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RESEARCH ARTICLE

Integrating biocultural conservation and sociocultural valuation in the management of sacred forests: What values are important to the public?

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Abstract

1. The need to recognise plural values and integrate these into policy design has long been of interest in nature conservation. However, we also need to understand whether and how different values are prioritised among diverse stakeholders. This is particularly important when indigenous and traditional cultures play a role in how land is managed and protected.
2. Working in the sacred forests of Nigeria, we applied the principles of biocultural conservation and sociocultural valuation to understand the values that underpin people's relationship with nature and with other users of nature. We operationalised this by employing participatory workshop methods to identify multiple values of sacred forests, and conjoint analysis to elicit local people's value priorities and preferences for conserving sacred forests.
3. We identified multiple values attributed to sacred forests, but the strongest preferences were for improved provision of medicinal values. However, preference heterogeneity analysis showed that sacred forests are valued differently among clusters of people with distinct sociodemographic profiles.
4. Our findings also showed that the current management strategy for the conservation of sacred forests is inadequate to galvanise shared and collective responsibility from diverse stakeholders. Using a value-based approach, more robust management strategies that will yield high utility to the public were determined and recommended for implementation.
5. *Policy implications*. Overall, our study demonstrates that sacred forests are valued in multiple ways above and beyond their role in a cultural belief system. New strategies are therefore needed to effectively manage and conserve them. We recommend a plural approach to the conservation of sacred forests that will incorporate multiple values. This can be achieved by integrating biocultural conservation and sociocultural valuation.

KEYWORDS
conjoint analysis, contingent ranking method, heterogeneity, Nigeria, participatory workshop

1 | INTRODUCTION

Forests are the most diverse terrestrial ecosystems holding the vast majority of the world's flora and fauna (Brockerhoff et al., 2017). They are also one of the most important global natural resources upon which human survival and livelihoods depend (Kumar et al., 2019). Despite several decades of efforts to conserve forests, there is still evidence of widespread degradation in both protected (Wade et al., 2020) and unprotected forest ecosystems (Freitas et al., 2018). According to the Food and Agricultural Organization [FAO] (2020), about 420 million ha of forest have been lost globally in the last three decades, largely in Africa and South America.

Designating forests as legally protected has not been wholly successful in slowing or halting deforestation (Wolf et al., 2021). According to Jones et al. (2018), about one-third of legally protected areas are undergoing various levels of degradation due to intense human pressure related to high population growth, increasing consumption, agriculture and infrastructural development. Consequently, several conservation studies have refuted the claim that only legally protected areas are capable of conserving forests (Cavanagh & Benjaminsen, 2014; Palacín & Alonso, 2018). One of the reasons for this is the failure of the protected area-based approach to nature conservation to engage with community needs and cultures and align with local priorities (Duan & Wen, 2017). This situation indicates a need to go beyond exclusionary approaches that involve forced removal of local rights, towards a more inclusive and diversified approach that can identify multiple values from diverse stakeholder perspectives (Lele et al., 2010). It is particularly important to include the values of local people in close proximity to conservation sites whose interests and actions can influence conservation outcomes (Ihemezie et al., 2022). Currently, only about 16% of forests globally are legally/formally protected (Ritchie & Roser, 2021). This leaves a greater percentage of the world's forests unprotected or covered by other forms of protection that uses informal approaches to conserve nature. There is need to explore informal conservation approaches that recognises the cultural relationship between people and other parts of nature (Reyes-García et al., 2023). The existing conservation approach has a dual goal of conserving for nature's sake (intrinsic) or for human use (instrumental) (Díaz et al., 2019). The challenge with this is that it misses the connecting values that capture people's relationship with nature and with other users of nature, such as cultural and social values.

The biocultural approach to conservation offers the opportunity to improve the existing conservation approach through the recognition of placed-based relationships that have supported enduring socio-ecological systems that aligned with local priorities (Reyes-García et al., 2023). In this study, biocultural conservation is defined as a conservation approach that uses indigenous knowledge and traditional methods to address issues of biological and cultural diversity (Gavin et al., 2015). Biocultural conservation is premised on the central theme that emphasises the interconnectedness of nature and culture through coevolution processes (Wengerd & Gilmore, 2022). According to Gavin et al. (2015), one of the fundamental principles of biocultural conservation is the acknowledgement of multiple objectives from different stakeholders who hold diverse values. This aligns with the concept of sociocultural valuation, a method that aims to recognise the multiple values of nature beyond monetary terms (Breyne et al., 2021). Sociocultural valuation, as used in this study, is an umbrella term for the collection of diverse nonmonetary held values assigned to natural ecosystems, which can determine human preferences towards ecosystem services (Santos-Martín et al., 2017). Therefore, sociocultural valuation can be a suitable technique to achieve biocultural conservation objectives. Both sociocultural valuation and biocultural conservation are increasingly recognised as important approaches with great potential to conserve informally protected forests with sacred status (Bernués et al., 2014; Pradhan & Ormsby, 2020).

Most of the values and practices identified via the biocultural approach to conservation are associated with forest landscapes with sacred status (Pradhan & Ormsby, 2020; Sharma & Kumar, 2021). Sacred forests are cultural landscapes that are protected primarily because of their cultural values, religious functions, traditional importance and symbolic identity (Irakiza et al., 2016; Ormsby & Bhagwat, 2010). About 15% of global forestlands have sacred connotations (Alliance of religion and conservation, 2011). However, recent studies have shown that sacred forests face existential threats ranging from overexploitation to conversion to other land uses (Plieninger et al., 2020; Sinthumule, 2022), which calls for an improvement in their management approach. Some of the factors that predispose sacred forests to threats are their small sizes and isolated locations, which exposes them to edge effects and human pressures (Cardelús et al., 2017). Furthermore, sacred forests are very vulnerable to the influence of sociocultural changes such as the adoption of new religious faiths such as Christianity, modernisation and population growth (Sinambela et al., 2021). The gradual loss of indigenous knowledge, erosion of traditional customs and diminishing regard for culture, which have hitherto protected these areas, are some of the greatest underlying threats to the sustainability of sacred forests (Mavhura & Mushure, 2019). Previous studies have detected that the decline in sustaining sacred forest traditional religious customs is most common among young people (Negi et al., 2018). This implies that the current management approach to the conservation of sacred forests, which relies mostly on religious beliefs and traditional customs, is inadequate. These distinct factors threatening the existence of sacred forests differentiate them from other protected forests, thereby necessitating differentiated management strategies.

The application of biocultural conservation and sociocultural valuation can improve the management of sacred forests by identifying and recognising multiple values that can attract and sustain the interest of all members of society. The identification of the multiple values of nature is also in line with a recent report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] (2022), where it is noted that one of the key factors driving the depletion of the world's natural resources is the limited set of nature's values on which individuals, communities and government base their decisions. Biocultural conservation and sociocultural valuation, therefore, offer a more integrated and holistic approach that can identify the multiple values ascribed to sacred forests and incorporate them into decision-making as policy incentives for conservation.

The main aim of this study was to inform improvement to the existing approach to the management of sacred forests through the integration of biocultural conservation approach and sociocultural valuation. To operationalise this, we combined the strengths of participatory methods and conjoint analysis valuation to elicit local people's value preferences for conserving sacred forests. Specifically, we: (i) identified the sociocultural values of sacred forests, (ii) estimated the individual utility of values of sacred forests and determined the relative importance of the values that can influence preferences for the conservation of sacred forests, (iii) assessed heterogeneity in value preference among the population and (iv) designed management strategies for improvement in the conservation of sacred forests. This is important, especially in developing countries such as Nigeria, where there are little or no institutional frameworks or government policies to protect sacred forests. Our study advances the literature on sacred forest conservation, in which to date, no empirical study has demonstrated how biocultural conservation and sociocultural valuation can be integrated to enhance sacred forest management. The information obtained shows what values should be prioritised and which management strategies should be implemented to promote the conservation of sacred landscapes.

