Understanding the multiple values people hold for forest conservation

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Submitted in accordance with the requirements for the degree of Doctor of Philosophy

The University of Leeds

Sustainability Research Institute

School of Earth and Environment

April 2023

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PhD in Alternative Format

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Three journal papers were written as part of this thesis and are presented as the following joint-authored publications:

Chapter 2: **Ihemezie, E.J.,** Nawrath, M., Strauß, L., Stringer, L.C. and Dallimer, M (2021). The influence of human values on attitudes and behaviours towards forest conservation. *Journal of Environmental Management*, 292. https://doi.org/10.1016/j.jenvman.2021.112857

Chapter 3: **Ihemezie, E.J.,** Stringer, L.C. and Dallimer, M (2022). Understanding the diversity of values underpinning forest conservation. *Biological Conservation*, 274. https://doi.org/10.1016/j.biocon.2022.109734

Chapter 4: **Ihemezie, E.J**., Albaladejo-García, A.A., Stringer, L.C. and Dallimer, M (Accepted with minor revisions which have been addressed). Integrating biocultural conservation and sociocultural valuation in the management of sacred forests: what values are important to the public? *People and Nature*

Contributions to those papers were as follows: I conceived the research design, collected the data, analysed the results, and wrote the manuscripts. M. Dallimer and L.C. Stringer provided feedback and advice on the research design, contributed to the writing of the manuscripts, and gave final approval for publication. M. Nawrath and L. Strauß supported data analysis for Chapter 2., while A.A. Albaladejo-García supported data analysis for Chapter 4. All commented on manuscript drafts and gave final approval.

Rationale for publication by alternative format

This thesis looks at three distinct aspects of human value integration in forest conservation to understand the multiple values people hold for forest conservation in both government and community-protected forests. Every analysis involved different research methods and data collection, each with an independent grounding within the literature. The three result chapters are the three papers listed on the previous page. The multi-perspective approach with different sets of methods has been achieved more efficiently with three distinct academic publications than as a traditional monograph.

Acknowledgement

An empirical research work of this magnitude would not have been successful without the input, support, encouragement and immeasurable contributions of a number of people. Foremost, I am sincerely grateful to my two supervisors- Prof. Martin Dallimer and Prof. Lindsay Stringer. Your professional guidance and inspiration provided the sense of direction I needed to successfully complete this thesis. I enjoyed every bit of the time I worked with you two, and I look forward to future collaborations. I could not have asked for more supportive and understanding supervisors. Martin, thank you for believing in me right from my master's programme days in 2015-2016 as my personal tutor, programme leader, and dissertation supervisor. You have had a huge impact on my life and career. Your encouraging words contributed massively to building my confidence that I can succeed in academia. Lindsay, thank you for your organisation and speedy feedback, for the opportunities you have shared with me, and for your support throughout the challenging periods of Covid-19. You both have supported and inspired me to reach higher than I ever thought I could go.

My indebtedness goes to the UK Commonwealth Scholarship Commission for funding this PhD between September 2019 and September 2022 and also for offering me an exceptional full funding extension till March 2023 due to Covid-19 interruption. This PhD thesis is dedicated to them. In the same vein, I also wish to extend my heartfelt gratitude to the leadership of the Sustainability Research Institute, University of Leeds, for providing me with funding support to attend conferences, workshops, and summer schools, all of which have contributed immensely to building my skills and expertise, preparing me for an exciting career in academics. I am grateful to the Environment and Development Research Group for providing me with the platform to share my research, receive valuable feedback, and develop broad research networks.

I would also like to thank everyone who supported me during my fieldwork in Nigeria: Messrs. Chijioke Ngobili and Chinemelu Ndichie from the University of Nigeria, Nsukka, and members of staff from Enugu State Forestry Commission for supporting me with fieldwork administration. Many thanks to Chikezie Ugwuokpe, Rabbiu Ugbedeojo, Odinaka Okwesili, Chinweokwu Ukwueze, Chidozie Eze, and David Okoronkwo, for their support in facilitating participatory workshops, interviews and household surveys.

I would also like to appreciate the edifying concerns and contributions of my senior friends and colleagues whose pecuniary support aided the success of this research: Dr Maximilian Nawrath, Dr José Albaladejo-García, Dr Samuel Eze, Dr Okumah Murat, and Zubaida Umar. In a special way, I want to thank Dr Elias Nkiaka for calling me almost every week to check on the progress of my PhD research. Your brotherly advice and inspiration are well appreciated. Special appreciation also to my colleague and friend Lena Strauß whom I started this PhD journey under the same supervision of Prof. Martin. Our occasional discussions and laughs were very supportive and helpful to my mental health. To all the members of Lindsay's PhD and Post-doc Research Group both in Leeds and York, thank you for the moments and interactions we shared together, the platform to share research progress and challenges, and the career job opportunities provided. They are an integral part of the beautiful memories I experienced and am taking away from this PhD journey.

Last but not least, I am very grateful to my dear wife and daughter, Joy and Adanna, for your unconditional love and amazing support. Joy, for offering me emotional support, for waking me up at night to study, and for your understanding and patience all the while I left you alone due to the demands of this PhD. You are the best partner anyone could ask for. Together, we would continue to support and inspire each other to achieve our potential. To Adanna, you provided those necessary moments of distractions during data analysis and paper writing. Your smiles brighten my day, and your presence in our life is enough motivation to continue working hard. Thank you all for going through this journey with me and for many others to come.

Abstract

People value forests in multiple ways depending on factors such as indigenous knowledge systems, traditional culture, economic conditions, and environmental contexts. Forest conservation also pursues multiple objectives, such as biodiversity conservation, the maintenance of well-functioning ecosystems, economic benefits, preservation for cultural, heritage and aesthetic reasons and providing opportunities for recreation or tourism. Balancing these multiple objectives can be challenging, particularly given the diverse values, viewpoints, and behaviours towards forest conservation that people hold. To achieve multiple objectives, conservation policies need to identify diverse values and recognise how values differ between and within stakeholders. By doing so, conservation policy and practice are more likely to be successful. This thesis employed an interdisciplinary mixed-methods approach to further our understanding of the multiple values people hold for forest conservation, with a focus on Nigeria, a country with one of the highest rates of deforestation globally and where forests play a critical role in sustaining livelihoods.

Based on a scoping review of existing literature, three broad human value orientations (anthropocentric, relational, and biocentric) were identified. These orientations could positively or negatively influence forest conservation attitudes and behaviours, depending on the perception or motivational goal/concern driving the value holder. Two key research gaps emerged from this review. First, there is a need to identify those specific values underpinning forest conservation that can motivate and empower people to support and participate in forest conservation projects. Secondly, there is a need to identify multiple human values and understand if and how these values are prioritised amongst diverse stakeholders, especially in locations where indigenous knowledge systems and traditional cultures play a role in how forests are managed and protected.

To address the first research gap, Q-methodology was used to examine the viewpoints of different stakeholders regarding the values underpinning forest conservation policies and programs in Nigeria. The findings revealed a consensus preference for values that have economic, cultural or environmental relevance. There were, however, broad differences between stakeholders regarding their values and viewpoints, which highlights the need for conservation practitioners and policymakers

to differentiate value types that target the specific needs of stakeholders in addition to focussing on consensus values.

To address the second research gap, a participatory workshop method and conjoint analysis valuation were used to identify multiple sociocultural values and elicit local people's value priorities for conserving sacred forests. The findings showed that instrumental values, such as medicinal value, are particularly important and should play a prominent role in designing forest conservation management strategies for local people. This result indicates a possible shift in the dominant way people now conceive, perceive, and relate to sacred forests from non-material cultural value to material values, such as medicinal value.

