as carbon sinks which is key to climate change mitigation. Recommendations for protecting sacred forests and associated taboos are drawn up based on these results.

KEYWORDS

forest conservation, resource and habitat taboos, spiritual governance, natural resource management, informal institutions, traditional ecological knowledge, Vhembe District

1 Introduction

According to the latest United Nations report (published by the Food and Agriculture Organization of the United Nations (FAO), 2020), the world has a total forest area of 4.06 billion hectares (ha), which is 31% of the total land area. However, in the 30 years from 1990 to 2020, the global forest area declined by about 178 million ha, which is an area about the size of Libya. Over the past two decades, there have been successive increases in the average annual rate of net forest loss in Africa (3.28 million ha for the 1990–1999 period and 3.40 million ha for 2000–2009). For 2010–2020, the African continent experienced a 3.94 million ha loss of forest area, which was the greatest loss at the global scale, followed by South America with 2.6 million ha (Food and Agriculture Organization of the United Nations (FAO), 2020). This loss in forests is because of the high rate of deforestation stemming from high population growth combined with small-scale agriculture needed to sustain livelihoods (Food and Agriculture Organization of the United Nations (FAO), 2020). Thus, Africa is now considered a deforestation hotspot, surpassing South America (the previous leader). South Africa is among those countries in Africa that have shown an increase in the annual net loss of forests. The forests that are found in South Africa include indigenous forests, indigenous woodlands and plantations covering just over 40 million hectares (about 32.7%) of the country's 122 million hectare land surface area (South Africa, 2020/2021). Of interest to the discussion of this paper is South Africa's indigenous forests.

The country's indigenous forests are small and cover just under 0.5 million hectares (492 700 ha), approximately 0.5% of the country's land surface area. Almost half of all indigenous forests in South Africa are found on private property or land under communal tenure, and the bulk of these areas are found in the Eastern Cape, KwaZulu-Natal, Mpumalanga and Limpopo Province (Department: Government Communication and Information System, 2021). Even though South Africa's indigenous forests and trees are protected under the National Forests Act, 1998 (Act No. 84 of 1998), they continue to decrease in extent owing to human-induced deforestation and other land use activities (Gatticchi, 2023). However, as studies conducted in the Himalayas have shown, patches of indigenous sacred forest have survived human-induced deforestation and conversion to non-forested land use; exploitation of such patches of indigenous sacred forest is taboo. The institution of taboo is the pillar supporting the conservation of sacred sites including natural sacred forests and their associated biodiversity (Chaudhry and Murtem, 2016; Sinthumule and Mashau, 2020; Ahmed et al., 2023).

The literature indicates that in the African context, there is a wealth of research focusing on the important conservation role of taboos, but this has mostly focused on Madagascar (Jones et al., 2008; Van Amstel et al., 2022) and West Africa – notably in Ghana (Alexander et al., 2017; Osei-Tutu, 2017) and Nigeria (Anoliefo et al., 2015; Ihinmikaiye et al., 2022). This study also contributes to this existing debate on the role of taboos in nature conservation practices by focusing on the Vhembe District Municipality in Limpopo, a province of South Africa. It does this by assessing the involvement of the Vhavenda tribe in the conservation of the remaining patches of forest. Understanding the role of taboos in forest conservation in the context of South Africa is important because the term 'taboo' is applied differently in different countries. This understanding will contribute to the existing knowledge of the potential role of taboos in the protection and management of forests. To obtain a clearer picture of taboos and forest conservation, this study answers the research questions: Why is the practice of ancient taboos still relevant in the 21st century? How do taboos contribute to forest protection? The study begins by providing a discussion of taboos, followed by a description of the study area and the methodology applied. The results and discussion are presented in Sections 4 and 5 and the last section sets out the conclusions of the study.

2 Understanding traditional taboos

'Taboo' is derived from the Tongan *tabu* and came into use in English towards the end of the 18th century. In Polynesian languages, tabu (hereafter referred to as 'taboo') means 'to forbid' or 'is forbidden' and can be applied to any sort of prohibition (Allan, 2018). As Colding and Folke (2001), p. 584) have noted, *taboo* can therefore be broadly defined as 'a prohibition imposed by social custom or as a protective measure'. Unlike formal institutions that have judicial laws written on a piece of paper that are consciously designed to govern people, taboos are orally transmitted from one generation to another. Thus, they have no written rules and regulations and regulate human behaviour by social customs (Negi, 2017). In addition, they are self-imposed, self-monitored and hard to change (Cleaver, 2017; Sinthumule, 2022), and the most common form of decree communicated is the imperative 'you shall not' or 'thou shalt not' (Bloch, 2001). From this explanation, taboos are good examples of informal institutions that do not depend on the government for either enforcement or promulgation of rules and regulations (Osei-Tutu, 2017).

Interest in taboos has been growing over the past five decades, partly owing to a recognition that such informal and invisible knowledge can contribute to environmental conservation (Van Amstel et al., 2022; Sinthumule, 2023). In an era where Earth's biodiversity is disappearing at the fastest rate in history, there is growing evidence that informal institutions such as taboos can be effective in promoting conservation. There are species-specific taboos that a cultural group apply in both time and space to ban the killing and the detrimental use of specific species (Sharma et al., 2021). For instance, in Southeast Nigeria, killing the Sclater's monkey (*Cercopithecus sclateri*) in forest groves is taboo because they are considered the property of the deities. Because they are closely related to human beings, there are adverse consequences for people who intentionally kill monkeys. This taboo ensures the monkey is well protected (Baker et al., 2018). Species-specific taboos are also common in Zimbabwe, where certain animals (for instance, forest elephants, baboons, monkeys, zebra and buffalo) are totems to certain clans. The elephants are totems to the Nzou Samanyanga and Mhukahuru clans; as a result, they do not eat flesh from elephants. The clan also prohibits the killing or hunting of elephants for ivory trade or recreation, and this provides protection for the species

(Mavhura and Mushure, 2019). Totemism is also common among the Vogoni in Ghana where animals such as the monitor lizard ('Wuo'), crocodile ('Ebaa') and python ('Zigu') are totemic animals that cannot be killed or consumed by this clan (Kosoe et al., 2020). Similarly, traditional community members worship under fig trees (locally known as Ebule). These trees are associated with spirituality; hence, it is forbidden for people to harvest wood from them (Ayaa and Waswa, 2016). In the Sariska region in Rajasthan, India, cutting the peepal and banyan trees for any purpose is taboo because it is believed that the spirits of the ancestors reside in these trees (Angsongna et al., 2016).

The literature also suggests that there are habitat taboos that prohibit the extraction of resources from sacred sites. For instance, in South-west Region of Cameroon, extraction of any resources from the Ekpe, Mawooh, Obhon and Amgbu sacred forests is not allowed, and this has contributed to forest conservation (Bobo et al., 2015). Similarly, the Ndola sacred forest in the Tanga region of Northeastern Tanzania is another example of a habitat taboo that is only used for cultural purposes, and local communities are not allowed to harvest anything from the forest (Fadhilia et al., 2016). In the western Himalayas, extraction of any resources (including fuel and fodder) is forbidden from sacred forests. The latter include Falyani Narayan, Panchali Naryan and Bhalthi Narayan (all located in the Lug Valley) and Devnala Ajaypal (in Chhota Bhangal) (Sharma et al., 2021). Apart from habitat forests, there are segment taboos that regulate resource use by certain segments of society. For instance, in Cameroon's South-west Region, segment taboos persist and are manifested by restrictions on women and children from consuming certain animals such as red river hog, snakes and most primates; this in turn has led to the protection of those species (Bobo et al., 2015). In Nigeria, some households forbid pregnant women from eating elephant meat; the belief is that if a pregnant woman does this, she will deliver a baby which looks like an elephant. This protects elephants, since most men will not go hunting for meat that their wives and children are prohibited from eating (Jimoh et al., 2012). It is also taboo for some women in Nigeria to touch a civet cat, because any children they then give birth to will have sex organs looking like those of the civet (Jimoh et al., 2012). In the Nharira community in the Chikomba district in Zimbabwe, women of childbearing age are forbidden from visiting the sacred hills during their menstrual period. Such temporal restrictions play a significant role in protecting natural resources, given the reduced amount of time these women can go out harvesting (Mavhura and Mushure, 2019).