2 | METHODOLOGY

2.1 | Study area

Nigeria is a multicultural society with a network of sacred landscapes where nature conservation is an integral part of cultural ethos and values (Onyima, 2016). This study was carried out in Enugu State (Figure 1), one of the five states in South-Eastern Nigeria, with abundance of forest vegetation and distribution of sacred forests. The area is dominated by the Igbo-speaking tribe of Nigeria. Enugu (meaning 'hilltop') is an area named for its hilly topography and distinct orographic features. Its geographical coordinates lie between Latitudes 5°′56′ and 7°′06′ N and Longitudes 6°′53′ and 7°′55′ E (Enugu State Government, 2019). The state's agroecology is divided between the Niger Delta swamp forest in the south and the drier Guinean forest-savanna mosaic in other parts of the state (Enugu State Government, 2019). The state occupies a land area of 7161 km^2 and has an estimated population of 4.4 million (National Bureau of Statistics, 2021). Agriculture and trading are the dominant occupations, and forests play an important role in supporting livelihoods (Enugu State Government, 2019).

Enugu State comprises four forestry zones: Awgu, Enugu, Nsukka and Oji-River, which are forest administrative boundaries in the state (Emeodilichi, 2018). The state is densely forested, with protected forests covering a land area of about 35,000 ha (Enugu State Forestry Commission, 2020). In addition to the 12 government-protected forests, there is a network of other undocumented forest sites (sometimes called evil forests) locally protected because of their cultural significance (Opata, 2020). In this area, rural community dwellers believe that protecting sacred trees, animals and inanimate natural features will protect their environment, provide rain, bring good luck and fortune and avoid god's punishment (Chukwu et al., 2019).

Recent land-use land-cover studies have shown that Enugu State is experiencing rapid forest cover loss in urban and rural areas, primarily driven by economic development (Nnaji et al., 2022). The annual deforestation rate is 5.7% (Enugu State Forestry Commission, 2020), which is relatively high than the national average of 4% (Orji, 2021). Despite signs and evidence of deforestation around the state, many rural communities still have remnants of relatively intact culturally protected forests.

2.2 | Methodological approach

Given the aim of this study to apply biocultural conservation approach and sociocultural valuation to improve the management of sacred forests, a mixed methods approach was used, combining a participatory workshop method and conjoint analysis valuation. Eliciting value preference is a complex process, which cannot be sufficiently captured by one method due to the diversity of human concepts of nature (Ducarme et al., 2020). We therefore used two methods, which allowed us to use the outcomes of the participatory workshops as an important input into the design and implementation of the conjoint analysis valuation. The participatory workshops were used to identify and describe the multiple sociocultural values of sacred forests, what the values mean to the people and possible management strategies. Conjoint analysis was used to determine the relative importance (utility) of values that can influence preferences for the conservation of sacred forests. One of the key advantages of combining different methods and data sources to study the same phenomenon is that it helps the researcher ascertain convergence and corroboration of research evidence, improving credibility (Bowen, 2009).

Participatory workshops allow for coproduction of knowledge and give the opportunity to balance and mobilise values from diverse stakeholders. According to Bohunovsky et al. (2011), conservation management strategies should be developed in a participatory way by involving the ideas and perceptions of multiple stakeholders, including local people, experts and decision-makers. Combining multiple ideas and interests can create additional knowledge that can be used to develop new management solutions, which can meet stakeholder

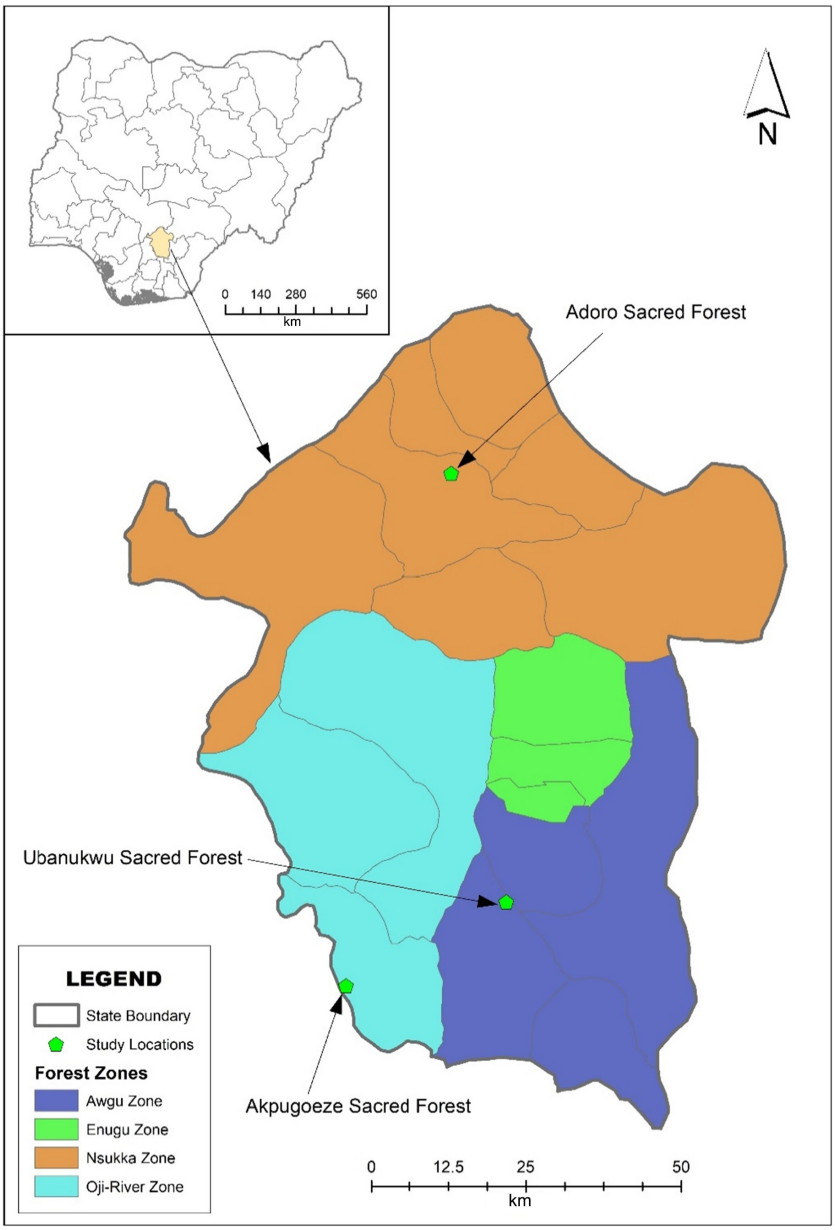

FIGURE 1 Location of Enugu State in Nigeria (upper inset), and the map of Enugu State showing the four forestry zones and studied sacred forest sites.

expectations and promote support for conservation. This is because the participatory approach creates a sense of stakeholdership, making people accept conservation outcomes because they are part of the processes that produced them (Grodzińska-Jurczak & Cent, 2011).

To complement our participatory workshops, conjoint analysis valuation was applied to make visible a wider diversity of values. Conjoint analysis is a nonmonetary valuation technique that has been applied in valuing nonmarket public goods such as natural resources or ecosystem services (Haghjou et al., 2016). The method was used in this study because of its suitability in measuring passive use values and nonuse environmental values (Lee et al., 2006). By this, it helps to overcome one of the key limitations of using monetary approaches in nature valuation by capturing the full range of nonmarket and intangible held values that cannot be quantified in monetary terms (Ihemezie et al., 2021; Rode et al., 2015). In addition, it can help us to assess how the general public differs in their value preference for sacred forests, which is currently lacking in the sacred forest literature. Heterogeneity of preferences has been shown in the valuation of protected spaces (Zabala et al., 2022) and may exist even more in sacred spaces with a high emotional and cultural attachment, which can make preferences very different, if not contradictory, between groups. In what follows, we present the details of our participatory workshop method and the subsequent conjoint analysis valuation.

3 | PARTICIPATORY WORKSHOPS—METHODS

Three of the four forestry zones that make up Enugu State were purposively selected because of the presence of sacred forest sites. One community with the largest sacred forest was chosen from each of the three selected forest zones. Information about the size of the sacred forests

and their identification was obtained with the assistance of forestry officers at the Enugu State forestry commission. The selected sacred forests are Ubanukwu sacred forest in Awgu forest zone, Adoro sacred forest Alor Agu in Nsukka forest zone and Akpugoeze sacred forest in Oji-River forest zone (Figure 1). We recruited the participants for the workshops by identifying individuals who can affect and be affected by changes in sacred forests. Here, relevant sacred forest stakeholders included traditional chief priests, herbalists, village heads, youths, middle-aged adults, elderly people and forest officials. To enable a manageable group size yet still capture the diversity of viewpoints, two participants were selected to represent each of these stakeholder groups through snowball sampling, with participants being invited to the workshop. Altogether, 14 people of different gender and age from each of the selected communities participated in the workshops (see Table S2 in Supporting Information for details). This number is considered adequate and falls within the range of participants needed to provide a valid result in participatory studies (Six & Macefield, 2016). To diversify our sample and reduce the biases and linearity of snowball sampling, participants were selected based on different starting points within the network.