By taking a mixed-methods approach, this thesis advances our understanding of which values should be prioritised in forest conservation. Specifically, it shows that in developing countries like Nigeria, where there is a high dependence on forest resources, instrumental values like economic, medicinal, and environmental values, and relational values like cultural value, play a vital role in promoting forest conservation. These multiple values can be integrated into decision-making to capture the interests of diverse stakeholders in order to improve forest management and enhance the effectiveness of conservation projects. Overall, this study underscores the need to embed plural values in conservation policies, where natural resources including forests are valued not just for their biocentric and utilitarian functions but also for their relational importance.

Table of Contents

Copyright……i

PhD in Alternative Format……ii

Rationale for publication by alternative format……...iii

Acknowledgement……...iv

Abstract……vi

Table of Contents……viii

List of Tables……xiv

List of Figures……xvi

Chapter 1: Introduction 1

1.1 Background..... 1

1.2 Conceptualising key thematic subjects.....3

1.2.1 Human values..... 3

1.2.2 Realms of human values.....4

1.2.3 Conceptual frameworks for understanding multiple values of nature and value orientations..... 5

1.2.4 Forest conservation approaches.....10

1.2.5 Integrating human values in forest conservation.....12

1.2.6 Forest conservation and human values in sub-Saharan Africa and Nigeria 14

1.3 Research aims and objectives.....16

1.4 Research philosophy: Positioning of the PhD research..... 17

1.5 Thesis structure 19

1.6 Methodological approaches.....20

1.7 Practicalities and ethical concerns..... 21

1.8 Thesis contribution..... 22

1.9 References..... 23

Chapter 2: The Influence of Human Values on Attitudes and Behaviours towards Forest Conservation..... 38

2.1 Abstract..... 38

2.2 Keywords..... 39

2.3 Highlights..... 39

2.4 Introduction..... 39

2.5 Methodology..... 42

2.5.1 Inclusion and Exclusion Criteria..... 43

2.5.2 Data Screening and Extraction..... 44

2.5.3 Quality Assessment..... 44

2.5.4 Data Analysis..... 46

2.6 Results..... 47

2.6.1 Study methodology..... 48

2.6.2 Human value orientations influencing forest conservation attitudes and behaviour..... 49

2.6.3 Anthropocentric value orientation..... 57

2.6.4 Relational value orientation..... 57

2.6.5 Biocentric value orientation..... 58

2.6.6 Influence of human values on forest conservation attitudes and behaviours 58

2.6.7 Geographic characteristics of forest conservation and human value evidence in SSA..... 60

2.7 Discussion..... 62

2.7.1 Anthropocentric value orientation..... 62

2.7.2 Relational value orientation..... 63

2.7.3 Biocentric value orientation..... 65
2.7.4 Geographic characteristics of forest conservation and human value evidence in SSA..... 66
2.8 Conclusion..... 67
2.9 Authorship contribution statement..... 68
2.10 Acknowledgements..... 68
2.11 Declaration of competing interest..... 69
2.12 References..... 69
Chapter 3: Understanding the diversity of values underpinning forest conservation.....79
3.1 Abstract..... 79
3.2 Keywords..... 80
3.3 Introduction..... 80
3.4 Methodology..... 82
3.4.1 Study area..... 82
3.4.2 Methods..... 84
3.4.3 Statement creation..... 85
3.4.4 Stakeholder identification..... 86
3.4.5 Data collection..... 88
3.4.6 Q Analyses..... 89
3.5 Results..... 90
3.5.1 Factor 1: Environmental and management values..... 93
3.5.2 Factor 2: Cultural values..... 95
3.5.3 Factor 3: Economic values..... 96
3.5.4 Consensus statements..... 97
3.6 Discussion..... 98
3.7 Conclusion..... 103
3.8 Authorship contribution statement..... 103

3.9 Acknowledgements..... 103
3.10 Data availability..... 104
3.11 Article impact statement..... 104
3.12 Declaration of competing interest..... 104
3.13 References..... 104
Chapter 4: Integrating biocultural conservation and sociocultural valuation in the management of sacred forests: what values are important to the public? 113
4.1 Abstract..... 113
4.2 Keywords..... 114
4.3 Introduction..... 114
4.4 Methodology..... 117
4.4.1 Study area..... 117
4.4.2 Methodological approach..... 119
4.5 Participatory workshops - methods..... 121
4.6 Conjoint analysis -Methods..... 123
4.6.1 Survey design and data collection..... 123
4.6.2 Valuation approach and model estimation..... 127
4.7 Participatory workshops - Results..... .. 130
4.7.1 Sociocultural values of sacred forests..... 130
4.7.2 Designing management strategies for decision-making in the conservation of sacred forests ……134
4.8 Conjoint analysis - Results..... 136
4.8.1 Socio-demographic characteristics of the sampled population..... 136
4.8.2 The relative importance of values influencing conservation preferences 136
4.8.3 Assessment of heterogeneity in value preference..... 138
4.8.4 Estimating the utility of management strategies..... 141
4.9 Discussion..... 142

4.10 Conclusion.....148
4.11 Authorship contribution statement.....148
4.12 Acknowledgements.....148
4.13 Statement on research ethics.....148
4.14 Data Accessibility Statement.....149
4.15 Conflict of interest.....149
4.16 Reference.....149
Chapter 5: Synthesis and Conclusion.....159
5.1 Introduction.....159
5.2 Contributions to research into human-conservation relationships.....160
5.2.1 Values are shaped by contextual environmental challenges and experiences.....165
5.2.2 Values are influenced by economic and social needs.....165
5.2.3 Fewer presence of biocentric values.....166
5.2.4 Values differ amongst group members of a society.....166
5.2.5 Socio-economic characteristics play a key role in the value people hold 167
5.3 Directions for future research.....168
5.4 Implications for policies and practice.....171
5.5 Conclusions.....178
5.6 References.....179
Appendix A1: Ethics Clearance for Chapters 3 and 4……..187
Appendix A2: Information sheets for Chapters 3 and 4……188
Appendix A2.1: Project information sheet using Q methodology……188
Appendix A2.2: Project information sheet using Participatory Workshop Methods……191

List of Tables

Table 2.1: Value types and value orientations.....49

Table 2.2: Motivational goals/concerns and values from quantitative studies.....51

Table 2.3: Motivational goals/concerns and values from qualitative studies.....54

Table 3.1: Classification and selection of participants ……86

Table 3.2: Participant loading for each rotated factor matrix.....90

Table 3.3: The 45 statements sorted by the participants.....91

Table 4.1: Orthogonal design of contingent ranking cards ……..126

Table 4.2: Description of sociocultural value attributes and levels.....131

Table 4.3: Management strategies (MS) for sacred forests 135

Table 4.4: Results of the OLS and OLOGIT models.....137

Table 4.5: The Mean part-worth and the relative importance (RI) of each attribute of sacred forests and the value types for both OLS and OLOGIT models.....137

Table 4.6: The mean part-worth and relative importance (RI) of different attributes for each cluster of respondents.....138

Table 4.7: Utility levels of different management strategies for the different cluster groupings and overall sample.....141

Table 5.1: Summary of research objectives, the key findings and implications for conservation policies and practice……161

Table B.1: Conceptual definition of key terms used in the study……200

Table B.2: Key concepts, logic grid, and search strings.....202

Table B.3: Summary of data extracted from quantitative studies included.....205

Table B.4: Summary of data extracted from qualitative studies.....213

Table B.5: Criteria for judging the risk of bias for quantitative studies using environmental-risk of bias tool..... 221

Table B.6: Criteria for grading the quality of quantitative studies..... 222

Table B.7: Criteria for quality assessment of qualitative studies..... 223

Table B.8: Outcome of environmental-risk of bias assessment for quantitative studies 224

Table B.9: Outcome of quality assessment of quantitative studies using environmental -grade assessment tool.....225

Table B.10: Outcome of quality assessment of qualitative studies using the Critical Appraisal Skills Programme (CASP) tool.....227

Table C.1: Value statements for Q-sorts using value orientation framework…….232

Table C.2: Consensus Statements -- Those That Do Not Distinguish Between ANY Pair of Factors.....245

Table C.3: Participants' demographic information and stakeholder category.....246