Taboos that dictate harvesting methods are also used to minimise the collection of natural resources and thus help in the sustainable utilisation of wildlife resources (Sharma et al., 2021). For instance, in the western Himalayas, examples of plant species that is afforded additional protection through taboos is *Staphylea emodi* which can only be harvested using non-metallic tools (Angsongna et al., 2016). In Limpopo Province in South Africa, the bark from trees such as *Ziziphus rivularis* is harvested from the eastern side of the tree, and the wound should be covered with a mixture of soil and water to help the recovery of the tree (Constant and Tshisikhawe, 2018). In Bevoahazo, central Madagascar, it is a taboo to use fishing nets when harvesting fish from the main river in the community (Angsongna et al., 2016). All these taboos reduce the consumption of species, which contributes to their conservation. There are also life history taboos that forbid the use of species at certain vulnerable life stages, based on age, size, sex and reproductive status. For instance, in Ghana, it is taboo to kill mating animals, or female animals that are pregnant or nursing young (Boafo et al., 2017). Similarly, to ensure deer progeny in the western Himalayas, the hunting and killing of pregnant is forbidden. Furthermore, in Uttarakhand in the Central Himalayas, hunters will not kill a deer with a white mark on its head as it is seen to be a reincarnated departed member of the community (Negi, 2010). All these are strategic measures enforced by the communities to ensure the continued growth of the wildlife population. Although taboos persist in many countries, they are rarely respected (particularly by the youth) (Bobo et al., 2015). In addition, the elder gerontocracy supporting sacred forests is waning both in power and number (Lynch et al., 2018); the viability of sacred forests is thus being undermined, especially given the ongoing anthropogenic pressure to extract resources (Roba, 2021).

3 Methodology

3.1 Study area

The study was conducted in Vhembe District, which is one of the five district municipalities in Limpopo, a province of South Africa. Vhembe District comprises Collins Chabane, Makhado, Musina and Thulamela Local Municipalities and its offices are in the town of Thohoyandou. The district is located in the northern part of Limpopo and shares international borders with Zimbabwe (to the north), Botswana to the north-west) and Mozambique (to the east of the Kruger National Park) (Figure 1). The Limpopo River valley forms the border between the district and its international neighbours. Vhembe District covers a geographical area that is predominantly rural. While there are taboos relating to water bodies, food and those that cover aspects including species-specific, method, segment and life history aspects, this study focused on the prohibitions relating to the entire forest areas. According to Sharma et al. (2021), the latter falls within the category of 'habitat taboos'. The study was conducted in Vhembe District in the Vhutanda sacred forest (near Duthuni village) and Tshidzivhe sacred forest (near Tshidzivhe village). Although there are myriad sacred forests in the region, these two sacred sites were chosen for several reasons: first, they fall under two different clans; second, they are the most respected sacred forests in the Vhembe region; third, they are unfenced; and lastly, they both represent the few remaining undisturbed forests in Vhembe District and Limpopo as a whole. According to Mucina and Rutherford (2006), the two sacred forests are positioned in the FOz 4 Northern Mistbelt Forest which has a relatively rich species diversity. The forests are dominated by tall (15–25 m) evergreen trees that have a multilayered and well-developed canopy. The vegetation is dominated by a range of deciduous and semi-deciduous trees. The two sacred sites receive high rainfall of approximately 1 500 mm per year. The two sites have a subtropical climate with an average temperature of 30°C in

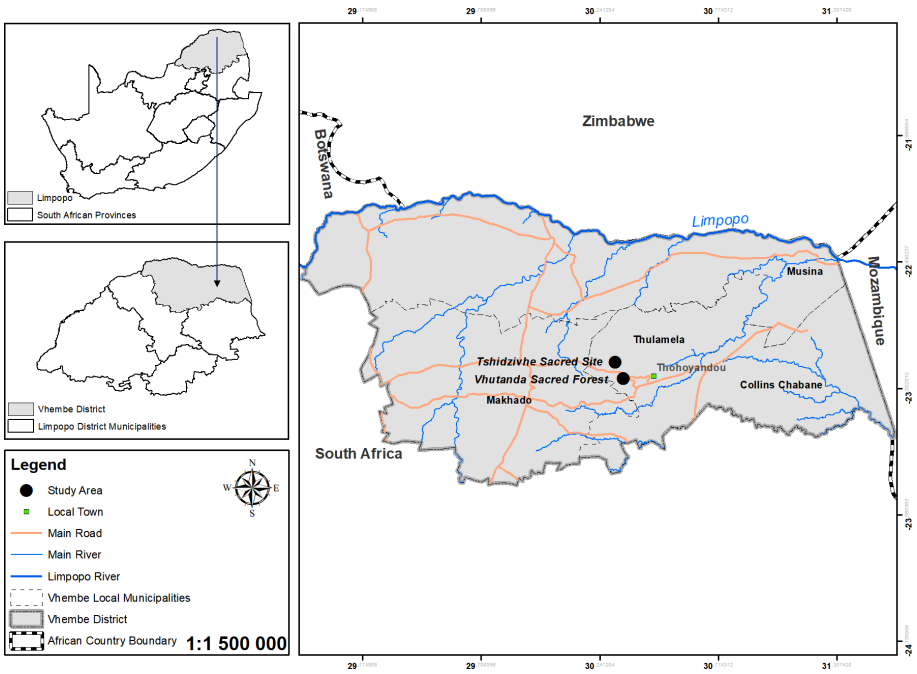

FIGURE 1
Location of Tshidzivhe and Vhutanda sacred forest in Vhembe District Municipality, Limpopo Province, South Africa. Source: Ndidzulafhi Innocent Sinthumule.

summer and 24°C in winter. Thus, the area is generally hot in summer and cold in winter (Munyati and Sinthumule, 2014, 2021).

3.2 Data collection

The study relied on data collected from December 2022 to December 2023 in Vhembe District. All activities followed procedures approved by the Faculty of Science Ethics Committee of the University of Johannesburg (Ethics Reference Number: 2022-11-18/Sinthumule). To answer the research questions of this study, the recruitment of participants was done using a non-probabilistic purposive sampling approach. The criteria that were used to purposefully select respondents included community members involved in sacred sites (custodian of the sacred forest, traditional healers, traditional leaders), community members knowledgeable about taboos who been staying in the area for more than 20 years, youth (<35 years), Christians, and government officials involved in indigenous forest conservation. In non-probabilistic sampling, there is no overall sampling design that dictates the number of interviewees to be interviewed. In line with Guest et al. (2006), respondents were interviewed until the point of data saturation when new information no longer emerged from respondents. Key informants that were interviewed in this study included the custodians of sacred forests (n = 23), traditional leaders (n = 5), traditional healers (n = 6), members of Dzomo La Mupo (meaning 'voice of nature') who are also custodians of sacred forests (14), local schoolteachers (n = 9) and officials from the Forestry Department (n = 4). Dzomo La Mupo is a non-profit organisation that was formed in 2007 to fight against the destruction of indigenous forests and natural resources in general. In addition, 60 community members (30 in each of the two villages, and particularly those that stay near sacred forests) were randomly selected to get their opinions on whether they adhere to the forest taboos or not. During the survey, youth and Christians were also interviewed to get their views regarding taboos and sacred forests. This information helped to validate the information provided by key informants. In the end, a total of 121 respondents were interviewed in this study (Table 1).

The interview questions were organised to assess the potential role of taboos in protecting and managing sacred forests (Table 2). This was important to find out if taboos are still relevant in the 21st century.

An ethics letter from the author's academic institution and an identification card (showing the author's university affiliation) helped with gaining access to the study area and obtaining interviews with potential respondents. All respondents were informed of the aim of the study, that participation in the study was voluntary, and that participants could withdraw their

TABLE 1 Key informants that were interviewed during the study.

Respondents	Number
Custodians of sacred sites	23
Traditional leaders	05
Dzomo la Mupo members	06
Local schoolteachers	14
Officials from the local Forestry Department	09
Local communities	04
Total	121

TABLE 2 The guiding questions for each group of respondents interviewed in the study area.

Respondents	Guiding questions
Custodians of sacred sites	What are the types of taboos that exist and how have they contributed to the protection of sacred forests? How are taboos enforced?
Traditional leaders	What are the roles of traditional leaders in enforcing taboos? What are the barriers to enforcing taboos?
Traditional healers	What are your roles in preserving traditional practices? Do you harvest some of your medicines from the sacred forests? If not, why?
Dzomo la Mupo members	What is your role in preserving indigenous knowledge and how has traditional ecological knowledge (taboos) contributed towards the protection of indigenous forests?
Local schoolteachers	What is your role in preserving indigenous knowledge and how has traditional ecological knowledge (taboos) contributed towards the protection of indigenous forests? Do you think that taboos are still relevant in the 21st century? Are taboos part of the school curriculum?
Officials from the local Forestry Department	Do you think traditional ecological knowledge (taboos) has any role in biodiversity conservation? What are the factors affecting sacred forests? How are your working relationships with traditional leaders and custodians of sacred forests? Do you think that taboos are still relevant in the 21st century?
Local communities	Do you comply with forest taboos? Why? What are the challenges facing taboos?

participation at any time should they feel that they no longer wanted to participate. Respondents were also made aware that the study was being done for academic purposes and were assured that their participation would remain anonymous in line with the Protection of Personal Information Act (POPIA), 2013, Act 4 of 2013. All informants who participated in this study were asked to sign a consent form and those who could not write gave their verbal consent. Before data collection commenced, a reconnaissance survey was conducted, and informal discussions were held with the people in the study villages. The reconnaissance assisted with getting insights from communities about the role of taboos in forest protection; further, it helped to contextualise the questions to be asked during field data collection. A semi-structured face-to-face interview was used as the main data collection tool. This method was chosen because it is flexible and allows for open dialogue; respondents can also be asked to clarify, elaborate, or rephrase their answers if required (Creswell, 2013). In addition, this method was determined to be ideal because it allowed the researcher to compare feedback obtained from interviewees based on the same set of questions (McIntosh and Morse, 2015).