Workshops were conducted in each selected community in two phases. The first phase involved traditional chief priests, herbalists, village heads, youths, adults and elderly people. The goal of this was to identify the multiple sociocultural values of sacred forests and what the values mean to the people, the current level of value provision and possible management strategies/payment vehicles to achieve conservation. In the second phase, a subset of the stakeholders who participated in the first phase and officials from the Enugu State forestry commission were invited for each of the three communities. The goal of the second phase was to co-interpret the outcomes of the first phase. Here, the identified sociocultural values were described, and the level of value provisions ranked. Management strategies were also harmonised and described, and participatory scenarios were used to simulate possible value outcomes when different management strategies are applied to sacred forests.

A question guide provided the framework for discussions during the workshops (see Section S3). To reduce the influence of power dynamics, workshop participants were divided into subgroups according to their stakeholder category. Towards the end of each workshop, there was a joint section where each subgroup's outcomes were presented and discussed. Workshops were conducted in both English and Igbo languages. Where Igbo was used, discussions were translated into English during data transcription. Verbatim transcription was used to transcribe all discussions.

The data from the different workshops were aggregated before analysis. We applied thematic analysis to explore the workshops' data, which were transcribed and coded. Here, the final workshop transcripts were iteratively read. Relevant phrases and sentences were highlighted and manually coded to establish reoccurring themes and patterns in line with the goal of the workshops. We also used key quotes to explain what the workshop participants reported.

One of the limitations of this study was the difficulty in accessing key participants for the participatory workshops. Due to religious sentiments and local perceptions of sacred forests as the abode of deities, most people refused to participate in workshops or speak about sacred forests unless permission was obtained from the traditional chief priest. This took a long time. Given this limited access to some potential participants, it may have introduced a selection bias in our sampling. However, this limitation was managed by ensuring that all potential participants were given an equal chance to participate in the workshops. Moreover, all the selected participants reflected our target population and covered all the stakeholder categories in our study design.

4 | CONJOINT ANALYSIS—METHODS

4.1 | Survey design and data collection

A multistage random sampling technique was used to select respondents from each of the three communities where the participatory workshops were carried out, using a list of households obtained with the help of community leaders. From each community, 100 households were selected at random from those lists. This gave an overall sample size of 300, which falls within the range of 200 to 2000 that is used for most contingent surveys (Lawton et al., 2020). Household sampling was carried out with the help of trained local enumerators. If the selected household was not accessed, we moved to the next house. The survey was administered to household heads (i.e. those who make final decisions on behalf of the household as a whole), or, in their absence, another adult with influence over household decision-making.

Draft questionnaires and ranking cards were piloted prior to data collection. This was to ensure that the questionnaire and ranking exercise could be completed in time with minimal risk of respondent fatigue, which can reduce their effectiveness in providing accurate information and making a quality decision during ranking. The pilot survey also helped ensure that questions were clearly worded and the ranking card details were realistic, clear and understandable. The questionnaire was developed in English and translated to the local language (Igbo) for those respondents who were not literate in English.

The questionnaire was divided into three sections. The first asked about the general perception of the values of sacred forests to understand respondents' knowledge, attitudes and relationships with sacred forests. The second section covered the conjoint analysis questions, which involved contingent ranking of value attribute levels identified from the participatory workshops to determine value preferences. This was performed with the aid of ranking cards containing visual representations of the different sociocultural values and levels of value provision (Figure 2). Visual images not only facilitated choice ranking but also helped counter low literacy. To understand the context and situations of our respondents, the third section of the questionnaire collected data on sociodemographic characteristics (see Section S2 in the Supporting Information).

To optimise the number of alternative profiles presented to the respondents in the contingent ranking, the value attributes and their levels were combined to create a hypothetical value provision. A combination of the seven attributes with two levels each resulted in 128 possible alternatives. A fractional factorial design using the

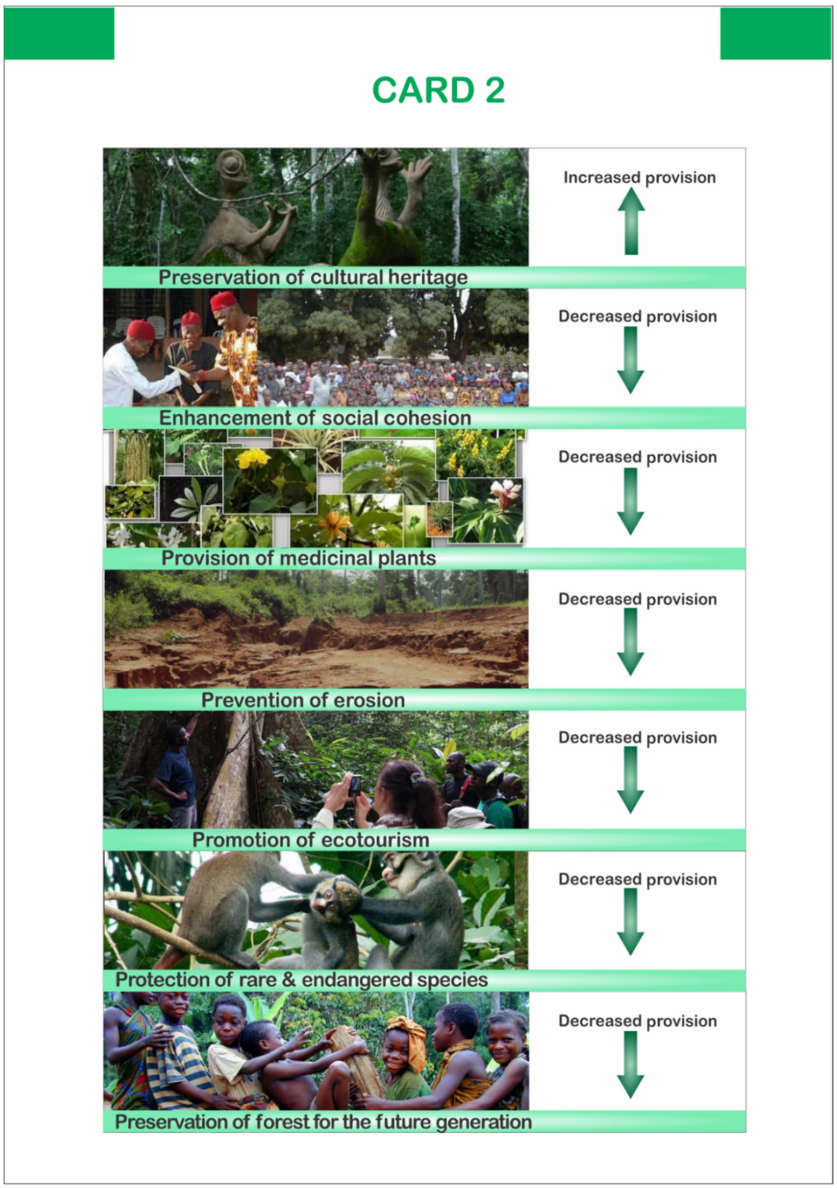

FIGURE 2 Pictorial representation of the ranking cards presented to respondents showing different levels of value provision.

orthogonal array method was used to select the minimum number of alternatives representing a suitable fraction of all combinations of the attribute levels. This resulted in a final set of eight value combinations (Table 1), which included the status quo as card 2.

4.2 | Valuation approach and model estimation

Conjoint analysis assumes that when presented with a set of alternative choices, individuals make decisions to maximise their utility or satisfaction. This utility is comprised of both observed and unobserved values, which therefore introduces randomness in the utility function (Masozera et al., 2013). From the random utility model, the utility that the *i*th individual derives from *j*th alternative choices can be expressed as:

$$U_{ij} = \beta X_{ij} + e_{ij} \quad (1)$$

where: β = vector of unknown parameters

X_{ij} = vector of variables representing values of attribute of the *j*th alternative for the *i*th individual.

e_{ij} = error term or the random disturbance, representing the unobserved values.