Table D.1: Socio-demographic parameters of the total sample population and that of the identified five clusters……..250

Table D.2. General perception of the values of the sacred forest..... 251

Table D.3: Contingent ranking of Value Preferences for Sacred Forest Conservation 252

Table D.4: Profile of participatory workshop participants.....256

List of Figures

Figure 1.1: Framework for understanding the multiple human values of nature 8

Figure 1.2: A visual representation of the cognitive hierarchy model of human behaviour. 13

Figure 2.1: PRISMA flow chart for reporting systematicreview ……..48

Figure 2.2: Map of Africa showing 19 countries in the sub-Saharan region where the selected studies for the review were carried out.....61

Figure 3.1: The location of Nigeria in Africa and the location of Enugu state and the study conservation sites……..…….83

Figure 4.1: The location of Enugu state in Nigeria, and the map of Enugu state showing the four forest zones and studied sacred forest sites……..……..119

Figure 4.2: Pictorial representation of the ranking cards presented to respondents showing different levels of value provision..... 125

Figure 5.1: Integration of human values in conservation policy and practice at different scales…….173

Figure C.1: Q-Sort Distribution Grid…….244

Chapter 1: Introduction

1.1 Background

Humans have a long shared history with forests and the benefits they provide. For centuries, forests have been a major asset many people depend on for their livelihoods (Iponga et al., 2018). Most rural populations directly or indirectly depend on forest resources for food, fuelwood, herbs, and fodder (Chirwa et al., 2017; Nguyen et al., 2018). Over 1.6 billion rural people are estimated to depend on forests for their livelihoods (Newton et al., 2020). Forests are also sources of national income through timber businesses, ecotourism and the establishment of game reserves, game sanctuaries, and national parks (Busch and Mukherjee, 2018; Fasona et al., 2019). However, the benefits of forests extend beyond the utilitarian. Forests have been described as a home of indigenous people, inspiring human traditions, knowledge and culture, and serving as a symbol of heritage identity, places of spirituality and inspiring aesthetic appreciation (Cooper et al., 2016; Motiejūnaitė et al., 2019). These benefits strengthen social interdependencies (Barnaud et al., 2018) and support socioecological systems where humans are integral parts of the natural environment (Chazdon et al., 2016). Sustainable Development Goal 15 recognises the vital role of forests in sustaining life and ensuring environmental well-being (Convention on Biological Diversity, 2016). Forests play an ecological role in climate control, atmospheric purification, flood regulation, habitat provision for fauna, and flora conservation (Ahammad et al., 2019; Jonsson et al., 2019).

The capacity of forests to keep providing multiple benefits is not, however, limitless (Tegegne et al., 2016). The sustainability of forests is increasingly threatened due to human actions such as intensified logging, agricultural development, and urban sprawl, which has resulted in about 420 million hectares of forest globally being lost in the past three decades (Food and Agricultural Organization (FAO), 2020). Despite the efforts of international institutions and national governments to conserve forests, sustainable management has remained a challenge, partly due to the mismatch in how forests are perceived and valued between local people and conservationists (Pascual et al., 2017). The multiple benefits of forests have generated conflicting interests in their management. For example, while local people are interested in using forest resources to satisfy their economic and cultural needs (Chirwa et al., 2017),

conservationists are more interested in conserving forests to preserve biodiversity and ensure continuous provision of other ecosystem services (Asiyanbi et al., 2019). This latter interest often implies that the forest has to be protected or reserved against the economic and cultural interests of the community. According to Mazziotta et al. (2017), these conflicting interests of diverse stakeholders are rooted in people's values regarding how forests should be managed and conserved. Therefore, achieving the diverse goals of forest conservation requires an in-depth knowledge of the values that drive attitudinal and behavioural preferences towards forests (van Riper et al., 2018). Understanding the wide range of human values will help to interpret and predict behaviours towards forest conservation initiatives. There is, therefore, a need to first map out the plural values people hold for forest conservation and then to integrate them into conservation policy, practice and decision making.

Furthermore, forests are interconnected systems with conflicting and intricate interdependencies (Everard et al., 2021). Efforts to achieve a particular conservation goal often result in trade-offs and disproportionate distributions of conservation benefits. For example, conservation efforts that attempt to protect a forest landscape from excessive use can result in the loss of livelihoods for forest-dependent communities. Restricting the harvest of products that drive deforestation, such as timber and palm oil, can adversely impact the livelihoods of those who depend on the timber or palm oil industry. Attempts to formally conserve forests with sacred connotations may disrupt cultural functions, such as religious/spiritual practices. Addressing these complex and interconnected problems of forest conservation calls for a pluralistic approach (Pascual et al., 2021). It requires an interdisciplinary and holistic understanding of human values regarding forest conservation. Several researchers have now recognised that a conservation system involving multiple stakeholders needs to move beyond scientifically-driven ecosystem management in biological sciences to one focusing on multiple human values, interests, and behaviours in social sciences and humanities (Teel et al., 2018; Bennett et al., 2017). Considering that forest conservation does not exist in isolation from humans with a wide range of values, there is a need to understand further the values people hold for forest conservation. Addressing this knowledge gap forms the major focus of this thesis.

The rest of this chapter provides a detailed review of the key thematic subjects of this thesis. This includes the concept of human value, realms of human values, conceptual frameworks for understanding multiple values of nature and value orientation, forest conservation approaches, and the integration of values in forest conservation in sub-Saharan Africa and Nigeria, where this thesis is grounded. Next, the research aims and objectives, the research philosophy, thesis structure, methodological approaches, practicalities and ethical concerns, and the contributions of this thesis to knowledge are presented.

1.2 Conceptualising key themes

1.2.1 Human values

Human values have been conceptualised from different perspectives. Within the environmental social sciences, two broad and opposing perspectives exist: the ecological and social-psychological perspectives. The ecological perspective conceptualises human values as intrinsic features, properties, or qualities inherent in the natural environment or specific species (Fearnside, 2021; Tenen, 2020; Sandler, 2012). People who place such value on forests assume that the forest has inherent worth; thus, its utility functions are less important (Piccolo et al., 2018). In practice, individuals possessing this value orientation believe that a forest feature or species should exist for its own sake, independent of its use or function (Hyde, 2018; Taylor et al., 2020). One of the most common depictions of this value dimension is seen in the appreciation of the natural structure and function of the forest, which produces an *ecocentric* value (Kopnina et al., 2018; Kellert, 2008). From this perspective, value resides within the environment and is basically non-instrumental (Fritz-Vietta, 2016).

The social psychological perspective conceptualises human values as deeply held beliefs and cognitions that deal with desirable end states (Bouman et al., 2018). They serve as the foundational basis upon which other human cognitions (orientations, attitudes, norms, intentions, and behaviour) are built (Reser and Bentrupperbäumer, 2005). Here, values are conceived to be generated by humans and reside within people (Jones et al., 2016). This means that rather than perceiving the environment as having inherent value, the environment and its features are perceived as having value for humans. Value under this perspective has been operationalised as a shared belief system reflecting human judgements, preferences, evaluative stances, morals,

perceptions, and ideals domiciled within individuals, cultural communities and institutions (Kenter et al., 2015). It defines what is important, ascertains what is ‘good’ or ‘bad’, and determines the worth/importance of an object or subject for the well-being of an individual, group, culture, and the human society as a whole (Reser and Bentrupperbäumer, 2005; Manfredo et al., 2017). It also refers to how humans perceive and relate to nature, including the multiple benefits humans derive or want to derive from nature (Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES), 2022). This thesis conceptualises value as motivational goals or concerns that people hold regarding forest use and conservation embedded with a society’s culture, traditions, and institutions.