The average duration of an interview was approximately 60 minutes. Interviews were conducted in the local language, namely Tshivenda, by the author who is fluent in both Tshivenda and English. For the key respondents who were not able to read, all information captured was read back to them after the interview to ensure that it was correctly captured; corrections were made in instances where data was recorded incorrectly. Key respondents who were literate were given back the transcripts of interviews and a summary of the analysis to read and make remarks. Any comments, disagreements or additional information provided by the respondents were amalgamated into the final analysis. This was important to enhance the credibility and rigour of the analysis (Pyett, 2003).

Observations were also conducted as a complementary qualitative method. Rather than relying only on your informants, sometimes, the best way to get a better idea about the place is to see for yourself. Observations aim at collecting first-hand data on societal processes occurring in a natural context (Ciesielska et al., 2018). As Cohen et al. (2017) noted, observations can also provide insight into the similarities and differences between what is explicitly stated/spoken on the one hand, compared with tacit knowledge on the other hand (giving access to actual practice). In this study, observation was used within and outside the sacred forests to check any form of deforestation, evidence of harvesting resources, the presence of guards and fences around the forests, and general activities happening within and around the sacred forests. The author also attended a funeral which was held in Vhutanda sacred forest. All observations were recorded in a notebook and were supplemented by a photographic record of the site visit.

3.3 Data analysis

Data collection and analysis were done concurrently throughout the research process. Data gathered in interviews during the daytime was analysed in the evenings. As Kumari et al. (2023) noted, this approach makes analysis an ongoing, lively enterprise that contributes to energising the fieldwork process. Concurrent analysis also allows errors made during data gathering to be corrected in subsequent interviews (Richards and Hemphill, 2018). In this study, data was analysed through thematic content analysis. According to Braun and Clarke (2006, p. 6), thematic content analysis is a qualitative analytic method of 'identifying, analysing and reporting patterns (themes) within data'. As Terry et al. (2017) have noted, this involves the search for (and identification of) common threads that extend across an entire interview or set of interviews. The interview transcripts gathered during the day were read over several times that same evening, which helped to identify common themes emerging from the data. The two themes (that is, taboos that restrict entry into sacred forests, and taboos that prohibit noise or activities that disrespect sacred forests) that emerged from analysis are discussed below. In some cases, episodes were recounted, and cases were described often in the exact words used by the respondents without altering the material recorded (after Alase, 2017). In line with Imran and Yusoff (2015), information collected through field observations helped to corroborate evidence given by respondents during interviews.

4 Results

The research showed that there are two main taboo types in the study area. These involve a taboo that restricts entry into and use of the sacred forests (i.e. entering the sacred forest, cutting its trees or hunting and hiking in the forest) and a taboo that prohibits noise or

activities that disrespect sacred forests (Table 3). They both fall under the habitat taboo category because they both help to protect the sacred forests.

4.1 Taboos that restrict entry into the sacred forests

This study found that the sacred forests in the study area have their origins in traditional belief systems or religions, but they are also burial grounds for the custodians of the sites. Local taboos and sanctions for sacred forests restrict entry into these sites except for a few specific individuals or limited groups, and only for specific events. For instance, custodians of these sites visit the sacred forests to pacify the ancestors or consult them for spiritual, social, economic and political reasons. In both the Vhutanda and the Tshidzivhe sacred forests, custodians pacify the ancestors through the annual performance of *Thevhula* (the biggest sacrificial ritual carried out in these forests). Performed by *Makhadzi* (the senior sister of the family head or senior paternal aunt), this important ritual is an integral part of keeping good relations with the ancestral spirits. During the performance of this ritual, the senior paternal aunt requests anything the family desires (such as rain or a good harvest); importantly, she also thanks the ancestors for protection and peace for the nation.

Custodians of sacred forests also visit these sites when there are funerals. While in Tshidzivhe there is a burial at home that community members are allowed to attend (*Tshiendeulu*), they are not allowed to attend the reburial in the sacred forest. However, in the case of Vhutanda, only one burial occurs in the sacred forest and community members are allowed to attend this on condition that they abide by the rules and regulations which include removal of shoes before entering the sacred forest and by keeping quiet while there.

In the case of Vhutanda, a ritual is performed to ask the ancestors to allow the public to enter the sacred forest and this is the only time that communities are allowed to do so. In the case of Tshidzivhe, only the *Makhadzi* and uncircumcised male members of the clan can enter the sacred forest during reburial, and the public cannot take part in the process. Prohibition of the public from visiting the sacred forests in both Tshidzivhe and Vhutanda has been in place for centuries and continues to be enforced in the 21st century. During the interviews with key informants, it was indicated that entering the sacred forests was taboo because it is believed that if you enter, some misfortune may happen to the offender; the latter may be held hostage by the spirits and in extreme cases, offenders may die as a form of retribution by spirits. Thus, the sacred forests are not governed and managed by people, but by spirits. In the case of Tshidzivhe, it was narrated that the sacred forest is protected by a white lion that guards against any intruders. In support of this belief, it was reported that in the 1970s, a local Tshidzivhe man stubbornly ignored the taboo and mysteriously disappeared for a week without a trace in the sacred forest. As one elder respondent narrated:

He entered the forest on Sunday, but everywhere he walked looked the same. He walked inside the forest day and night for a week hoping that he would find a way out, but unfortunately, he could not. He claimed that he did not feel hungry for the entire time when he was in the forest. On the morning of day seven (a Sunday), he walked around and decided to sit down as he was tired. He covered his face with his hands, regretting having entered the forest. After some minutes he removed his hands from his face, only to see a small path for the first time. He decided to follow the path and after walking for a short time, suddenly he was out of the sacred forest. When he arrived home, his lips were dry and white, and he was feeling hungry (Anonymous Respondent, 22/12/2023).

It was explained by the respondent that this man was held hostage by the spirits for a week and he was lucky that he was able to come back alive. In a similar incident, in the 1950s some Caucasian people were held hostage inside the Vhutanda sacred forest, and they could not find their way out. As one custodian elder explained about that incident:

A group of Caucasian men used to camp near our sacred forests so that they could hunt. One day he shot an animal, but the animal ran and collapsed inside the sacred forest. In chasing the animal, the hunter inadvertently entered the area, not knowing that the forest was sacred. However, he could not find his way out of the forest until the rest of his party was advised by the community to inform the elders of the Vhutanda family. It was only after a ritual was performed that the ancestors were able to release him (Anonymous Respondent, 2023).

It was also reported by a respondent that some Caucasian people then erected a fence to ensure that they did not find themselves straying into the sacred forest; however, the fence was uprooted by the ancestors overnight. These testimonies were confirmed by various key informants and community members who were interviewed. The taboo prohibiting the public from entering the sacred forests continues to be respected by local communities and they do not dare to enter these forests. The taboo restricting entry into the sacred forests also prohibits the cutting or collecting of dead wood, hunting of animals, and hiking within the sacred forests. Similarly, harvesting leaves, roots or bark of plant species within the sacred forests for medicinal purposes is also taboo, as made clear by the traditional healers who were interviewed. This begs the question, what happens if you cut, hunt or hike in the sacred forests? For this taboo, the general principle is the same in the Vhutanda and Tshidzivhe sacred forests. It is believed that if you collect wood within the forest, the wood will change into snakes when you arrive home. As one custodian elder explained in Vhutanda:

TABLE 3 Categories of taboos in the study area.

Category	Meaning
Taboo that restricts entry into sacred forests	Prohibit entry into the sacred forests, meaning that there is no harvesting of resources, hunting of wildlife and hiking in these areas is forbidden.
Taboo that prohibits noise or activities that disrespect sacred forests	Prohibit making noise within or near sacred forests. Other human activities such as pollution (including defecating and urinating) and sexual activities in or near sacred forests are forbidden.

It is taboo for anyone to collect sacred trees for wood. If you dare to collect wood from sacred trees, the pieces of wood will change into snakes. When you arrive home, you are carrying a load of snakes on your head. You can collect wood anywhere but not from the sacred forest. And there is no sign of such [the sacred] trees being cut. You can go and see for yourself if anyone has ever tried to cut or collect fuelwood from the sacred forest. (Anonymous Respondent, 2023).