Contingent ranking method, the specific technique of conjoint analysis used in this study, requires respondents to rank their preferences from the highest to the lowest based on the attributes of each profile.

In this study, respondent's individual utility U_{ij} for each of the *j*th alternatives was not observed, but a ranking (r_j) was observed, corresponding to their underlying utilities' preference order. The probability of ranking alternative 1 above other alternatives is expressed as:

$$P_{i1} = \Pr(U_{i1} > U_{i2} \text{ and } U_{i1} > U_{i3} \ldots \text{ and } U_{i1} > U_{ij} = \Pr\left[(e_{i2} - e_{i1}) < (X_{i1}\beta - X_{i2}\beta) \text{ and } (e_{ij} - e_{i1}) < (X_{i1}\beta - X_{ij}\beta)\right] \quad (2)$$

TABLE 1 Orthogonal design of contingent ranking cards showing eight alternative profiles presented to the respondents to rank in the conjoint analysis. Each card consists of a combination of different levels of value provision.

Values	Card 1	Card 2	Card 3	Card 4	Card 5	Card 6	Card 7	Card 8
Preservation of cultural heritage	Decreasing provision	High provision	Decreasing provision	Decreasing provision	High provision	High provision	High provision	Decreasing provision
Enhancement of social cohesion	Improved provision	Decreasing provision	Decreasing provision	Decreasing provision	Decreasing provision	Improved provision	Improved provision	Improved provision
Provision of medicinal plants	Improved provision	Decreasing provision	Improved provision	Decreasing provision	Improved provision	Decreasing provision	Improved provision	Decreasing provision
Prevention of erosion	Decreasing provision	Decreasing provision	Improved provision	Improved provision	Decreasing provision	Improved provision	Improved provision	Decreasing provision
Promotion of ecotourism	Improved provision	Zero provision	Zero provision	Improved provision	Improved provision	Improved provision	Zero provision	Decreasing provision
Protection of rare and endangered species	Decreasing provision	Decreasing provision	Decreasing provision	Improved provision	Improved provision	Decreasing provision	Improved provision	Improved provision
Preservation of forest for the future generation	Decreasing provision	Decreasing provision	Improved provision	Decreasing provision	Improved provision	Improved provision	Decreasing provision	Improved provision
Ranking								

The same expression holds for each of the next chosen alternatives in the choice set.

The individual utilities or part-worths are determined based on the modelling of rankings. Following Martínez-Paz et al. (2022), two models were used: the ordinary least square (OLS) and the Ordered-logit (OLOGIT). Both models were used because while OLS is traditionally applied in estimating the relative importance of experimental factors and factor levels of part-worth utilities (Jaeger et al., 2013), OLOGIT is appropriate in estimating utilities where the dependent variable is ordinal (Peel et al., 1998). The results of both models were compared.

The OLS model is given as:

$$Y_{ij} = \alpha + \Sigma_{k-1}^{k} \beta_{jk} X_{jk} + e_{ij} \tag{3}$$

where: Y_{ij} = the observed variable, obtained by the ranking of the preference of the jth

alternatives for the ith individual.

α = constant term or the threshold.

j = alternative choice sets assigned values 1–8 s.

β_{jk} = marginal utility or part-worth associated with jth levels of the attribute k (k = 1,2, … k).

X_{jk} = a dichotomous variable that takes the value of 1 when the jth level of the attribute k is present in the choice set and 0 otherwise.

e_{ij} = a normally distributed random variable.

In the OLOGIT model, the Y_{ij}^* variable is latent and relates to the X_{jk} variable via the following equation:

$$Y_{ij}^* = F\left(\beta X_{jk}\right) + v_{ij} \tag{4}$$

where:

Y_{ij}^* = a continuous latent variable that quantifies the relative rank of the jth alternative in the choice set.

β = a vector of unknown parameters.

X_{jk} = a linear combination of the jth levels of the attribute k.

v_{ij} = a logistic distributed random variable.

The relationship between the observed variable Y_{ij} and the true unobserved utilities, U_{ij} of the latent variable, Y_{ij}^* is expressed as:

$$Y_{ij} = 0 \text{ if } U_{ij} \le \mu_{i1,}$$

$$Y_{ij} = 1 \text{ if } \mu_{i1} < U_{ij} \le \mu_{i2,}$$

$$\vdots$$

$$Y_{ij} = j - 1 \text{ if } U_{ij} > \mu_{ij} - 1 \tag{5}$$

The boundaries of the unobserved utilities, U_{ij} are defined by μ_{ik} cut-off points, which correspond to the observed ranks, Y_{ij}. While estimates are obtained by maximum likelihood, the probabilities of entering the log-likelihood function correspond to the probabilities that the observed ranks, Y_{ij} will fall within the jth ranges defined by $j+1\mu$ values. The signs and magnitude of the estimated coefficients (or part-worths) indicate if changes in the attribute levels will negatively or positively

influence preference (Masozera et al., 2013). CA analysis was carried out using IBM SPSS version 28.

Once the individual utilities had been obtained using both models, we calculated the relative importance scores of each attribute $(Rimp_k)$ based on the difference between the marginal utilities, β_{jk} of the highest and lowest part-worth (Masozera et al., 2013). This is given as:

$$Rimp_k = imp_k \div \Sigma_{k=1}^{k} imp_k \,.\, 100 \tag{6}$$

where

$$imp_k = \left[\max(\beta_{jk}) - \min(\beta_{jk})\right] \tag{7}$$

The larger the $Rimp_k$ score, the more important the attribute is in influencing the overall preference for a particular *j*th alternative choice. To assess heterogeneity in value preference among the population, we performed a *k*-means cluster analysis (Kodinariya & Makwana, 2013). To do this, we first performed a hierarchical cluster analysis using Ward's method because of its ability to create equal size clusters (Schonlau, 2004). The hierarchical cluster analysis provided a good estimate of the number of clusters in our database, which was then used in the k-means cluster analysis. An analysis of differences was conducted to ascertain whether the identified clusters of respondents vary according to their sociodemographic characteristics. Considering the types of variables and their normality distribution, a Kruskal–Wallis test was used to analyse the continuous sociodemographic variables, while chi-squared (X^2) was used to analyse the categorical sociodemographic variables.

To obtain utility for the management strategies identified from the participatory workshops, the part-worths of different levels of value attributes associated with the different strategies were summed for the entire sample population and for the different clusters. The essence of this analysis was to ascertain which of the identified management strategies will yield the highest utility both for individual clusters and for the entire population.

4.3 | Ethics statement

This study conforms to the research code of ethics, and ethics approval was granted by the University of Leeds Research Ethics Committee (Reference Number: AREA 21-002). Prior to data collection, an information sheet was developed and given to all the research participants. The information sheet explained the aim of the study, participant's involvement, risks, and activity, free and informed prior consent, voluntary participation and withdrawal from the study, anonymity and confidentiality, data access and protection. Also, a written consent form was developed, which was signed by all the participants before the commencement of the data collection. Copies of the questionnaires and questions for the different methods are provided within the supporting online information for this study.

5 | PARTICIPATORY WORKSHOPS—RESULTS

5.1 | Sociocultural values of sacred forests

Responses show that cultural values such as religious functions, traditional practices, spiritual protection and masquerade performance are the dominant values currently placed on sacred forests by the key custodians (chief priests and community leaders) and some members of the community. As noted by one of the chief priests 'This forest houses and shelters the community deity, … it is owned by the deity…it is a sacred place where we worship… it is also where we keep and prepare our masquerades for traditional functions'. While the custodians of sacred forests seem content with the cultural values, other workshop participants identified further benefits that can be derived from sacred forests. We grouped these benefits as attributes (Table 2) under different value types using the value orientation framework (Ihemezie et al., 2021). Currently, the studied sacred forests provide no ecotourism value. Still, some participants, especially the youths, indicated ecotourism as one of the values they would like to derive from sacred forests. One of the youths noted 'people visit this forest from different places in search of spiritual solutions to their problems…but I will be happy if this attraction can be converted to ecotourism so that it can provide jobs and income to youths in this community'.