Analysis of Schwartz’s theory of basic values (Schwartz, 2012) shows that implicit in the social psychological perspective of human value is the many constructs that constitute human value relations. These value contents include: i) values are beliefs that can be activated to influence feelings and actions; ii) value functions as standards or criteria for evaluating individual/group actions; iii) they serve as underlying motivational goals that can direct actions and behaviours; iv) they transcend specific situations and actions, which is what distinguishes them from norms and attitudes that refers to a particular action or situation; v) they represent individual or group interests; vi) they are acquired through personal experience or through socialisation; vii) they are ordered by human priorities according to their perceived relative importance; viii) they are expressed through human actions and relationships; ix) they serve as predictors of attitudes and behaviours; and x) they reside in people, cultural communities and institutions. Using these value constructs, this study examined dominant value orientations guiding and influencing individual and group attitudes and behaviours towards forest conservation and applied these in an exploration of the multiple values people hold regarding forest conservation.

1.2.2 Realms of human values

Existing studies have applied the concept of human value to understand environmental issues in many different "value realms", often divided into held values, assigned values and felt values. Each of these is explored in turn, to articulate the application of the human value concept in this thesis. Held value is the generic and conceptual value, often abstract in form, representing social ideals such as morals

(Kenter et al., 2015). Held values depict how things ought to be and how individuals should interact with natural resources (McIntyre et al., 2008). Held values also provide the basis for preference judgements and can take the form of desirable modes of environmental behaviour, customary rules and regulations (Jones et al., 2016). An enquiry into held values can help us to understand the rationale behind people's belief that a particular behaviour is personally or socially more (or less) desirable than a converse behaviour.

Assigned values are attached to certain features, objects, species or places, such as sacred forests or totems (Seymour et al., 2010). As such, they are context-specific, depicting values inherent in a species or a forest ecosystem. They reflect the relative importance or worth of an object or place to an individual or group. These values are shaped by held values and other factors such as knowledge, perception, and socialisation processes (Muñoz et al., 2019). Within the context of nature conservation, Seymour et al. (2010) argued that assigned values are better predictors of human behaviour than held values. An enquiry into assigned values can reveal how people think about a particular forest conservation practice and the importance they attach to a particular species, forest, or forest function.

Felt values are experiential values that explain the relationships between held values (conceptual realm) and assigned values (object realm) (Brown, 1984). Building on the works of Brown, Schroeder (2013) explained that felt values are often associated with subjective feelings about the importance or significance of nature for an individual. An enquiry into felt values can provide a detailed perspective of the physical or mental benefits people derive or seek to derive from forest conservation (Jones et al., 2016). It can also explain the motivation or incentive behind a particular forest conservation practice (Himes and Muraca, 2018). These three value realms depict how humans conceive and relate with the multiple of nature.

1.2.3 Conceptual frameworks for understanding multiple values of nature and value orientations

Various conceptual frameworks have emerged over the last decades to understand the multiple values of nature. The first attempt to conceptualise the multiple values of nature was the Ecosystem Service framework of the Millennium Ecosystem Assessment (MEA), a framework designed to capture the interconnected benefits that

ecosystem services provide to people (World Health Organization, 2005). The framework categorised ecosystem services into four categories: provisioning (e.g., timber, fuel, food), regulating (e.g., climate regulation, flood regulation, water purification), cultural (e.g., education, recreation, aesthetics) and supporting (e.g., soil formation, biomass production, nutrient cycling). Operationalisation of the Ecosystem Service framework has led to the formulation of policy instruments like the Payment for Ecosystem Services (PES) (Chan et al., 2017) and REDD+ (Visseren-Hamakers et al., 2012) to incentive local people to conserve ecosystem services. Previous studies have also applied the Ecosystem Service framework to value the flow of nature-based services in various regions of the world (Vallecillo et al., 2019; Davies et al., 2015; Nahlik et al., 2012).

While the Ecosystem Service framework has been useful in supporting practical conservation and decision-making (Ellis et al., 2019), similar to other economic/utilitarian conceptualisation of nature values such as the Total Economic Value (TEV) (Randall, 1987), the Economics of Ecosystems and Biodiversity (Earthscan, 2010) and the Dasgupta Review (Dasgupta,2021), it has been criticised for its methodological approach of monetising nature (Unmüßig, 2014),its failure to integrate diverse and competing values of different stakeholders (Peterson et al., 2018), and for ignoring intrinsic values of nature and focusing on narrow instrumental values (Bull et al., 2016).

To partly address the above limitations, the IPBES builds on the Ecosystem Service framework to propose an inclusive valuation of nature's contributions to people (NCP) in conservation decision-making (Ellis et al., 2019). The NCP framework primarily differs from the Ecosystem Service framework by emphasising the role of local and indigenous knowledge in understanding nature's contribution to people, and recognising the central role of culture in defining the links between people and nature (Díaz et al., 2018). NCP conceptualises both positive and negative contributions of nature to quality of life in three categories: material, non-material, and regulating (Hill et al., 2021). While this categorisation may look similar to the Ecosystem Service framework from the surface, a detailed look at NCP shows the fluidity of values across categories. For example, food may be categorised as a material contribution but also as a non-material contribution based on other intangible significance that it holds for people, such as rights, spirituality or identity. Although the NCP framework has been

useful in examining socioecological systems and incorporating social sciences into understanding ecological and economic aspects of ecosystem services (Dean et al., 2021), its structure has been criticised for having a one-directional flow of values from nature to people, which negates the coproduction of values between nature and people (Peterson et al., 2018).

Building on the NCP framework, the recent IPBES Values Assessment (IPBES, 2022) developed a framework which expanded the scope and structure of values considered in nature valuation beyond the material, non-material and regulating categories while also recognising multiple feedbacks and scales in value production. Drawing from a wide range of indigenous and scientific perspectives, IPBES developed a multi-layer framework with five key concepts that can support understanding nature's multiple values. These include worldviews, knowledge systems, broad values, specific values, and value indicators. These concepts were organised across four key life frames of human-nature relationships (living from nature, living in nature, living with nature, and living as nature). This thesis adapts the IPBES Values Assessment framework (Figure 1.1) to understand the multiple values people hold for forest conservation. This framework was used because it is the most recent and arguably the most comprehensive interdisciplinary typology of values of nature to date and fits best in operationalising the overall thesis aim.