Being in deep rural villages in the Vhembe District, most of the people still rely on fuelwood as a principal source of energy. Despite this, community members interviewed indicated that they do not harvest fuelwood from the sacred forests because this is taboo. This prohibition has been in place for centuries, and as one community member narrated:

Even if I am drunk, I can never try and collect wood from the sacred site. Even if I am desperate and urgently need a load of fuelwood, I can never try and cut them because they will change into snakes. No one has ever tried that, and I don't think anyone will ever try it during our lifetime because this is like playing with fire. (Anonymous Respondent, 27/12/2023).

This statement summarises the views of all the respondents who were interviewed in the study area. The taboo thus compels everyone within the community to unquestioningly obey, meaning this and other taboos are self-enforcing. In the case of Vhutanda, it was reported that in the 1960s when the government wanted to plant tea, the Vhutanda people were evicted from their land near the sacred forest and their houses were burnt. The government also wanted to remove the sacred forest; however, this plan failed. As an elderly member from the Vhutanda clan explained (after sprinkling snuff on the ground to appease the spirits):

A black officer in an excavator was told to clear the sacred forest by his Caucasian senior. However, he refused because he knew it was taboo to remove the sacred forest. The Caucasian officer decided to get into the excavator himself to remove the sacred forest so that they could plant tea. As the excavator removed the first tree, the tree screamed, blood started coming out of the tree and the officer mysteriously disappeared. The excavator that tried to remove the sacred forest is still there even today and is covered by soil (Anonymous Respondent, 2023).

Elderly respondents, and traditional healers and leaders who were interviewed corroborated this information. They and other community members interviewed also agreed that the cutting of sacred trees was a taboo, and no one had ever tried it before. This is the explanation for why the Vhutanda sacred forest is surrounded by tea plantations while it has remained intact (Figure 2).

The forest thus avoided destruction during the apartheid era. The forestry officials who regularly monitor indigenous forests (including sacred forests) also corroborated information given by the key respondents. When forestry officials were asked if the sacred forests are part of the forests they manage and monitor in the region, they all said yes because they manage all indigenous forests in the Vhembe region. They indicated that they work closely with traditional leaders and custodians of sacred forests. When asked if there were any signs of deforestation in the two sacred forests, they said 'no' because it was taboo to extract resources from the sacred forests. As one officer narrated, 'I have been working in this area [Vhembe region] for more than 15 years. Part of my duties is to community awareness and monitoring all indigenous forest. Although most of the indigenous forest are under threat because of human induced deforestation, there are no known incidence of sacred forest destruction'. When they were asked if taboos are still important in forest conservation to this day, they all affirmed that it was, evidenced by the number of resources that are protected within the Tshidzivhe and Vhutanda sacred forests. The information given by key respondents and local communities was also corroborated through field observations. The sacred forests comprised tall dense stands of trees and there were no signs of plants having been cut – not even on the boundaries. This was in sharp contrast to the

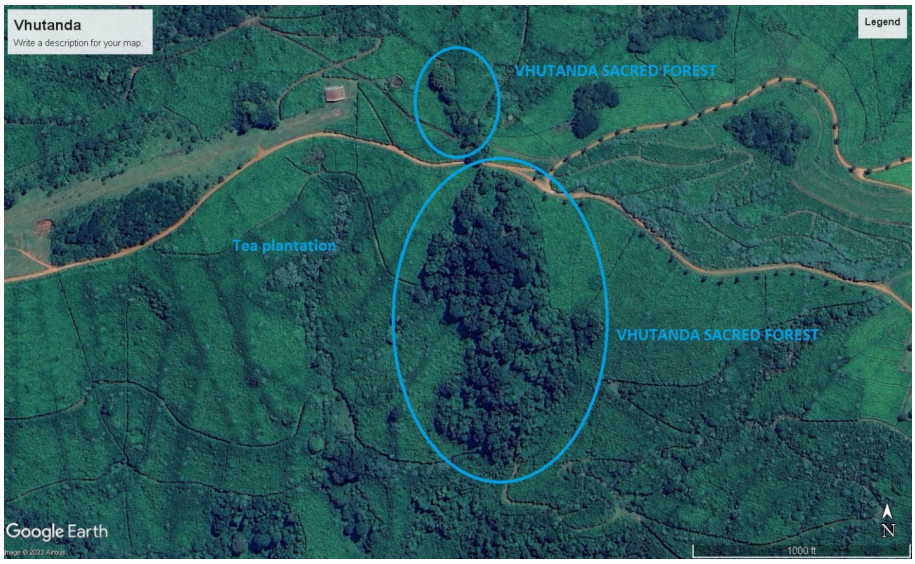

FIGURE 2
Vhutanda sacred forest surrounded by a tea plantation in Vhembe District Municipality (Google Earth, 2024).

surrounding areas where there had been extensive harvesting of trees. This was also despite no fences being in place or field rangers in attendance to protect the forest areas from intruders. This confirmed that the forests are protected by belief in the spirits. As with the harvesting of wood, hunting within the sacred forests is also taboo. Everything that is found within the sacred forests is considered to belong to the ancestors and people are expected to stay away from the sacred forests for fear of angering the spirits. The trees and animals that are found within the sacred forests are considered the ancestors – meaning that killing those plants and animals equates to killing the ancestors. This taboo has been respected for generations and this explains why the sacred forests are more densely populated with a broad variety of animal species than surrounding areas.

Although hiking has become an important pastime in contemporary South Africa, Tshidzivhe and Vhutanda sacred forests are not among the sites designated for hiking, despite being located in beautiful mountainous ecosystems with scenic terrain that hikers would be eager to experience. The taboo that forbids people from entering sacred forests applies to hiking and other activities. In the case of Vhutanda, visitors are only allowed to enter the forest while attending a funeral and no other activity is allowed in the area. Regarding Tshidzivhe sacred forest, although there is a road within the sacred forest, all visitors are expected to remain in their cars. This means that visitors can access the forest via the main road, provided they are accompanied by a local guide. Walking or driving off the main road in this spiritual place is taboo. It is believed that if you drive off the road, your car will get stuck and if you walk off the main road you may not find your way out of the forest. This taboo has been observed by locals and visitors over the years and no one has ever hiked in this beautiful and majestic forest for fear of disturbing the spirits. The researcher accessed Tshidzivhe sacred forest via the main road and only observed dense forest without any signs of hiking trails or illegal footpaths. This taboo has contributed to the protection of the soil and the plant and animal species within the forests. The respect and fear people hold for the sacred forests has resulted in these areas having taller trees than surrounding areas. These isolated forest remnants are embedded in a transformed, non-forest landscape and constitute the only remaining mist belt patches of what were formerly expanses of old-growth forests. Although taboos are not necessarily understood as instruments for the conservation of resources and nature by the people who practice them, they nonetheless have a powerful role in protecting biodiversity.

4.2 No noise or activities that disrespect the forests

Interview findings revealed that even during burial, noise in or near (that is, within about 20 metres) the sacred forests is forbidden. It is for this reason that no singing is allowed during burial in the sacred forests. In addition, other human activities such as polluting in any way (including defecating and urinating) and sexual activities in or near sacred forests are forbidden. It was noted by respondents that noise (made by humans and other entities) in the posthuman world is taboo because this disturbs and angers the spirits. As one key respondent explained, 'The spirits do not want to be disturbed. They want to rest peacefully'. This taboo has been followed from one generation to the next. During interviews with key informants, it was emphasised that humans violating this taboo may experience serious repercussions because of what the spirits could do. In support of this belief, it was reported that in 2010, an aircraft that was aerially spraying fertilisers onto the tea plantation surrounding the Vhutanda sacred forest crashed beyond repair because the spirits had been angered. As one elder member explained:

Although I was not there it was explained to me that the Caucasian officer was spraying fertilisers onto the plantation. The biggest mistake he made was to pass over our sacred forest. What did he want to see? When this was explained, I knew that making such noise over the sacred forest disrupted and angered the ancestral spirits which caused the aircraft to crash beyond repair. (Anonymous Respondent, 2023).

It was reported that a few minutes after the crash, baboons (a species occurring naturally in the Vhutanda sacred forest) moved across to the site of the accident and formed a circle around the wreckage of the aircraft. They then returned to the sacred forest. Interviews with community members who had heard about the incident corroborated information given by this key respondent.