Altogether, seven sociocultural values were identified: (i) cultural values; (ii) social values; (iii) medicinal values; (iv) environmental values (v) ecotourism value; (iv) existence value; and (vii) bequest value. Participants in the second phases harmonised a common description of each of these values. They also ranked and described the current provision level of each of the values. While the cultural value provision of sacred forests was felt to still be high, social, medicinal, environmental, existence and bequest values are currently decreasing due to threats facing the forest, which has its root in the diminishing regard for traditional religion, especially among young people. According to one of the elders: 'many people, especially young people, are abandoning the traditional taboos, customs, and rituals that have preserved this forest for ages because of their Christian faith'. Consequently, encroachment and degradation are occurring in sacred forests from uncontrolled hunting and logging of woods.

Drawing from the outcomes of the participatory workshops, a set of sociocultural attributes was formulated that considered the benefits of sacred forests. This resulted in seven attributes associated with sacred forests (Table 2).

Given that this study aims to improve the values of sacred forests through conservation policy and management, each identified value attribute was assigned two possible levels or options for conservation outcomes. The first level represents the current provision level of sacred forests for each of the identified values. In contrast, the second level represents the expected level of value provision if conservation management strategies are applied to sacred forests. This was anticipated through participatory scenarios. The underlying

TABLE 2 Description of sociocultural value attributes and levels associated with sacred forests. The first level for each of the attributes explains the current level of value provision, while the second level explains the expected level of value provision after management strategies are applied.

Attributes	Attributes description	Levels	Level description
Preservation of cultural heritage (cultural value)	These are values associated with the cultural functions and benefits of sacred forests, such as providing an abode for ancestral deities, providing space for religious practices, offering spiritual protection, supporting traditional practices like masquerade performances, and serving as a symbol of cultural heritage and identity	High provision	Sacred forests are currently highly valued for their cultural functions in the community such as spiritual and traditional religious uses, symbol of cultural heritage, cultural ceremonies
		Decreasing provision	Some cultural functions of sacred forests, such as religious practices, may be disrupted when certain conservation strategies are applied to achieve other values
Enhancement of social cohesion (social value)	This is the value derived from the perception of sacred forests as a source of life and communal protection where community members feel connected to the forest. This connectedness engenders social relationships and communal bonds	Decreasing provision	Decreasing social roles of sacred forests due to opposing values of traditional religion and Christianity
		Improved provision	Improved social roles of sacred forests due to shared values promoted by conservation management
Provision of medicinal plants (medicinal value)	This is the value derived from the provision of medicinal products such as plants and herbs in sacred forests, which contributes to improved health and household income	Decreasing provision	Shortage of medicinal plants due to overexploitation
		Improved provision	Improved provision of medicinal plants due to application conservation management strategies like replanting and sustainable use
Prevention of erosion (environmental value)	Sacred forests trees help control floods that cause soil erosion in surrounding agricultural lands	Decreasing provision	Ongoing deforestation is reducing the flood-control functions of sacred forests
		Improved provision	Enhanced soil erosion control when conservation management is in place to halt deforestation
Promotion of ecotourism (Ecotourism value)	This is the forest value generated when ecotourists pay to visit sacred forests to see the natural beauty, historical trees, and cultural artefacts in sacred forests	Zero provision	The sacred forest currently does not provide ecotourism services due to traditional barriers and a lack of conservation management strategies
		Improved provision	The application of conservation management may kick-start and revive the ecotourism value of sacred forests
Protection of native, rare and endangered species (existence value)	Sacred forest are also a reservoir of rare and indigenous plant and animal species	Decreasing provision	Gradual loss of rare indigenous plants and animals due to uncontrolled hunting and resource exploitation
		Improved provision	Improved preservation of endangered plants and animals due to the application of conservation management strategies
Preservation of forest for future generation (bequest value)	An important non-use value of sacred forests is its preservation for the future	Decreasing provision	The gradual degradation of sacred forests may not allow it to be passed unto future generations
		Improved provision	Availability of a well-preserved sacred forest to future generations

assumption that guided scenario development was that when conservation management strategies are applied to sacred forests, they can improve most of the identified values. However, some current cultural values such as religious uses or cultural ceremonies may reduce as a trade-off to achieve other noncultural values.

The possibility of monetary payment as a way of managing the trade-off to achieve conservation benefits was unanimously ruled out by all the participants in the workshops. They did not support any form of monetary contribution to sacred forests, which they consider their heritage. For instance, one of the participants in the elderly category mentioned that '...We will not pay any money to protect the forest because we inherited it from our ancestors without paying anyone...You cannot use money to protect our deity, ...it is the deity that protects the forest'. While

the participants who practice traditional religion preferred willingness to contribute in labour terms, adherents of the Christian religion opposed it. One of the Christian participants in the middle-aged adult category noted, 'I cannot even enter this forest not to talk of providing labour for it, because it is against my faith'. Meanwhile, there is an already organised system where practitioners of traditional religion contribute labour to maintain the forests during their festival periods which occur three times a year. Consequently, labour was excluded as an attribute in the contingent ranking survey.

5.2 | Designing management strategies for decision-making in the conservation of sacred forests

Participants identified different management strategies based on the major values they would want to derive from sacred forests. Four management strategies associated with the combination of different levels of value provision were identified (Table 3). This was refined and described by participants in the second phase of the workshops as follows:

Management Strategy 1(MS1): No-action management strategy (status quo). This maintains the current level of value provision without deliberate measures to improve the multiple values that can be derived from sacred forests. As shown in Table 3, the current approach supports only a high provision of cultural values with decreasing provision for other values.

Management Strategy 2 (MS2): Traditional medicine management strategy. This management strategy recognises the interconnectedness of traditional practices and herbalism. It seeks to manage sacred forests to ensure the continuous provision of cultural values and improved medicinal value provision. Combining traditional practices (cultural value) and provision of medicinal plants and herbs (medicinal value) was considered appropriate by the participants since those who have the skills and knowledge to identify and harvest medicinal plants and herbs are usually the custodians of traditional religion, such as the chief priests, native doctors and herbalists. This management strategy, therefore, consists of allowing them to continue using sacred forests for their traditional and religious practices and encouraging them to sustainably use and/or replant medicinal plants and herbs. It is expected to preserve the cultural values of the sacred forest and improve the medicinal values. However, the trade-off is that it may reduce the level of provision of other values, such as social, environmental, ecotourism and bequest values.

Management Strategy 3 (MS3): Ecotourism management strategy. This seeks to introduce community-based ecotourism and its associated benefits, such as employment, profit sharing and alternative/supplementary means of livelihoods, as an incentive to protect native, rare and endangered forest species (existence value). This management strategy is expected to change the current status quo of sacred forests from one that provides only cultural value to one that also provides economic value by using tourism to reinforce conservation and vice versa. However, achieving the goal of this strategy may disrupt/reduce the level of provision of other values, for example restricting access to sacred forests for social/cultural activities or to harvest medicinal plants. Environmental and bequest values are also not of key interest to this strategy.

Management Strategy 4 (MS 4): Biodiversity management strategy: This strategy seeks to protect nonuse values of sacred forests by preserving native and endangered flora and fauna (existence value) for future generations (bequest value). In practice, this strategy may control access to sacred forests and restrict the harvesting of plants and animals. However, in the course of achieving the goal of this strategy, environmental values, such as reduced erosion, will also be improved as a cobenefit. This strategy may reduce the provision of other values, linked to cultural, social and ecotourism activities, as well as the harvest of medicinal plants.

TABLE 3 Management strategies (MS) associated with the combination of different levels of value provision in sacred forests. The upward blue arrows depict high/improved value provision, while the downward orange arrows depict zero/decreased value provision.