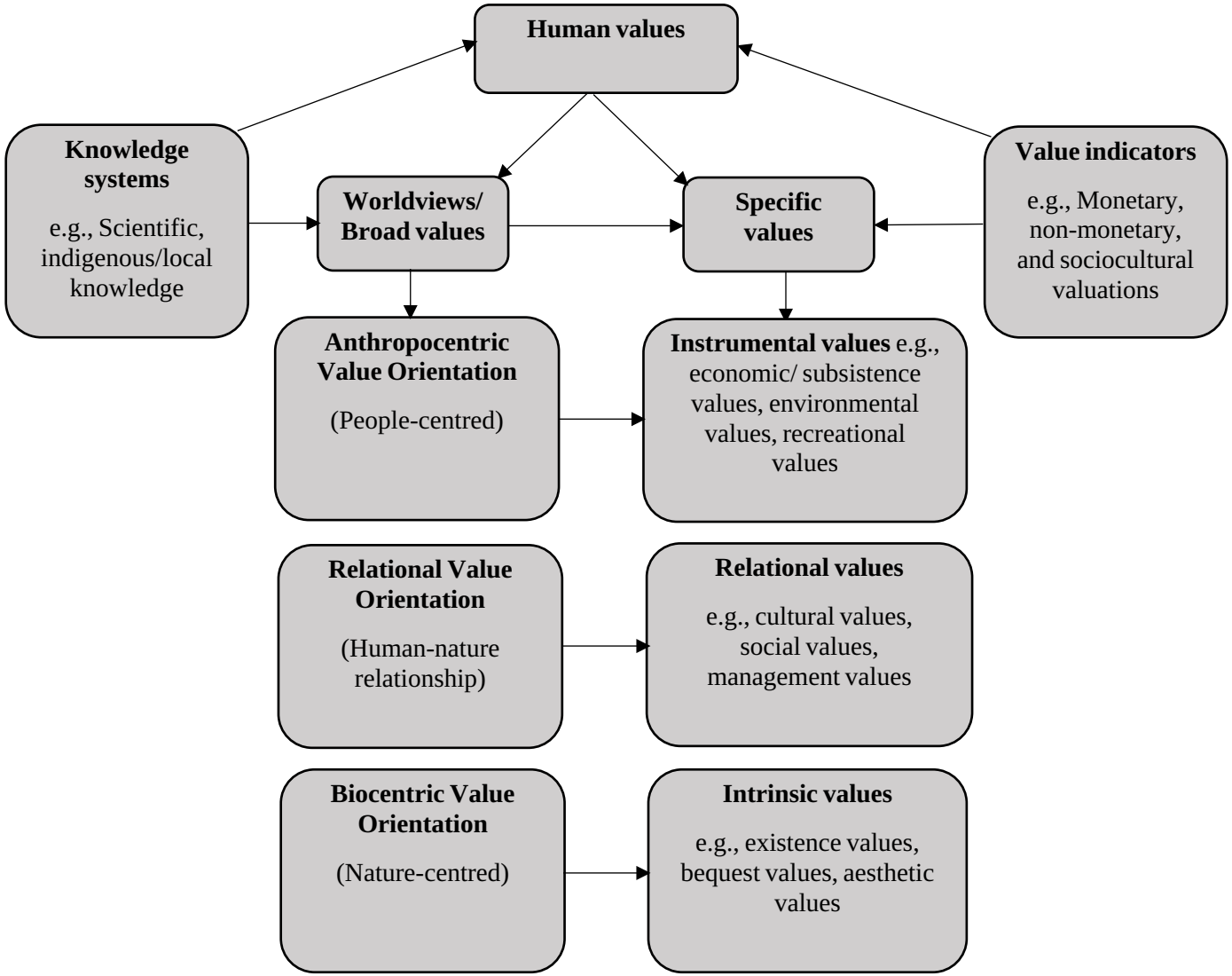

Figure 1.1: Framework for understanding the multiple human values of nature, adapted from IPBES value assessment typology (2022). The framework illustrates key concepts for understanding nature's multiple values (knowledge systems, worldviews/broad values, specific values, and value indicators). The arrows represent the interrelationship between the key concepts and how each key concept influence or lead to another.

Knowledge systems are bodies of knowledge, beliefs and practices embedded in worldviews from which human values and interactions with nature are understood. Knowledge systems have two main sources: i) scientific knowledge, which is knowledge derived from the application of formal methodology, and ii) indigenous/local knowledge, which is traditional knowledge derived from different sociocultural contexts. These knowledge systems influence how people manage natural resources such as forests.

Worldviews are cultural and epistemic lenses through which people perceive and understand nature. They inform broad values which are moral guiding principles and life goals. An individual's worldview provides a foundation for the formation of value orientation, a cluster of values that shapes human relationships and interactions with nature and other users of nature. An anthropocentric value orientation, for instance, is a people-centred value orientation that is utilitarian in nature. Biocentric/ecocentric value orientation is a nature-centred value orientation that recognises nature's right to independent existence without use or function. Relational value orientation focuses on the appropriateness of human relationships and interaction with nature and with other users of nature. This value orientation can be pluricentric (i.e., multiple dimensions of the human-nature relationship) and cosmocentric (i.e., living in harmony with nature and with all forms of existence connected to nature). The different value orientations from worldviews are expressed through specific values.

Specific values express the importance or benefits of nature in a particular context. These specific values include instrumental, relational, and intrinsic values. Instrumental values are those that use natural resources as a means to a desired end, such as using forest resources like timber to construct buildings. Intrinsic values are values of nature expressed independent of use, such as the value of habitat or species to exist on their own. Relational values express human-nature interaction, for example, perceptions of the forest as a symbol of cultural identity or as a sacred ecosystem rooted in cultural beliefs, norms, and traditional ecological knowledge (Irakiza et al., 2016). One key distinguishing factor between instrumental, relational and intrinsic values is that while instrumental values are substitutable, relational and intrinsic (i.e., non-instrumental values) are non-substitutable. For example, a forest can be reclaimed through reforestation/afforestation programmes and used for timber provision. In contrast, a lost sacred forest with cultural significance cannot be replaced

or compensated for by reforestation/afforestation programmes. Overall, specific and broad values are collectively expressed as shared values through group deliberations and long-term socialisation processes (Kenter, 2016).

Value indicators are quantitative and qualitative approaches used to capture people's multiple human values. These approaches can be monetary (e.g., contingent valuations), non-monetary (e.g., conjoint analysis), and sociocultural. This thesis adopts non-monetary and sociocultural approaches as they allow the capture of diverse plural values, including non-market and intangible values that cannot be quantified in monetary terms.

The central message of the IPBES Values Assessment framework is that it strongly supports the recognition of diverse values of nature in economic and environmental decisions. While this is crucial in nature conservation, there is also a further need to understand if and how people perceive these diverse values in their interactions with nature and how they differ in their value preferences. This is the focus of this thesis, as it relates to forest conservation.

1.2.4 Forest conservation approaches

Historically, the framing of forest conservation has undergone four different phases (with some overlaps), each phase focusing on distinct conservation ideas with implications for the science underpinning conservation management (Mace, 2014). The first phase of conservation between the 1960s and 1970s focused on conserving 'nature for itself' (Admiraal et al., 2017; Mace, 2014; Godet and Devictor, 2018). Key ideas characterising this conservation thinking include prioritising intact forests and species conservation. Forest conservation under this framing employed the Protected Areas (PA) system, although contested due to its mixed conservation outcomes, to conserve forests (Godet and Devictor, 2018; Oldekop et al., 2016). This led to the establishment of forest reserves and national parks in various countries. The approach prioritised conserving and preserving natural resources without much attention to social welfare (Jones et al., 2018). Forest conservation under this conservation framing was seen as an exclusive responsibility of the government (Bingham et al., 2019). Therefore, to ensure protected areas' security, governments often employed draconian policies and laws to keep local people from intrusion. However, although control and regulations are necessary conditions to achieve forest

conservation, they are not sufficient for sustainable conservation (Simmons et al., 2018). Mutekwa and Gambiza (2017) reported that this exclusionary conservation approach separated the people from the forest, and as expected, the approach was resisted by the locals who felt marginalised from accessing, using and managing their own resources. Thus, the approach recorded little success with increased impacts of human activities such as overharvesting and poaching (Jones et al., 2018).

In an attempt to address the weaknesses and outcomes of the ‘nature for itself’ conservation framing, the focus of conservation shifted to conserving ‘nature despite people’ around the 1980s and 1990s (Mace, 2014). The key ideas that characterised this thinking include addressing threats to species, reversing habitat loss, reducing overexploitation, and promoting sustainable use. During this period, Community-Based Natural Resource Management (CBNRM) emerged as an approach to achieve conservation objectives (Nilsson et al., 2016). CBNRM approached forest conservation from the community perspective, the assumption being that the management of natural resources like forests will be more successful if left in the hands of the local communities (Chomba et al., 2015). Consequently, community members were integrated into conservation programmes' management and governance structures.

Despite the efforts of the CBNRM, nature degradation continued to increase due to pressure from human activities. It was then realised that one of the major drivers of nature degradation is that there are irreplaceable goods and services provided by nature upon which people depend for livelihoods (Fedele et al., 2021). Consequently, around 2000 and 2005, conservation thinking shifted to conserving ‘nature for people’ (Mace, 2014). An example of an approach adopted under this conservation thinking is integrated forest management, which aims to sustainably manage nature to benefit people through ecosystem services (Aggestam et al., 2020). The Millennium Ecosystem Assessment (MA) in 2000 was a key factor that drove the widespread adoption of this thinking (Mace, 2014). However, the ES approach adopted under this conservation framing was overly utilitarian (Bull et al., 2016), which made it unsustainable for nature conservation.