Even though there are taboos that protect the sacred forests (and the taboos are therefore important for biodiversity conservation), this informal institution faces challenges including modernization, advances in science, technology and formal education. Dominant religions also pose a threat to these taboos. For instance, the young people who participated in this study view taboos as outdated, backward/old-fashioned, and irrelevant because they do not advance science and technology. They find it difficult to comprehend and admire, contributed to by not seeing this kind of knowledge practice on television or social media. Young people participating in the study were also of the view that taboos or traditional ecological knowledge are not part of the school curriculum; this was also confirmed by teachers who were interviewed. Thus, since 1994, the education system in South Africa has done very little to transform and incorporate traditional ecological knowledge into the school curriculum. The formal education in South Africa is still rooted in Western values (human rights, individualism, Christianity, modern technology and scientific thinking) that are often in disagreement with the local culture of taboos, customs and rituals. As a result, they view this knowledge as insignificant. The two villages in this study are dominated by churches (including the Faith Mission, Roman Catholic, Lutheran, Zion Christian and Baptist Churches) and all the Christians who participated in this study were of the view that they do not believe in taboos. They view taboos as satanic, demonic or insignificant in their lives. The Christians interviewed in this study indicated that they did not believe in taboos; nevertheless, they were not opposed to others believing in taboos, and out of a desire to be obedient, they indicated they would not do anything to disturb the sacred forests. As one community member narrated: 'I am a Christian and do not believe in taboos, but I respect the sacred forests. I do not hate or despise those who practice traditional religion. We may differ in religion, but we are all created by God'. Another respondent explained:

I do not believe in taboos. I can never get closer to those forests because I see them as demonic and satanic. I do not have a problem with traditional religion, if they stay in their lane, I will also stay in my lane. (Anonymous Respondent, 21 December 2023).

Thus, even those who did not express belief in taboos reported avoiding non-sanctioned behaviour (such as trespassing) or activities that could destroy or disrespect the forests. In this study, age and religion did not affect the level of compliance with existing taboos in the two sacred forests.

5 Discussion

Although protected areas are vital for the protection and conservation of the biodiversity within their borders, literature suggests that they are not sufficient solution to avoid loss of biodiversity and extinction of species (Hilty et al., 2006; Hansen and DeFries, 2007). As a result, conservation of biodiversity outside formally protected areas has become important not only to protect species, but also to meet global conservation targets. For instance, the global protected area targets agreed by the Convention on Biological Diversity under what was called "Aichi Target 11" set coverage targets for the year 2020 at 17% in the terrestrial realm and 10% in the marine realm (Gannon et al., 2019). However, scientists considered these targets as interim measures that were politically driven and not science based. As a result, these targets are viewed in scientific literature as insufficient solutions to avoid loss of biodiversity and extinction of species (Noss et al., 2012; Dinerstein et al., 2017). In addition, they are considered inadequate to stop climate change and ensure a healthy planet for future generations (Teske, 2019). In an era where there is ongoing massive extinction of species and a high rate of habitat loss and over-exploitation (McRae and Böhm, 2021), there are new ambitious global targets (replacing Aichi targets agreed in 2010) for conserving at least 30% of the Earth by 2030. The adoption of Kunming-Montrel Global Biodiversity Framework (GBF) by Parties to the Convention on Biological Diversity in December 2022 marked an important milestone in the global effort to mitigate and reverse biodiversity loss. At the centre of this framework lies an ambitious "30x30" target that aim to protect or conserve 30% of the world's terrestrial and marine areas by 2030 through the establishment of protected areas and other effective area-based conservation measures (OECMs) (CBD COP, 2022; WWF and IUCN WCPA, 2023).

The IUCN-WCPA Task Force on OECMs (2019: 3) defined OECMs as "a geographically defined area other than a protected area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the *in-situ* conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio–economic, and other locally relevant values". Under the slogan "30x30", the key target would be protecting biodiversity (in protected and non-protected areas) by targeting among others, areas with unique and rare biodiversity, areas with primary or old-growth habitats, and connecting such areas with habitat corridors (Dinerstein et al., 2019). Although the objective of sacred forests and their associated taboos is not the conservation of nature, they nonetheless contain unique and significant biodiversity and could be recognized as OECM. Sacred forests offer opportunities to be integrated into a "30x30" conservation targets because they are the remaining patches of primary or old-growth habitats and provide critical habitats for rare and threatened species as in the case of Kaya in Kenya (Metcalfe et al., 2010), Osun Osogbo Sacred Grove in Nigeria (Yusuf, 2016) and the Nkodurom and Pinkwae Sacred Groves in Ghana (Ntiamoa-Baidu, 2008). Sacred forests also offer the opportunity to be incorporated into a "30x30" conservation plan because they can serve as corridors that can promote connectivity of habitat or protected areas along environmental gradients.

Habitat linkages are important for facilitating seasonal migration; increasing the viability of local populations of species (by allowing individual animals access to a larger habitat); allowing genetic exchange with other local populations and permitting local individuals to move away from degraded habitat (see Bennett, 2004). As Travers et al. (2021) have noted, this approach can also help to solve the problem of habitat fragmentation. Conservation of biodiversity in OECMs (outside the borders of formally protected areas) also supports the principles of bioregionalism that uses bioregions as a unit of measurement (Fanfani and Ruiz, 2020). Bioregionalism encourages the protection of species wherever they are found; thus, administrative borders (for example, protected areas) become irrelevant (Sinthumule, 2016). It also encourages the integration of social and ecological systems (Miller, 2014). The rationale behind the integration of people and nature is clear from Sale (2000) who argued that people will tend to protect the place and the environment on which they live and depend. As with "30x30" conservation target (Dinerstein et al., 2019; WWF and IUCN WCPA, 2023), a bioregional approach also promotes connectivity of bioregions or habitats to encourage free movement of species. As Johnson et al. (2017) have noted, conservation experiences worldwide show that bioregional management approaches can encourage local communities and institutions to improve the long-term sustainability of natural resource management practices.

Whilst 30% is the target, there is also a call for an additional 20% to ensure that there is "global safety net" that will enable effective response to the climate and biodiversity crises by 2030 (Dinerstein et al., 2019). Thus, although protecting 30% of the Earth as high-priority conservation areas will be essential, it is argued that it will be insufficient for holding emissions below 1.5°C (Teske, 2019). As a result, natural habitats outside protected areas under a "30x30" conservation target can play a significant role in serving as carbon sinks or store houses of carbon emissions (Dinerstein et al., 2019). One such natural habitats are sacred forests, which according to IUCN's definition qualify as OECMs that are used for cultural and religious purposes and managed by indigenous people in communal lands. Sacred forests offer an opportunity to store massive amounts of carbon because they are the only remaining patches of tall trees that are not affected by human-induced deforestation (Brack, 2019). This carbon sequestration service is key to climate stabilization and to climate change mitigation (Ussiri and Lal, 2017). This is in line with the Paris Climate Agreement of encouraging parties to conserve and enhance forests as sinks and reservoirs of greenhouse gases. Thus, it is anticipated that combining or pairing a "30x30" conservation target and the 2015 Paris Climate Agreement (which aim to reduce global greenhouse gas emissions) would not only conserve species, and secure essential

ecosystem services, but will also avoid catastrophic climate change which is a threat to the environment (Dinerstein et al., 2019).

Given that global loss of biodiversity and ecosystems has accelerated at an unprecedented rate, in parallel with "30x30" conservation target, there is also an ambitious call or vision by scientists of protecting Half the Earth or 50% target to achieve comprehensive biodiversity conservation (Noss et al., 2012; Wilson, 2016; Dinerstein et al., 2017; Sala and Rechberger, 2018). According to Wilson (2016), this vision is to be achieved by linking up protected areas by 2030 to save global biodiversity. This vision aligns with the United Nations 2030 Agenda for Sustainable Development and the post-2020 GBF discussed earlier. Under the motto 'Half-Earth' or 'nature needs half' (http://natureneedshalf.org/), this vision is led by prominent conservation scientists such as Edward O. Wilson (2016) and George Wuerthner (Wuerthner et al., 2015). Wilson uses the ecological concept of the species–area relationship to back up his suggestions and recommendations. According to the latter relationship, if half of the planet's habitats are protected, then 85% of Earth's current biodiversity will not go extinct from loss of habitat or over-exploitation from that habitat (Wilson, 2016). Wilson provided guidance on the types of areas that should be preserved and protected, including biodiversity hotspots, areas with unique biodiversity, and corridors that connect such areas. Sacred forests in the study area have proved to be important refuges for biodiversity because of the taboos that are associated with those areas. Similarly, studies in Kaboli (Togo) (Lynch et al., 2018), Southwest Nigeria (Onyekwelu et al., 2022), Western Highlands of Cameroon (Tankou et al., 2014), Ghana (Boadi et al., 2017), Ethiopian Highlands (Aerts et al., 2016), and Upper Guinea (Soumah et al., 2018) also found that sacred forests were significantly more biodiverse than surrounding non-sacred sites. Sacred forests are not only biodiversity hotspots with unique biodiversity (Bossart and Antwi, 2016; Patwardhan et al., 2021), but they also offer an opportunity to be integrated or interconnected with exiting protected areas. Thus, they can serve as critical ecological corridors that can help to facilitate the flow or movement of individual members of species, genes and ecological processes between isolated habitat patches. This idea is also supported by island biogeography theory which considers that protected areas form islands inside human-altered landscapes (MacArther and Wilson, 1967; Lomolino et al., 2010). Although this radical vision of turning half the earth into a network of protected areas has been criticised (particularly by social scientists) as either feasible or just (see Büscher et al., 2017), other conservationists concur with Wilson that this vision is the 'only defensible target' from a 'strictly scientific point of view' to allow for a sustainable future (Wuerthner et al, 2015).