Attributes	MS1 no management	MS2 traditional medicine	MS3 ecotourism	MS4 biodiversity
Preservation of cultural heritage (Cultural value)	↑	↑	↓	↓
Enhancement of social cohesion (Social value)	↓	↓	↓	↓
Provision of medicinal plants (Medicinal value)	↓	↑	↓	↓
Prevention of erosion (Environmental value)	↓	↓	↓	↑
Promotion of ecotourism (Ecotourism value)	↓	↓	↑	↓
Protection of rare and endangered species (Existence value)	↓	↑	↑	↑
Preservation of forest for future generation (Bequest value)	↓	↓	↓	↑

6 | CONJOINT ANALYSIS—RESULTS

6.1 | Sociodemographic characteristics of the sampled population

The sociodemographic profiles of the respondents (Table S1 in Supporting Information) show that many respondents were male (53%) with a median age of 54 years (interquartile range [IQR] 39 years). The median household size in the area is seven (interquartile range [IQR] 5), with a low median monthly income of ₦50,000 (interquartile range [IQR] ₦58,750; $109 USD). The median distance between households and the closest sacred forest is about 1.45 km (interquartile range [IQR] 3.2 km). The majority of households (63.7%) use fuelwood as a source of household cooking energy, undertake crop farming (53.7%), keep domestic livestock (68.3%) and have a home garden (76.7%). The educational level in the area was low, with only about 29% attending education up to the tertiary level. Although most of the population are adherents of the Christian religion, with only about 36.7% practising traditional religion, many people (77%) have visited sacred forests in the past year, with a median of 20 visits (interquartile range [IQR] 51 visits/person).

6.2 | The relative importance of values influencing conservation preferences

The result of the conjoint analysis provided an estimate of the individual utility for each of the values of sacred forests, and the relative importance of the values influencing conservation preference (Table 4).

The results of both models exhibit a good fit and are similar in the statistical significance of each attribute and the magnitude of coefficients. All the attributes are also significant in both models at a 1% significance level. The regression coefficients are all positive, implying that the identified values are positive indicators of preference for the values of sacred forests.

In both models in Table 5, improved provision of medicinal value was most preferred (1.98; $p < 0.01$), while improved provision

TABLE 4 Results of the OLS and OLOGIT models showing the utility of value attributes of sacred forests and the value types.

Attributes	OLS (Std. Error)	OLOGIT (Std. Error)
Constant	0.85 (0.10)***	—
Preservation of cultural heritage	1.26 (0.07)***	1.07 (0.08)***
Enhancement of social cohesion	0.65 (0.07)***	0.74 (0.07)***
Provision of medicinal plants	1.98 (0.07)***	2.06 (0.08)***
Prevention of erosion	0.81 (0.07) ***	0.82 (0.08)***
Promotion of ecotourism	0.89 (0.07)***	0.98 (0.08)***
Protection of rare and endangered species	0.74 (0.07)***	0.85 (0.07)***
Preservation of forest for future generation	0.97 (0.07)***	1.08 (0.08)***
Log-likelihood		653.65
Adjusted R^2	0.42	
Nagelkerke R^2		0.43
Chi-square (7)		1299.14***

***Significant at 1% level. The estimated cut-off point (μ) of the OLOGIT model satisfies the condition that $\mu1 < \mu2 < \mu3 < \mu4 < \mu5 < \mu6 < \mu7$. This shows that the attribute categories in the OLOGIT are ranked in an ordered manner.

TABLE 5 Mean part-worth and the relative importance (RI) of each attribute of sacred forests and the value types for both OLS and OLOGIT models.

Attributes	Value type	Levels	OLS part-worth	OLS RI (%)	OLOGIT part-worth	OLOGIT RI (%)
Preservation of cultural heritage	Cultural value	High provision	1.26	16.58	1.07	14.07
Enhancement of social cohesion	Social value	Improved provision	0.65	9.22	0.74	9.72
Provision of medicinal plants	Medicinal value	Improved provision	1.98	26.55	2.06	27.08
Prevention of erosion	Environmental value	Improved provision	0.81	11.18	0.82	10.76
Promotion of ecotourism	Ecotourism value	Improved provision	0.89	12.39	0.98	12.89
Protection of rare and endangered species	Existence value	Improved provision	0.74	10.21	0.85	11.23
Preservation of forest for future generation	Bequest value	Improved provision	0.97	13.88	1.08	14.25
Total				100		100

of social value was least preferred (0.65; $p < 0.01$). In between, the order of preference for other values shows the relative importance of cultural, bequest, ecotourism, environmental and existence values, respectively.

6.3 | Assessment of heterogeneity in value preference

All seven attributes were significant in determining cluster grouping. Considering that results from OLS and OLOGIT models were similar (Tables 4 and 5), we therefore only present the OLS results for clarity (Table 6).

Nine of the 13 sociodemographic parameters were significant at 5% level, namely gender, age, education, use of fuelwood, household income, religion, distance from household to sacred forest, visit to sacred forests and the number of visits to sacred forests.

Cluster 1 gave the highest relative importance to the bequest value of sacred forests. We, therefore, designated it as a 'Pro-bequest value group'. This cluster made up 19% of the study sample. The group-dependent differences in Table S1 show that this cluster of respondents had a high proportion of older people (median 70 years), and the second-highest proportion of females (47.40%). They also had the second-highest household monthly income (median ₦125,000.09 [$ 271.73 USD]). They are the second least educated cluster, with only 15.80% attending tertiary education. They had the highest percentage (86%) of respondents who use fuelwood as a source of household cooking energy. All respondents that fall under this cluster have visited sacred forests in the past year. They live closest to sacred forests (median 1.00 km) and visit the second highest number of times in a year (median 50).

Cluster 2 gave the highest relative importance to the ecotourism potentials of sacred forests. We therefore designated it as a 'Pro-ecotourism value group' and it made up 13% of the study sample. This cluster differs from the rest in having the highest population of young people (median 27 years). Relative to other clusters, they are the most educated cluster, with 71.80% attending tertiary education. However, they had a low household monthly income (median ₦30,000.00 [$65.22 USD]). No respondents in this cluster practice traditional religion. They live farthest from sacred forests (median 6.00 km) and visit the fewest number of times a year (median 0.00).

Cluster 3 gave the highest relative importance to the role of sacred forest trees in controlling erosion, especially around surrounding agricultural lands. We therefore designated it as a 'Pro-environmental value group'. This cluster, however, had the lowest proportion of respondents (9.7%) in our study sample. They are the second most educated, with 69% attending tertiary education. This cluster had the lowest number of respondents who use fuelwood as a source of household cooking energy. They had the highest household monthly income (median ₦220,000.00 [$478.24 USD]). Similar to cluster 2, no respondents here practise traditional religion. They live second farthest from sacred forests (median 2.00 km) and visit it the second-fewest number of times a year (median 1.00).

Cluster 4 gave the highest relative importance to the cultural value of sacred forests. We, therefore, designated it as a 'Pro-cultural value group'. The cluster had the second-highest proportion of respondents (21.0%) and the third-highest proportion of females (41%). Similar to cluster 1, this cluster had a high population of older people (median 70 years). However, they are the least educated cluster, with only 12.70% attending tertiary education. As expected, they had the highest percentage of respondents (58.70%) who practice traditional religion. All cluster members had visited sacred forests in the past year (median 100 visits). They live second closest to sacred forests (median 1.00 km).

Cluster 5 gave the highest relative importance to the medicinal value of sacred forests. We therefore, designated it as a 'Pro-medicinal value group'. The cluster had the highest proportion of respondents (37.3%) and the highest percentage of females (60.70%). It also had the second-highest population of young people (median 33 years), and the second-highest proportion of those who use fuelwood as a source of household cooking energy (83.90%). Similar to cluster 2, they had a low household monthly income (₦30,000.00 [$65.22 USD]) and second-highest percentage of those who practice traditional religion (53.60%). The majority (78.60%) of them had visited sacred forests in the past year.

6.4 | Estimating the utility of management strategies

Table 7 shows that the general population derived the highest utility by implementing a traditional medicine management strategy (MS2) followed by a biodiversity management strategy (MS4). Respondents in cluster 5 followed the same order of utility as the general population. However, for respondents in clusters 1 and 3, implementing the biodiversity management strategy generated the highest utility, followed by the traditional medicine management strategy. Implementing an ecotourism strategy provided the highest utility to respondents in cluster 2, followed by a traditional medicine management strategy. As expected, leaving the current status quo by implementing a no-action management strategy generated the least utility values for the entire population and all individual clusters, except those in cluster 4 who derived their second highest utility from implementing the status quo (MS1).

7 | DISCUSSION

We used a combination of two methods (participatory workshops and conjoint analysis) to inform improved management of sacred forests by integrating biocultural conservation approach and socio-cultural valuation. Participatory workshops identified seven critical values of sacred forests, which included cultural, social, medicinal, environmental, ecotourism, existence and bequest values. This emphasised that sacred forest is valued in multiple ways beyond the singular reliance on the traditional belief system. Given the

TABLE 6 Mean part-worth and relative importance (RI) of different attributes for each cluster of respondents. The sociodemographic characteristics of people in each cluster are provided in Table S1 in Supporting Information.

		Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
Attributes	**Levels**	**Part-worth**	**RI (%)**	**Part-worth**	**RI (%)**	**Part-worth**	**RI (%)**	**Part-worth**	**RI (%)**	**Part-worth**	**RI (%)**
Constant		0.65		0.99		0.966		0.93		0.821	
Preservation of cultural heritage (Cultural value)	High provision	1.11	12.97	0.19	2.66	0.48	5.92	3.83	52.30	0.46	5.92
Enhancement of social cohesion (Social value)	Improved provision	1.34	16.73	0.35	6.62	0.66	8.68	0.71	10.03	0.36	5.98
Provision of medicinal plants (Medicinal value)	Improved provision	0.89	10.55	0.81	11.45	0.62	9.13	1.08	15.12	3.80	50.89
Prevention of erosion (Environmental value)	Improved provision	0.36	4.47	0.64	8.87	2.93	43.28	0.19	2.95	0.88	11.73
Promotion of ecotourism (Ecotourism value)	Improved provision	0.26	5.09	3.65	48.94	0.72	9.02	0.29	4.96	0.65	8.42
Protection of rare and endangered species (Existence value)	Improved provision	0.97	13.51	1.13	16.10	1.45	18.71	0.18	3.13	0.63	8.27
Preservation of forest for future generation (Bequest value)	Improved provision	2.77	36.69	0.26	5.36	0.21	5.27	0.87	11.50	0.56	8.80
N (%)		57 (19.0%)		39 (13.0%)		29 (9.7%)		63 (21.0%)		112 (37.3)	

TABLE 7 Utility levels of different management strategies for the different cluster groupings and overall sample.

Management strategies	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Overall sample
Management Strategy 1	1.11	0.19	0.48	3.83	0.46	1.26
Management Strategy 2	2.97	2.13	2.55	5.09	4.88	3.98
Management Strategy 3	1.237	4.77	2.17	0.47	1.28	1.64
Management Strategy 4	4.11	2.03	4.59	1.24	2.24	2.52

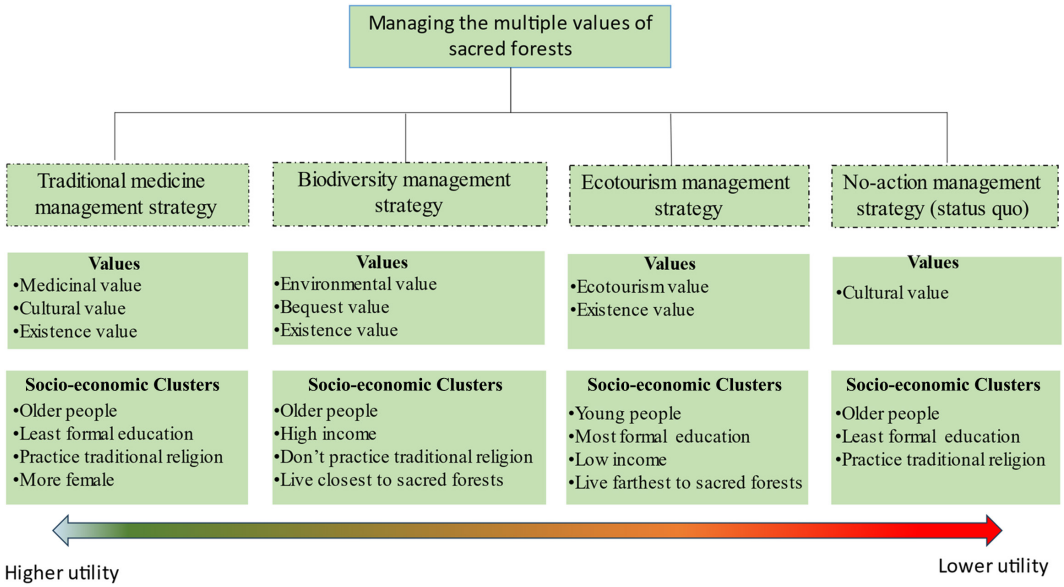

FIGURE 3 Managing the multiple values of sacred forests using different management strategies. The colour degradation shows the transition from higher to lower utilities for the different management strategies.

propensity for changes in human beliefs, which threaten the conservation of sacred forests (Sinambela et al., 2021), identification of multiple nonreligious values provides a basis to galvanise shared and collective responsibility towards sacred forest management and conservation. A combination of different management strategies is needed to harness and sustain these values in order to yield high utility to different socioeconomic clusters of the public (Figure 3). Our findings call for a plural approach to the conservation of sacred forests, one that recognises and incorporates a diversity of values as a way of understanding how people use and relate to nature (Pascual et al., 2017). This approach advances conservation understanding by going beyond the instrumental-intrinsic value dichotomy that characterises value discourse in conservation, to capture how relational values mediate the values that people place on nature. It, therefore, challenges conservation practices globally to expand the scope of values considered in conservation projects.

We estimated the individual utility of sacred forest values and sought to determine the relative importance of values that can influence conservation preferences. Our conjoint analysis result reveals that an increase in provision of the seven identified sacred forest values will increase the probability of local people preferring the conservation of sacred forests, albeit with varying levels of the utility of each of the values. Among the seven identified values, the highest utility was associated with improved provision of medicinal value followed by high provision of cultural value. While this confirms the findings of previous studies that sacred forest is a symbol of cultural heritage (Sharma & Kumar, 2021) and a reservoir of medicinal plants (Chanda & Ramachandra, 2019), it provides additional knowledge in terms of the scale and relative importance of these values, and the dominant value perceptions. Unlike previous studies that project cultural value as the primary value of sacred forest (Ormsby & Bhagwat, 2010; Undaharta & Wee, 2020), our study suggests a possible shift in the dominant way people now conceive, perceive and relate with sacred forest, from nonmaterial cultural value to material medicinal value. Two factors may be responsible for this shift. First, the polarity of religious faiths and views towards sacred forests and diminishing regard for culture, especially among young people (Mavhura & Mushure, 2019; Negi et al., 2018), may be influencing people to look beyond the polarised cultural value to a common shared value that will contribute to improving quality of life. Second, many households in developing countries rely on natural resources such as forests for their livelihoods (Nerfa et al., 2020). While the cultural contribution of sacred forests is still valued, material contributions such as medicinal value play a more direct role in livelihoods and hence more value is placed on it.

It is also important to note that while our result provided a good insight into the relative importance of values that can influence sacred forest conservation preferences, it does not really allow us to distinguish between true differences in value from perceived differences in the magnitude of change. This is because our attribute

level descriptions did not account for differences in the magnitude of change for each value attribute. Therefore, it may be possible that the respondents' ranking of medicinal value as very important could be because they perceived a decline in the provision of this value as a very high magnitude decline that could lead to complete disappearance of medicinal plants. As such they ranked it high in order to preserve it. Conversely, relative to medicinal value, their lower ranking of nonmaterial value like cultural value could be because of their perception that the magnitude of decline of this value will not have significant impact considering that they have remained stable over time. This, therefore, implies that the lowly ranked values may not mean that those values are not important to the people but that their magnitude of change may be small compared to the highly ranked values. Despite this methodological limitation, by ranking the utilities that can be derived from sacred forests, we show how sociocultural valuation can support biocultural conservation by highlighting the most important values that should be prioritised, which can increase the conservation of sacred landscapes.

Second, we wanted to assess heterogeneity in value preference among the population. One of the principles of biocultural conservation is recognising that conservation values differ among diverse stakeholders (Gavin et al., 2015). *K*-means cluster analysis and analysis of variance showed that sacred forests are valued differently among different clusters of people with distinct sociodemographic profiles. For example, females are more likely to have a high preference for medicinal values than males. This is unsurprising considering the prevalent use of medicinal plant products among women in rural African communities to treat various household ailments and manage pregnancy and childbirth (Ahmed et al., 2018; De Wet et al., 2013). Heterogeneity analysis further showed that high-income households have a higher preference for environmental value while low-income households have a higher preference for ecotourism value. Similarly, those who live closest to sacred forests are more likely to have a higher preference for bequest value than those who live farthest who have a higher preference for ecotourism value. Although the three studied sacred forest sites do not currently provide any ecotourism value, our analysis suggests that ecotourism value could provide high utility to the local people. According to Brandt and Buckley (2018), ecotourism accompanied by conservation mechanisms has the potential to contribute significantly to nature conservation. Previous studies have already established the fact that conservation strategies with apparent economic and social benefits will increase local people's support for conservation (Nilsson et al., 2016). An ecotourism approach to conservation is associated with several socio-economic benefits that can serve as an incentive to protect the forest (Kibria et al., 2021). It is, therefore, not surprising that this value is more common among low-income households who need livelihood support.