From the year 2010, a more nuanced conservation thinking emerged that recognised the dynamic relationships and interactions between people and nature, which shifted

conservation framing to conserving ‘nature with people’ (Mace, 2014). This emphasised the role and importance of cultural institutions in achieving sustainable conservation management. Some of the key ideas that characterise this framing include socioecological systems, adaptability, and resilience. The establishment of IPBES in 2010, which has undergone various reviews and updates, has sustained this framing (Pascual et al., 2021). It expands the utilitarian-intrinsic dichotomy that has dominated conservation discourses to include the concept of relational thinking, a concept that links the interdependence between people and nature (Eyster et al., 2023; Díaz et al., 2015). Relational thinking recognises the need for plural values as an incentive to achieve conservation objectives (Chan et al., 2018) and was subsequently reflected in the IPBES NCP framework and Values assessment.

There have been conflicting views regarding how these four different framings and their related conservation focus have affected the attainment of conservation objectives. While some scholars suggest that the four frames are competing (Linnell et al., 2015), others argue that they can co-exist to achieve conservation targets (Godet and Devictor, 2018). This thesis provides a basis for existing conservation approaches to expand their scope of values considered in conservation policies and practice. It highlights the need to integrate plural values in government-protected and community-protected forest conservation approaches. Beyond this, it also shows how this can be achieved for different stakeholders and different forest landscapes, for both formally and informally protected forests such as sacred forests.

1.2.5 Integrating human values in forest conservation

The interdependent relationship between forest conservation and human behaviour is well documented in the literature (Veríssimo, 2013; Nilsson et al., 2016). While human well-being is partly dependent on forest conservation, the success of forest conservation is also partly dependent on human behaviours. However, human behaviour is notoriously complex, difficult to predict, and subject to the influence of several cognitive factors (Sun and Hélie, 2013; Reddy et al., 2017). Human values are fundamental among these (de Groot and Steg, 2008; Jones et al., 2016).

The seminal study of the cognitive hierarchy model of human behaviour (Figure 1.2) by Fulton et al., (1996) shows that human values are the foundational basis upon

which other human cognitions (orientations, attitudes, norms, intentions, and behaviour) are built. Human cognition depicts how people perceive and think about their environment and how it influences their perceptions and actions (Jones et al., 2016). Values, which sit at the bottom of the inverted pyramid, are distinguished by certain features like being slow to change, they transcend situations, and are fewer in number, compared to behaviours which are faster to change, situation-specific, and numerous in number (Cetas and Yasué, 2017). According to Ives and Kendal (2014), value is the most stable form of cognition. This is because they are formed from childhood, develop and take shape through experiential knowledge of the occurrences in the environment and social interaction, and attain relative stability throughout adult life.

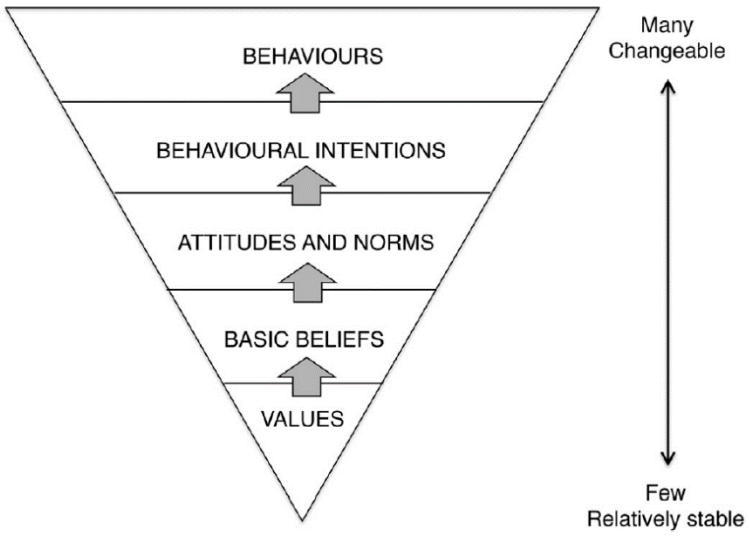

Figure 1.2: A visual representation of the cognitive hierarchy model of human behaviour by Fulton et al. (1996).

Values determine the human perception of the environment and how humans should relate to and treat the environment, including ecosystem services (Marshall et al., 2019). Values also significantly influence people's attitudes towards forest conservation and can serve as a leading guideline for forest behaviours (Rickenbach et al., 2017). Sharaunga et al. (2015) and Owen et al. (2009) noted that the values people associate with forest resources drive and direct their use and management. Values often manifest as behaviours, attitudes, perceptions, participation, or compliance with forest conservation projects (Dewu and Røskaft, 2018; Tadesse and

Teketay, 2017). These make it critical to understand the multiple values people hold for forest conservation, especially in sub-Saharan Africa, where the majority of the population directly or indirectly relies on forests for livelihood sustenance.

1.2.6 Forest conservation and human values in sub-Saharan Africa and Nigeria

Forest conservation is critical in sub-Saharan Africa as the region holds about 25% of the world's remaining rainforests and 17% of other forests (Franks and Hou Jones, 2020). It is estimated that the tropical forests of sub-Saharan Africa harbour over 45,000 plant species and 43 billion trees, making them one of the world's richest ecosystems (Mgini, 2022). Economically, over 70% of the population in the region depends on forest products for either subsistence use or cash income, and about 20% of rural households in sub-Saharan Africa directly rely on forests for daily needs (World Bank, 2017). Forest-related activities contribute about 6% to the region's GDP, more than any other region of the world (National Geographic Society, 2020). Forests also supply about 60% of household energy in the region (World Bank, 2017).

Several efforts have been made to conserve forests in sub-Saharan Africa, including through the establishment of PAs (Mutekwa and Gambiza, 2017), community-based forest management (Duguma et al., 2018) such as the CAMPFIRE programme in Southern Africa (Tchakatumba et al., 2019), market-based forest governance mechanisms such as REDD+ programme in Nigeria (Isyaku, 2021), and co-management of forest resources (Ward et al., 2018). Despite these efforts, the region accounts for about 43% of recent global deforestation (Otula et al., 2021). Humans destroy almost four million hectares of forests annually in the region (FAO, 2021). The human activities driving deforestation in the region are rooted in people's values and relationships with forests (Sharaunga et al., 2015). With a growing population that is projected to double to about 2.1 billion in 2050 (World Bank, 2019), the impact of human activities on forests in the region is expected to get worse if nothing is done to understand the underlying values regarding how people perceive, relate with, and use forest resources. This necessitates the need to understand the influence of human values on attitudes and behaviours towards forest conservation in sub-Saharan Africa in Chapter 2 of this thesis.

In Chapters 3 and 4 of this thesis, I focused on Nigeria, the most populous country in sub-Saharan Africa, with an estimated population of 206.4 million (Nigerian Bureau of

Statistics, 2020). Nigeria is a natural resource-based economy with a total land area of 923,770 km^2, out of which the percentage of forest area is 23.75 (Food and Agricultural Organization [FAO], 2020). The country was considered suitable to ground this thesis in because of the critical role of forests in supporting livelihoods and contributing to national development (National Forest Policy, 2020). However, according to FAO, Nigeria has the highest rate of primary forest deforestation not just in sub-Saharan Africa but in the world, having lost 55.7% of its primary forest in the last three decades (FAO, 2018). The country's forests are currently threatened by deforestation from agriculture, logging and timber extraction, charcoal production and fuelwood collection, and livestock grazing (Adetoye, 2019), all of which are rooted in the values regarding how forests should be exploited and managed. In terms of conservation efforts, Nigeria has 986 government forest-protected areas, comprising 925 forest reserves, 32 game reserves, seven national parks, two wildlife sanctuaries, and one strict nature reserve (World Database on Protected Areas [WDPA], 2018). Despite this, the country still has one of the highest deforestation rates in the world, with annual deforestation standing between 3.7 % and 4 % (National Forest Policy, 2020).