Although taboos applied in sacred forests are important for biodiversity conservation, they do not enjoy special legal protection and are increasingly threatened by changing mores and practices (Sinthumule, 2024). Examples of such changes include the religious conversion of people to e.g. Christianity, the provision of formal education, and modernisation and advances in science and technology. This is not unique to the study area; rather, the literature suggests that traditional practices have been abandoned in many areas particularly in countries with a history of colonialism (Tang and Gavin, 2016). For instance, many local people in Guatemala (Cook and Offit, 2008), Ghana (Kosoe et al., 2020), and Nigeria (Sambe et al., 2021) have accepted Christianity and Islam over traditional practices and taboos. External influences such as formal education have been cited by some scholars as another factor eroding taboos (Anoliefo et al., 2015; Tang and Gavin, 2016; Alexander et al., 2017). This is because as in South Africa, formal education in many countries with a history of colonialism is largely entrenched in Western values. For instance, formal education in countries including Ghana (Diawuo and Issifu, 2017), Malekula Island in Vanuatu (McCarter and Gavin, 2011), and Malaysia (Gopal, 2005) is rooted in Western culture that is mostly in disagreement with traditional ecological knowledge. In addition, Mekoa (2018) and Tang and Gavin (2016) have also reported that young people are more interested in topics that advance science and technology, thereby encouraging them to disregard traditional taboos. Anthropogenic pressure to extract resources has allowed the degradation of sites in many places where taboos are no longer active (Roba, 2021). Examples include Yorodougou in Côte d'Ivoire where the Dan people live (Olivier, 2019), the church forests in Ethiopia (Mequanint et al., 2020), and sacred forests in northern Morocco (Salah et al., 2018). In contrast, in the Tshidzivhe and Vhutanda sacred forests, taboos still play a significant role in the protection of sacred forests.

6 Conclusion

This study found two main types of taboos to be active in the study area. One taboo prevents people from entering sacred forests, and the other prohibits noise and activities that disrespect the sacred forests. These taboos have prevented the cutting of trees, hunting and hiking within sacred forests – allowing these areas to remain in natural or near-natural condition. Whether or not people believed in the taboos, they nevertheless obeyed taboos active in the study area. The study also found that the sacred forests are not governed and managed by custodians or local authorities but by the spirits themselves. Whether or not local people profess to believe in the taboos and related myths or not, they nevertheless stay away from sacred forests because of fear of the potential for retribution by the spirits. In the context of the study area, the sacred forests can therefore be defined as places dedicated to special events such as deity worship and burial. Only specific individuals or limited groups of people are allowed to access the area for those events, and all other activities are forbidden. This has allowed these areas to have dense, tall closed-canopy evergreen forests that in comparison are poorly represented in surrounding areas.

Although sacred forests and their associated taboos are not meant for conservation purposes, their unique species and abundance of biodiversity offer opportunities to be integrated into global conservation targets of "30x30" and "Half-Earth" or "nature need half" by 2030. The remaining patches of forests also offer opportunity of serving as carbon sinks or store houses of carbon emissions which is key to climate stabilization and to climate change mitigation. Thus, integrating sacred forests with protected areas would not only conserve species, and secure essential ecosystem services, but will also avoid catastrophic climate change

which is a threat to the environment. Despite being significant for forest conservation, sacred forests face several challenges including religious beliefs, formal education, modernisation and advances in science and technology. Without urgent intervention, the institution of taboos and sacred forests may be lost forever. Sacred forests are not legally protected at the moment in South Africa, and the custodians of these areas are not recognised by the local, provincial or national government. In an era where indigenous forests are under threat from anthropogenic land use activities, this study recommends that sacred forests in South Africa and the rest of the continent should be granted juristic personhood or natural rights to ensure some form of legal protection. Failure to recognise and legalise sacred forests risks the destruction and collapse of these areas and the eroding of bio-cultural values, including ecosystem services that are critical for the well-being of people. Efforts should also be made to educate young people about the importance of taboos and sacred forests. Parents in their households should take it upon themselves to educate their children about traditional ecological knowledge and its role in society. It is also recommended that the government should include traditional ecological knowledge in school curricula, particularly in subjects such as languages, geography and agricultural sciences. This will help young people in particular to learn about the importance of taboos and their role in natural resource management.

Data availability statement

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

Ethics statement

The studies involving humans were approved by Faculty of Science Ethics Committee, University of Johannesburg, South Africa. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

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References

Aerts, R., Van Overtveld, K., November, E., Wassie, A., Abiyu, A., Demissew, S., et al. (2016). Conservation of the Ethiopian church forests: threats, opportunities and implications for their management. *Sci. Total Environ.* 551, 404–414. doi: 10.1016/j.scitotenv.2016.02.034

Ahmed, M., Sharma, V., and Dhiman, M. (2023). Sacred groves: the gene banks of threatened and ethnomedicinal flora, associated taboos and role in biodiversity conservation in the Peer Panchal range of North Western Himalayas, India. *Ecol. Questions* 34, 1–20. doi: 10.12775/EQ.2023.030

Alase, A. (2017). The interpretative phenomenological analysis (IPA): A guide to a good qualitative research approach. *Int. J. Educ. literacy Stud.* 5, 9–19. doi: 10.7575/aiac.ijels.v.5n.2p.9

Alexander, L., Agyekumhene, A., and Allman, P. (2017). The role of taboos in the protection and recovery of sea turtles. *Front. Mar. Sci.* 4, 237. doi: 10.3389/fmars.2017.00237

Allan, K. (2018). *The Oxford handbook of taboo words and language* (United Kingdom: Oxford University Press). doi: 10.1093/oxfordhb/9780198808190.001.0001

Angsongna, A., Ato Armah, F., Boamah, S., Hambati, H., Luginaah, I., Chuenpagdee, R., et al. (2016). A systematic review of resource habitat taboos and human health outcomes in the context of global environmental change. *Global Bioethics* 27, 91–111. doi: 10.1080/11287462.2016.1212608

Anoliefo, G. O., Nwokeji, P. A., and Ikhajiagbe, B. (2015). Influence of traditional taboo practices on natural resource conservation in uli, ihiala local government area of anambra state Nigeria; sustainable community development. *J. Environ. Sustain.* 4, 2.

Ayaa, D. D., and Waswa, F. (2016). Role of indigenous knowledge systems in the conservation of the bio-physical environment among the Teso community in Busia County-Kenya. *Afr. J. Environ. Sci. Technol.* 10, 467–475. doi: 10.5897/AJEST

Baker, L. R., Tanimola, A. A., and Olubode, O. S. (2018). Complexities of local cultural protection in conservation: the case of an Endangered African primate and forest groves protected by social taboos. *Oryx* 52, 262–270. doi: 10.1017/S0030605317001223

Bennett, G. (2004). *Linkages in practice: a review of their conservation value* (Gland: IUCN).

Bloch, M. (2001). The ethnohistory of Madagascar. *Ethnohistory* 48, 293–299. doi: 10.1215/00141801-48-1-2-293

Boadi, S., Nsor, C. A., Yakubu, D. H., Acquah, E., and Antobre, O. O. (2017). Conventional and indigenous biodiversity conservation approach: a comparative study

of Jachie Sacred Grove and Nkrabea Forest Reserve. *Int. J. For. Res.* 2017, 1–8. doi: 10.1155/2017/1721024

Boafo, Y. A., Saito, O., Kato, S., Kamiyama, C., Takeuchi, K., and Nakahara, M. (2017). The role of traditional ecological knowledge in ecosystem services management: The case of four rural communities in Northern Ghana. *Int. J. Biodivers. Sci. Ecosyst. Serv. Manage.* 12, 24–38. doi: 10.1080/21513732.2015.1124454

Bobo, K. S., Aghomo, F. F. M., and Ntumwel, B. C. (2015). Wildlife use and the role of taboos in the conservation of wildlife around the Nkwende Hills Forest Reserve; South-west Cameroon. *J. Ethnobiol. Ethnomed.* 11, 1–24. doi: 10.1186/1746-4269-11-2

Bossart, J. L., and Antwi, J. B. (2016). Limited erosion of genetic and species diversity from small forest patches: Sacred forest groves in an Afrotropical biodiversity hotspot have high conservation value for butterflies. *Biol. Conserv.* 198, 122–134. doi: 10.1016/j.biocon.2016.03.029

Brack, D. (2019). "Forests and climate change," in *Proceedings of background study prepared for the fourteenth session of the United Nations forum on forests* (United Nations Forum on Forests, New York, NY, USA).