Sacred forests provide a unique opportunity and a natural environment for ecotourism activities. However, although ecotourism comes with benefits, such as providing sustainable income to local communities and generating income for protecting nature (Amoamo et al., 2018), it also poses some risks to the natural environment, and particularly to sacred forests. According to Blumstein et al. (2017) and Geffroy et al. (2015), the constant presence of humans in nature through nature-based tourism activities can make animals vulnerable by altering their behaviours and how they respond to predators and poachers. Similarly, ecotourism development is often accompanied by the construction of new infrastructure to accommodate more tourists. This can put pressure on nature and local resources and induce erosion, damaging soil and plant qualities (Motlagh et al., 2020). Besides these negative ecological implications, ecotourism may also have long-term negative social implications. For instance, ecotourism development has been reported to displace local indigenous communities from their native lands, thereby preventing them from benefiting economically (Büscher & Davidov, 2016). Furthermore, introducing ecotourism in sacred forests may even disrupt the cultural values of the forests. For example, some religious rituals performed in sacred forests may be lost due to modernisation brought about by ecotourism (Zhang & Lee, 2021). One factor that has preserved sacred forests is the sanctity attributed to them, which controls or restricts human access to them. Introducing ecotourism may abate the sanctity of sacred forests and deflate their cultural values to a mere performance for public entertainment. These negative implications may override the positive benefits of introducing ecotourism in sacred forests if deliberate efforts are not made to protect and preserve cultural values, indigenous rights to lands and forests, as well as reduce ecological impacts.

Analysis of variance in value preferences further showed that ecotourism value is more common among young people who completed a higher level of formal education, and who do not practice traditional religion and visit sacred forests less frequently. Conversely, older and less educated people who practice traditional religion and visit sacred forests more frequently have a higher preference for cultural value and are unlikely to have a high preference for ecotourism value, seeing that ecotourism may impact the sanctity of sacred forests. This aligns with the findings of Djagoun et al. (2022) that age and educational background have a significant influence on how sacred forests are valued. However, despite the fact that the younger people are more educated, this did not automatically influence their preference for other multiple values of sacred forests beyond ecotourism. One way to motivate young educated people to look beyond the income that comes from ecotourism would be to promote the knowledge of other multiple values of sacred forests such as erosion control, medicinal plants, and biodiversity. This can be done by incorporating environmental education in the curriculum of formal education and through environmental awareness campaigns. Altogether, our results demonstrate the extent to which socio-demographic features can influence heterogeneity in value preference. Assessing heterogeneity in value preference can improve the effectiveness of management strategies by identifying different target groups with distinct value interests. This can also help inform more equitable resource allocation when designing management strategies in a heterogeneous society.

Our last objective sought to design management options to improve the conservation of sacred forests. Analysis of participatory workshop data identified four management strategies based on the values people want to derive from sacred forests. These are the no-action management strategy, traditional medicine management strategy, ecotourism management strategy and biodiversity management strategy. By determining the utility of the individual values associated with each of these, we showed that the current status quo (no-action management strategy) would provide the least utility to the entire population and to all individual cluster groups of the population. This confirms that the current approach to the conservation of sacred forests that relies primarily on cultural values is inadequate. A traditional medicine management strategy and biodiversity management strategy were shown to provide the highest utility to the entire population, respectively. A traditional medicine management strategy recognises the relatedness of cultural and medicinal values and seeks to promote the prioritisation of these two values in the management of biocultural conservation. This strategy can help to address one of the underlying threats to the conservation of sacred forests arising from the erosion of traditional customs and diminishing regard for culture, by reaffirming traditional conservation practices (Undaharta & Wee, 2020), alongside the provision of material values such as medicinal value. In general, implementing a combination of the different identified strategies can capture the interest of multiple stakeholders, especially considering the heterogeneity in value preference among the public. This can attract support for the conservation of sacred forests from diverse stakeholders, including those uninterested in the traditional religion often associated with sacred forests, due to change in religious beliefs.

At the individual cluster level, it was found that implementing an ecotourism strategy will provide the highest utility to people in cluster 2, made up of young, educated people with low income. This may be important in the survival of sacred forests. According to Orlowska and Klepeis (2018), most sacred forests globally are managed by old members of local communities, which poses a threat to their sustainability. There is a decline in the generational transfer of traditional knowledge of sacred forests due to the dwindling interest of young people (Negi et al., 2018). To attract the interest of younger people, more nonreligious management strategies, such as ecotourism, need to be pursued in combination with other approaches that will preserve the cultural value of sacred forests. Overall, we show that different management strategies are needed for the effective biocultural conservation of sacred forests.

Although management strategies for sacred forest conservation have been discussed in the literature (Undaharta & Wee, 2020; Verschuuren, 2016), this is the first empirical study that simulated utility value-based management strategies for sacred forest conservation for an entire population and different groups of a population. Future research could expand the scope of the study by carrying out other types of sociocultural assessments in places with different socio-ecological contexts, comparing results to see how socio-ecological structures interact to influence value preferences for conserving sacred forests. This could help to establish a framework for the biocultural conservation of sacred forests that is widely accepted by society, with the present study being a point of reference for extending knowledge to other parts of the world.

Lastly, when designing our study, we sought to ascertain the appropriate payment vehicle to achieve sacred forest conservation, during the participatory workshops. We found that the possibility of monetary payment as a way of managing the trade-off to achieve conservation benefits was unanimously ruled out. Including monetary attributes was seen as an attempt to monetise cultural heritage and traditional belief systems, which was perceived disrespectful to culture. This implies that using monetary attributes in valuing sacred landscapes may have ethical implications that can impact the reliability of results from such studies. Although conservation outcomes are usually context-specific and shaped by local socio-ecological realities (Gavin et al., 2018), our study flags the ethical concerns of using a monetary attribute in the valuation of sacred landscapes.

8 | CONCLUSION

The current approach to the management of sacred forests using cultural beliefs and traditional customs is neither effective nor sustainable due to cultural changes and economic developments. This is recognised by one of the principles of biocultural conservation which emphasises the dynamic nature of culture, shaping how resources are used and conserved (Gavin et al., 2015). This implies that it is unsustainable and inadequate to keep relying on a single value system to support forest conservation. Conservation actions need to consider diverse values that can influence public support and preferences for protecting sacred forests. Here, we advanced knowledge in sacred forest conservation with our novel results, which showed that sacred forests enshrine both material and nonmaterial values of nature. We showed what values should be prioritised in sacred forest conservation and call for a plural approach in the conservation of sacred forests. Integrating biocultural conservation and sociocultural valuation can help to achieve a plural approach to conservation. The application of biocultural conservation and sociocultural valuation to enhance sacred forest conservation in this study, therefore, represents a fundamental shift in the way sacred landscapes are perceived and understood.

AUTHOR CONTRIBUTIONS

Eberechukwu Johnpaul Ihemezie conceptualised and designed the study, collected and analysed the data, and wrote the original and submitted draft of the manuscript. José A. Albaladejo-García contributed to data analysis, reviewing and editing, and responding to reviewers' comments. Lindsay C. Stringer and Martin Dallimer contributed to conceptualising and refining the design of the study, reviewing and editing, and made substantial comments to the drafts and revised manuscripts. All authors contributed critically to the drafts and gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. We also note that Martin Dallimer is an Associate Editor for People and Nature, but was not involved in the peer review and decision-making process.

DATA AVAILABILITY STATEMENT

Although study data are coded to ensure anonymity, the ethics approval associated with the project does not permit public sharing due to participants' consent agreement. Where feasible, derived summary data can be provided on request from the corresponding author.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Table S1. Sociodemographic parameters of the total sample population and that of the identified five clusters.

Table S2. Profile of participatory workshop participants.

Section S1. Description of socio-demographic variables.

Section S2. Household questionnaire.

Section S3. Participatory workshop question guide.

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