Understanding the multiple values people hold for forest conservation is critical and timely in Nigeria, especially during this period of unprecedented decline in the country's forest biodiversity, a resource upon which the majority of the population directly or indirectly depends for their livelihood (Nwankwo, 2020). This is somewhat paradoxical, as one would, in an ideal case, expect the people to sustainably manage forest resources if their lives depend on them.

Nigeria revised its National Forest Policy in 2020 which was subsequently launched in April 2022. This policy aims to enhance forest's contribution to the country's environmental, economic and social development through sustainable forest management (National Forest Policy, 2020). However, one of the major challenges facing effective conservation in Nigeria is the inability to balance national policies with local interests and expectations, which often leads to conflicts between the government, conservationists and local communities (Asiyanbi et al., 2019). As already established, the conflicting human interests in nature conservation are rooted in people's values regarding how nature should be managed and conserved (Mazziotta et al., 2017). This PhD research is, therefore, timely for Nigeria as it

provides empirical evidence on the values that matter most to people in forest conservation. This will support the uptake and effective implementation of the Nigeria national forest policy and offers insights relevant to other countries that are struggling to improve the effectiveness of conservation policies and programs.

1.3 Research aim and objectives

This thesis aims to advance our understanding of the multiple values people hold for forest conservation, with a focus on sub-Saharan Africa and Nigeria. To do this, it employed an interdisciplinary mixed-methods approach to achieve three objectives which constitute the three result chapters of this thesis:

a) Chapter 2: To examine the influence of human values on attitudes and behaviours towards forest conservation. This chapter aimed to systematically analyse and synthesise the extent of evidence and knowledge gaps in the relationship between human values and forest conservation attitudes and behaviours, using the sub-Saharan Africa region as a case study. Specifically, this chapter answered the following research questions:
    i. What are the human value orientations influencing forest conservation attitudes and behaviour?
    ii. How have human values influenced forest conservation attitudes and behaviours? and
    iii. What are the geographic characteristics of forest conservation and human value evidence from sub-Saharan Africa?
b) Chapter 3: To understand the diversity of values underpinning forest conservation. This chapter was grounded in Nigeria and aimed to better understand what should constitute the most important values guiding the country's forest conservation policies and programmes. This chapter is focused on government-protected forests (forest reserves). Specifically, it answered the following research questions:
    i. What are the viewpoints of different stakeholders regarding the values underpinning forest conservation in Nigeria? and
    ii. How do the values of the different stakeholders compare and contrast with each other?

c) Chapter 4: To ascertain what values are important to the public in the conservation of sacred forests. Grounded in Nigeria, this chapter integrated principles of biocultural conservation and sociocultural valuation to identify multiple values people hold as well as value preferences amongst diverse stakeholders in forest landscapes where indigenous knowledge systems and traditional cultures play a role in how forests are managed and protected. This chapter is focused on community-protected forests (sacred forests). Specifically, the chapter answered the following research questions:
    i. What are the sociocultural values of sacred forests?
    ii. What is the relative importance of the values that can influence preferences for the conservation of sacred forests? and
    iii. Is there preference heterogeneity in sacred forest values among the population?
    iv. What management strategies can improve the conservation of sacred forests based on values most important to people values?

1.4 Research philosophy: Positioning of the PhD research

This thesis takes a pragmatic approach to understand the multiple values people hold for forest conservation. Pragmatism is a research approach that suggests that knowledge is constructed based on the interaction of human experiences that forms social reality (Kelly and Cordeiro, 2020). It is hinged on the fact that there are many ways of understanding and interpreting the world (Maarouf, 2019). As such, it recommends using the most suitable technique or combination of techniques in research. It considers that combining different methods to investigate social phenomena will provide a broader understanding of the issue under investigation (Kaushik and Walsh, 2019). This flexibility that pragmatism offers was helpful in this PhD as it enabled application of an interdisciplinary mixed-methods approach. To understand complex social phenomena like human values, it is important for research to examine different worldviews from real-life socioecological experiences. Also, the pragmatic approach recognised that multiple factors influence people's actions and behaviours in a given situation (Kelly and Cordeiro, 2020). Thus, the approach acknowledges that while the research output may help to advance understanding of social phenomena, it may not lead to certainty or absolute conclusion (Revez and

Borges, 2018). This is because, in reality, knowledge built on human perceptions can change over time. Similarly, the values people hold for forest conservation are influenced by various factors such as indigenous knowledge systems, traditional culture, economic conditions, and environmental contexts- with potentially divergent opinions and conflicting interests (Sharaunga et al., 2015). Characterising values in forest conservation from a multi-perspective approach could help better understand and untangle the conflicting interests and diverse motivations affecting people's attitude and behaviour towards forest conservation. Therefore, pragmatism is a suitable approach to investigate the multiple values people hold for forest conservation.

Furthermore, it is important to acknowledge my positionality, i.e., how my cultural identity/background and life experiences influenced the research process in this PhD. I approached the research both from an 'insider' and 'outsider' position. As an 'insider', I approached the research as a Nigerian from the South-Eastern part of Nigeria, where the fieldwork aspect of this study was located. It could be argued that my 'insider' position provided me with the advantage of shared experiences with my research subjects (Berkovic et al., 2020), which helped to build trust and facilitated greater access to information, documents, and people. For example, I had good knowledge of Nigeria's forest conservation policies and programmes and how and where to access the documents and relevant stakeholders. Furthermore, as someone who possessed a deeper and more nuanced understanding of the research setting, I understand the culture of the people. Unlike an 'outsider', this 'insider' position enabled me to navigate the terrain and collect data on religiously sensitive issues around sacred forests.

However, one of the potential limitations of approaching research from an insider position is the possibility of making pre-determined judgements and having a formed opinion/belief about the subject of enquiry and unconsciously searching for or interpreting data that validate existing opinion on the research problem (Savvides et al., 2014).This stems from the closeness, 'over-familiarity' and "over-rapport" which the researcher with an insider positioning has with research participants (Innes, 2009), and which can lead to confirmation bias. To reduce the impact of this on the research process, I critically assessed and took notes of my experiences and thoughts about forest conservation in Nigeria. This self-reflexivity enabled me to keep away personal

thoughts and opinions throughout the research process (Soedirgo and Glas, 2020).

I also approached the research as a foreign student from the UK, which seems to have also projected me as an ‘outsider’ to the local people living in forest communities in Nigeria. This positioning helped in moderating some of the limitations of the ‘insider’ position that stems from closeness, ‘over-familiarity’ and “over-rapport”. It also presented me as a stranger with less prejudice, thereby creating objectivity and emotional distance from the studied communities (Chavez, 2008). It could also be argued that this ‘outsider’ position provided a comfortable ground for the local people to disclose important information regarding their relationship and challenges with forests, with the expectation that my international knowledge and connections may contribute to bringing them solutions (even though I sought to manage their expectations and not make promises that the research would lead to direct changes). Approaching the research both as an ‘insider’ and ‘outsider’ created a balance by allowing me take advantage of the strengths of both positionings while complementing their weaknesses.

To also control unintentional bias that can arise in lone data collection, I employed different research assistants who have no vested interests in the research to assist in the household survey and in recording and taking notes during the research workshops. Their notes were independently compared when analysing and interpreting the workshops’ data to enhance objectivity. Working with local research assistants supported my understanding of local context and culture and enabled me to collect less biased data (Moss and Hajj, 2020). To control the impact of their positionality and how that might affect data validity, the research assistants were trained before data collection and instructed to be reflexive and work within the boundaries of the workshop question guide and household questionnaires. Also, respondents’ phone numbers were collected in the questionnaires which were randomly used to verify the authenticity of the data. These quality checks and positionality mitigation strategies helped to ensure data quality and strengthen the validity of collected data (Schatz et al., 2015).