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101. doi: 10.1191/1478088706qp063oa

Büscher, B., Fletcher, R., Brockington, D., Sandbrook, C., Adams, W. M., Campbell, L., et al. (2017). Half-Earth or Whole Earth? Radical ideas for conservation, and their implications. *Oryx* 51, 407–410. doi: 10.1017/S0030605316001228

CBD COP (2022). *Kunming-montreal global biodiversity: framework: draft decision submitted by the president* (The Hague: CBD COP).

Chaudhry, P., and Murtem, G. (2016). Biodiversity conservation through totem, taboo and magico-religious beliefs in the eastern Himalaya of India: An Ethno Botanical Study. *IER* 17, 261–285. doi: 10.1504/IER.2016.080239

Ciesielska, M., Boström, K. W., and Öhlander, M. (2018). Observation methods. *Qual. methodologies Organ. studies: Volume II: Methods possibilities* pp, 33–52).

Cleaver, F. (2017). *Development through bricolage: Rethinking institutions for natural resource management.* (London: Routledge). doi: 10.4324/9781315094915

Cohen, L., Manion, L., and Morrison, K. (2017). "Observation," in *Research methods in education* (London: Routledge), 542–562. doi: 10.4324/9781315456539

Colding, J., and Folke, C. (2001). Social taboos: 'Invisible' systems of local resource management and biological conservation. *Ecol. Appl.* 11, 584–600. doi: 10.1890/1051-0761(2001)011[0584:STISOL]2.0.CO;2

Constant, N. L., and Tshisikhawe, M. P. (2018). Hierarchies of knowledge: ethnobotanical knowledge, practices and beliefs of the Vhavenda in South Africa for biodiversity conservation. *J. Ethnobiol. Ethnomed.* 14, 1–28. doi: 10.1186/s13002-018-0255-2

Cook, G., and Offit, T. (2008). Pluralism and transculturation in indigenous maya religion. *Ethnology* 47, 45–59.

Creswell, J. W. (2013). *Qualitative, quantitative, and mixed methods approaches* (Los Angeles: Sage).

Department: Government Communication and Information System (2021). *South africa yearbook. Government printers, pretoria.* (Pretoria, South Africa: Government Printers).

Diawuo, F., and Issifu, A. K. (2017). "Exploring the African traditional belief systems (totems and taboos) in natural resources conservation and management in Ghana," in *African philosophy and environmental conservation* (London: Routledge), 209–221.

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N. D., Wikramanayake, E., et al. (2017). An ecoregion-based approach to protecting half the terrestrial realm. *BioScience* 67, 534–545. doi: 10.1093/biosci/bix014

Dinerstein, E., Vynne, C., Sala, E., Joshi, A. R., Fernando, S., Lovejoy, T. E., et al. (2019). A global deal for nature: guiding principles, milestones, and targets. *Sci. Adv.* 5, eaaw2869. doi: 10.1126/sciadv.aaw2869

Fadhilia, B., Liwa, E., and Shemdoe, R. (2016). Indigenous knowledge of Zigi community and forest management decision-making: a perspective of community forest interaction. *JNRD.* 6, 14–21. doi: 10.5027/jnrd.v6i0.03

Fanfani, D., and Ruiz, A. M. (2020). *Bioregional planning and design: volume II* (Switzerland: Springer International Publishing). doi: 10.1007/978-3-030-46083-9

Food and Agriculture Organization of the United Nations (FAO). (2020). *Global forest resources assessment 2020: main report* (Rome: FAO). doi: 10.4060/ca9825en

Gannon, P., Dubois, G., Dudley, N., Ervin, J., Ferrier, S., Gidda, S., et al. (2019). Editorial Essay: An update on progress towards Aichi biodiversity target 11. *Parks* 25, 7–18. doi: 10.2305/IUCN.CH.2019.PARKS-25-2en

Gatticchi, G. (2023). "Unpacking deforestation, forest loss and carbon sinks," in *Mail and guardian*. (South Africa: Mail and Guardian) 5 June 2023.

Google Earth. (2024). https://earth.google.com/web/@-23.28091628,30.66613939,468.9687032a,87107.42602777d,35y,0h,0t,0r.

Gopal, R. (2005). Indigenous environmental knowledge in formal education. *Jurnal Penyelidikan MPBL* 6, 120–132.

Guest, G., Bunce, A., and Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods* 18, 59–82. doi: 10.1177/1525822X05279903

Hansen, A. J., and DeFries, R. (2007). Ecological mechanisms linking protected areas to surrounding lands. *Ecol. Appl.* 17, 974–988.

Hilty, J. A., Lidicker Jr., W. Z., and Merenlender, A. M. (2006). *Corridor ecology: the science and practice of linking landscapes for biodiversity conservation.* Washington DC: Island Press.

Ihinmikaiye, S. O., Ochekwu, E. B., and Ojo, V. I. (2022). The use of myths and taboos in wildlife conservation: The case of Bayelsa-East Senatorial District of Nigeria. *Zoologist* 20, 141–149. doi: 10.4314/tzool.v20i1.18

Imran, A., and Yusoff, R. M. (2015). Empirical validation of qualitative data: A mixed method approach. *IJEFI.* 5, 389–396.

IUCN-WCPA Task Force on OECMs (2019). "Recognising and reporting other effective area-based conservation measures," in *IUCN gland Switzerland*. (Switzerland: IUCN Gland). doi: 10.2305/IUCN.CH.2019.PATRS.3.en

Jimoh, S. O., Ikyaagba, E. T., Alarape, A. A., Obioha, E. E., and Adeyemi, A. A. (2012). The role of traditional laws and taboos in wildlife conservation in the Oban Hill Sector of Cross River National Park (CRNP), Nigeria. *J. Hum. Ecol.* 39, 209–219. doi: 10.1080/09709274.2012.11906513

Johnson, N., Miller, K., and Miranda, M. (2017). "Bioregional approaches to conservation: local strategies to deal with uncertainty," in *Ecology, uncertainty and policy* (London: Routledge), 43–65.

Jones, J. P., Andriamarovololona, M. M., and Hockley, N. (2008). The importance of taboos and social norms to conservation in Madagascar. *Biol. Conserv.* 22, 976–986. doi: 10.1111/j.1523-1739.2008.00970.x

Kosoe, E. A., Adjei, P. O. W., and Diawuo, F. (2020). From sacrilege to sustainability: the role of indigenous knowledge systems in biodiversity conservation in the Upper West Region of Ghana. *GeoJournal* 85, 1057–1074. doi: 10.1007/s10708-019-10010-8

Kumari, S. K. V., Lavanya, K., Vidhya, V., Premila, G. A. D. J. S., and Lawrence, B. (2023). Research methodology *(1)* (India: Darshan Publishers).

Lomolino, M. V., Riddle, B. R., Whittaker, R. J., and Brown, J. H. (2010). *Biogeography* (Sunderland: Sinauer Associates, Inc publishers).

Lynch, L., Kokou, K., and Todd, S. (2018). Comparison of the ecological value of sacred and nonsacred community forests in Kaboli, Togo. *Trop. Conserv. Sci.* 11, 1940082918758273. doi: 10.1177/1940082918758273

MacArther, R. H., and Wilson, E. O. (1967). *The theory of island biography*. (Princeton and Oxford: Princeton University Press).

Mavhura, E., and Mushure, S. (2019). Forest and wildlife resource-conservation efforts based on indigenous knowledge: The case of Nharira community in Chikomba district, Zimbabwe. *For. Policy Econ.* 105, 83–90. doi: 10.1016/j.forpol.2019.05.019

McCarter, J., and Gavin, M. C. (2011). Perceptions of the value of traditional ecological knowledge to formal school curricula: opportunities and challenges from Malekula Island, Vanuatu. *J. Ethnobiol. Ethnomed.* 7, 1–14. doi: 10.1186/1746-4269-7-38

McIntosh, M. J., and Morse, J. M. (2015). Situating and constructing diversity in semi-structured interviews. *GQNR.* 2, 2333393615597674. doi: 10.1177/2333393615597674

McRae, L., and Böhm, M. (2021). "Biodiversity: The decline in global biodiversity and how education can be part of the solution," in *Meeting the challenges of existential threats through educational innovation* (London: Routledge), 42–66.

Mekoa, I. (2018). Essentialising African indigenous knowledge systems in the midst of globalization and modernity. *Afr. Renaissance* 11–28. doi: 10.31920/AA_AR

Mequanint, F., Wassie, A., Aynalem, S., Adgo, E., Nyssen, J., Frankl, A., et al. (2020). Biodiversity conservation in the sacred groves of north-west Ethiopia: diversity and community structure of woody species. *GECCO.* 24, e01377. doi: 10.1016/j.gecco.2020.e01377

Metcalfe, K., Ffrench-Constant, R., and Gordon, I. (2010). Sacred sites as hotspots for biodiversity: the Three Sisters Cave complex in coastal Kenya. *Oryx* 44, 118–123. doi: 10.1017/S0030605309990731

Miller, K. R. (2014). "Bioregional planning and biodiversity conservation," in *Partnerships for protection* (London: Routledge), 41–49.

Mucina, L., and Rutherford, M. C. (2006). *The vegetation of South Africa, Lesotho and swaziland* (South Africa: SANBI, Pretoria).

Munyati, C., and Sinthumule, N. I. (2014). Cover gradients and the forest-community frontier: Indigenous forests under communal management at Vondo and Xanthia, South Africa. *J. Sustain. For.* 33, 757–775. doi: 10.1080/10549811.2014.925809

Munyati, C., and Sinthumule, N. I. (2021). Comparative suitability of ordinary kriging and inverse distance weighted interpolation for indicating intactness gradients on threatened savannah woodland and forest stands. *Environ. Sustain. Indic.* 12, 100151. doi: 10.1016/j.indic.2021.100151

Negi, C. S. (2010). The institution of taboo and the local resource management and conservation surrounding sacred natural sites in Uttarakhand, Central Himalaya. *Int. J. Biodivers. Conserv.* 2, 186–195.

Negi, C. S. (2017). "The sacred natural sites, the social taboo system and the scope of developing some of the sites as biodiversity heritage sites, uttarakhand, central himalaya," in *Ethnobotany of India*, vol. 4. (New York: Apple Academic Press), 445–477.

Noss, R. F., Dobson, A. P., Baldwin, R., Beier, P., Davis, C. R., Dellasala, D. A., et al. (2012). Bolder thinking for conservation. *Conserv. Biol.* 26, 1–4.

Ntiamoa-Baidu, Y. (2008). Indigenous beliefs and biodiversity conservation: The effectiveness of sacred groves, taboos and totems in Ghana for habitat and species conservation. *JSRNC.* 2. doi: 10.1558/jsrnc.v2i3.309

Olivier, D. K. (2019). "The sacred sites of dan populations in côte d'Ivoire: environmental conservation factors," in *Culture and environment*, (Netherlands: Brill), 127–137.

Onyekwelu, J. C., Agbelade, A. D., Tolorunju, M. S., Lawal, A., Stimm, B., and Mosandl, R. (2022). Conservation potentials, tree species diversity, distribution and structure of sacred groves in South-Western Nigeria. *JTFS* 34, 334–346. doi: 10.26525/jtfs

Osei-Tutu, P. (2017). Taboos as informal institutions of local resource management in Ghana: Why they are complied with or not. *For. Policy Econ.* 85, 114–123. doi: 10.1016/j.forpol.2017.09.009

Patwardhan, A., Ghate, P., Mhaskar, M., and Bansude, A. (2021). Cultural dimensions of sacred forests in the Western Ghats Biodiversity Hot Spot, Southern India and its implications for biodiversity protection. *IJAE* 5, 12. doi: 10.1186/s41257-021-00053-6

Pyett, P. M. (2003). Validation of qualitative research in the 'real world'. *Qual. Health Res.* 13, 1170–1179. doi: 10.1177/1049732303255686

Richards, K. A. R., and Hemphill, M. A. (2018). A practical guide to collaborative qualitative data analysis. *JTPE* 37, 225–231. doi: 10.1123/jtpe.2017-0084

Roba, G. O. (2021). Anthropogenic menace on sacred natural sites: the case of Me'ee Bokko and Daraartu sacred shrines in Guji Oromo, Southern Ethiopia. *Heliyon* 7, e06460. doi: 10.1016/j.heliyon.2021.e06460

Sala, E., and Rechberger, K. (2018). Protecting half the ocean. *From summits to solutions: Innov. implementing Sustain. Dev. Goals*. 239–261.

Salah, H. B., Bombín, R. E., and Taïqui, L. (2018). Natural sacred sites as indicators of social-ecological system change in traditional landscapes of Northern Morocco. *Landsc. Ecol. Eng.* 14, 121–133. doi: 10.1007/s11355-017-0338-6

Sale, K. (2000). *Dwellers in the land: The bioregional vision* (Athens: The University of Georgia press).

Sambe, L. N., Yager, G. O., Ver, P. N., and Ikape, M. O. (2021). Approaches and challenges of traditional institutions in conservation of biodiversity: Implications for sustainable management of natural resources in Nigeria. *Plants Environ.* 3, 14–22. doi: 10.22271/2582-3744

Sharma, A., Thakur, D., and Uniyal, S. K. (2021). Taboos: Traditional beliefs and customs for resource management in the western Himalaya. *IJTK.* 20, 575–581.

Sinthumule, N. I. (2016). Multiple-land use practices in transfrontier conservation areas: The case of Greater Mapungubwe straddling parts of Botswana, South Africa and Zimbabwe. *Bull. Geogr. Socio-Econom. Ser.* 34, 103–115. doi: 10.1515/bog-2016-0038

Sinthumule, N. I. (2024). Challenges facing traditional ecological knowledge in the Vhembe District Municipality in Limpopo Province, South Africa. *Soc. Sci. Humanit. Open*. 10, 101027.

Sinthumule, N. I. (2022). Conservation effects of governance and management of sacred natural sites: Lessons from Vhutanda in the Vhembe region, Limpopo Province of South Africa. *IJERPH.* 19, 1067. doi: 10.3390/ijerph19031067

Sinthumule, N. I. (2023). Traditional ecological knowledge and its role in biodiversity conservation: a systematic review. *Front. Environ. Sci.* 11. doi: 10.3389/fenvs.2023.1164900

Sinthumule, N. I., and Mashau, M. L. (2020). Traditional ecological knowledge and practices for forest conservation in Thathe Vondo in Limpopo Province, South Africa. *GECCO.* 22, e00910. doi: 10.1016/j.gecco.2020.e00910

Soumah, F. S., Kaniewski, D., and Kokou, K. (2018). The sacred forests of Guinea: Between ecology and conservation. *Comptes Rendus Biologies* 341, 433–443. doi: 10.1016/j.crvi.2018.09.001

Tang, R., and Gavin, M. C. (2016). A classification of threats to traditional ecological knowledge and conservation responses. *Conserv. Soc* 14, 57–70. doi: 10.4103/0972-4923.182799

Tankou, C. M., de Snoo, G. R., de Iongh, H. H., and Persoon, G. (2014). Variation in plant biodiversity across sacred groves and fallows in Western Highlands of Cameroon. *Afr. J. Ecol.* 52, 10–19.

Terry, G., Hayfield, N., Clarke, V., and Braun, V. (2017). Thematic analysis. *SAGE Handb. Qual. Res. Psychol.* 2, 25.

Teske, S. (2019). Achieving the Paris climate agreement goals: Global and regional 100% renewable energy scenarios with non-energy GHG pathways for+ 1.5 C and+ 2 C *(491)* (Switzerland: Springer Nature).

Travers, E., Härdtle, W., and Matthies, D. (2021). Corridors as a tool for linking habitats–Shortcomings and perspectives for plant conservation. *J. Nat. Conserv.* 60, 125974. doi: 10.1016/j.jnc.2021.125974

Ussiri, D. A., and Lal, R. (2017). Carbon sequestration for climate change mitigation and adaptation *(287-325)* (Cham, Switzerland: Springer International Publishing). doi: 10.1007/978-3-319-53845-7

Van Amstel, N. P., Rakotondrainy, R. M., Castellano, C. M., and Arts, K. (2022). Tortoise panopticon: Linkages between taboos and conservation management in Madagascar. *Geoforum* 129, 85–97. doi: 10.1016/j.geoforum.2021.10.013

Wilson, E. O. (2016). "Half-earth," in *Our planet's fight for life* (Liferight Publishing, London).

G. Wuerthner, E. Crist and T. Butler (Eds.) (2015). "Protecting the wild," in *Parks and wilderness, the foundation for conservation* (Island Press, London). doi: 10.5822/978-1-61091-551-9

WWF and IUCN WCPA. (2023). *A guide to inclusive, equitable and effective implementation of target 3 of the kunming-montreal global biodiversity framework: version 1, august 2023*. (Switzerland: WWF and IUCN World Commission on Protected Areas).

Yusuf, T. G. (2016). A micro analysis of tourists, other participants and tourism activities at Osun Osogbo Sacred Grove, Nigeria. *JTR* 68.