1.5 Thesis structure

This thesis is divided into five chapters. This introductory chapter (Chapter 1) discusses the background of human values and forest conservation, highlighting the

motivation and building a logical case for why this thesis is important. It sets the aims and objectives for the thesis and provides a detailed literature review and conceptual clarifications of the key thematic terms used in this study. In addition, it describes the research philosophy, thesis structure, methodological approaches, research practicalities and ethical concerns, and the contributions of the thesis to knowledge. Chapters 2 to 4 are the results chapters written as three academic journal articles, each addressing the objectives outlined in section 1.3. Chapter 2 is titled 'The influence of human values on attitudes and behaviours towards forest conservation', published in the *Journal of Environmental Management*. Chapter 3 is titled 'Understanding the diversity of values underpinning forest conservation, published in *Biological Conservation*. Chapter 4 is titled 'Integrating biocultural conservation and sociocultural valuation in the management of sacred forests: what values are important to the public', which at the time of this writing has been accepted with minor corrections in *People and Nature*. The minor corrections have been addressed and resubmitted to the journal. The thesis concludes in Chapter 5 by bringing together insights from the three results chapters, discussing the implications for forest conservation in Nigeria, and suggesting directions for future research.

1.6 Methodological approaches

This PhD applied an interdisciplinary and mixed-methods approach by integrating knowledge from different social science disciplines. In Chapter 2, a scoping review method was used to explore the extent of evidence and knowledge gaps regarding how human values influence forest conservation attitudes and behaviours in sub-Saharan Africa. A scoping review is a systematic literature review approach that seeks to map, analyse, and explain the wide range of available studies within a particular research area, thereby helping to identify main concepts, theories, and relevant knowledge gaps within a subject of study (Arksey and O'Malley, 2005; Peters et al., 2015). The scope of the review was limited to the sub-Saharan African context partly because it is the area in which my research is located, and it is useful to situate my thesis within the broader context of existing literature in an area in order to identify advances, debates, and relevant gaps in research.

Chapter 3 employed Q-methodology to examine the viewpoints of different stakeholders regarding the values underpinning forest conservation. Q-method is an

exploratory and semi-quantitative research method developed in psychology to understand stakeholders' subjective viewpoints on various social issues via a statement-sorting exercise (Watts and Stenner, 2012). It is increasingly used in environmental social science because of its usefulness in eliciting and exploring human perspectives on environmental issues (Zabala et al., 2018). The method facilitates the interdisciplinary link between social and natural sciences by combining qualitative techniques to elucidate subjective opinions with the statistical robustness of quantitative analysis (Watts, 2015). It was therefore considered suitable for achieving this chapter's objective as it allowed the capture of multiple values, including intangible values that cannot be easily quantified in monetary terms regarding the conservation of government-protected forest reserves.

Chapter 4 applied the principles of biocultural conservation and sociocultural valuation to understand the values that underpin people's relationship with sacred forests- a community-protected forest where indigenous knowledge and cultural traditions play a central role in how forests are managed and conserved. This was operationalised using a sequential mixed-methods study design, drawing from social science methods and market research. In a novel combination of research methods, I used participatory workshops to identify multiple values of sacred forests and conjoint analysis to elicit local people's value priorities and preferences for conserving sacred forests.

1.7 Practicalities and ethical concerns

Chapters 3 and 4 involved fieldwork with human participants, which requires wide ranging ethical considerations, particularly in the collection, processing and storage of participants' data. Ethical approval for this PhD was granted by the University of Leeds Research Ethics Committee (Reference Number: AREA 21-002). To address important ethical issues, an information sheet was developed and presented to the participants for each of the two fieldwork chapters (see appendix A2). The form explained the aim of the study, participant involvement, risks, and activity, free and informed prior consent, voluntary participation and withdrawal from the study, anonymity and confidentiality, data access and protection. Written or verbal informed consent was gained from all participants before the commencement of the data collection (see appendix A3).

Full anonymity was granted to the participants. This means that their names were not published and they were only identified to the level of their stakeholder category. Also, their information was aggregated during publications. Furthermore, all devices holding identifiable personal data were encrypted, and all data were uploaded to a secure location (University of Leeds OneDrive) at the first opportunity and later erased from the local peripatetic device. Audio recordings for the Q-method post-sorting interviews and the Participatory Workshops were deleted immediately after transcription, and the transcribed data was securely stored on the University of Leeds OneDrive.

An important concern with research fieldwork is the health and safety of the researcher and research participants. To manage this, a full high-risk assessment approval was obtained before the commencement of the fieldwork in accordance with the University of Leeds' research ethical guidelines for overseas fieldwork. Fieldwork for this PhD was carried out when Nigeria's Covid-19 pandemic guidelines for social interactions were still in place. Consequently, all participatory workshops and interviews took place in well-ventilated environments to manage the Covid-19 ethical nature of interfacing with people during a pandemic. There was strict compliance with all Covid-19 protocols, including observing appropriate social distancing of two meters, wearing FFP2 face masks, washing hands and regular use of hand sanitisers during all workshops, interview sections and surveys.

1.8 Thesis contribution

By taking a mixed-methods and interdisciplinary approach to examine the multiple values people have for forest conservation, this thesis advances understanding of which values should be prioritised in forest conservation in developing countries like Nigeria, where there is a high dependence on forest resources. The systematic scoping review approach in Chapter 2 explores the extent of evidence and knowledge gaps regarding how human values influence forest conservation attitudes and behaviours in sub-Saharan Africa. Chapter 2 identifies the range of human values influencing forest conservation and provides novel insight into how value orientations can positively or negatively influence several forest conservation attitudes and behaviours. Chapter 2 thus establishes the need for conservation managers to first understand the prevalent and dominant contextual values guiding people's perceptions and interactions with the forest and design their management strategies

to fit into the existing value structure. Based on the outcome of Chapter 2, Chapters 3 and 4 employ mixed-methods approaches to capture the perspectives of different stakeholders regarding the multiple values underpinning forest conservation in government-protected forests (forest reserves) and community-protected forests (sacred forests), respectively. By doing this, the studies contribute to understanding the interactions, overlaps, and differences in values affecting forest conservation under different management objectives and strategies, which was unclear from the literature before now. They also emphasise which values matter most in forest conservation and how multiple values differ amongst different stakeholders in Nigeria, one of the countries with the highest rate of global forest degradation. Chapters 2 and 3 thus challenge national conservation policies and programmes to recognise diverse and differentiated value interests in forest conservation. By integrating these findings, this thesis underscores the need to embed plural values in conservation policies and articulates how plural values can be integrated into decision-making to capture the interests of diverse stakeholders to improve forest management and enhance the effectiveness of conservation projects.

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Chapter 2: The Influence of Human Values on Attitudes and Behaviours towards Forest Conservation

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Manuscript published as:

Ihemezie, E.J., Nawrath, M., Strauß, L., Stringer, L.C. and Dallimer, M (2021). The influence of human values on attitudes and behaviours towards forest conservation. *Journal of Environmental Management*, 292. https://doi.org/10.1016/j.jenvman.2021.112857

2.1 Abstract

Human attitudes and behaviours have been linked to the degradation of global biodiversity, particularly forest ecosystems. Indeed, effective conservation actions require that the attitudes and behaviours of affected individuals and communities are taken into account. While several studies have examined how human attitudes and behaviours affect conservation, it is still unclear which, and how, human value orientations influence conservation attitudes and behaviour. This is critical because attitudes and behaviours are underpinned by the complex concept of human values. Thus, effective management and conservation of environmental resources requires an in-depth knowledge and understanding of these values, and how they affect attitudinal and behavioural preferences towards the natural environment and their protection. Here we review the human value orientations influencing people's attitudes and behaviours towards forest conservation, and discuss how conservation projects can be more successful by aligning their goals and operations to people's values. To

do this, we carried out a scoping review, using the sub-Saharan Africa region as a case study, and followed the PRISMA-ScR systematic review guidelines. A narrative synthesis was adopted for data analysis. We identified different value types that fall within three broad human value orientation domains influencing forest conservation attitudes and behaviours. Anthropocentric and relational value orientations emerged as most dominant, with both positive and negative influences on a number of forest conservation attitudes and behaviours, albeit with more evidence for positive influence. The positive attitudes and behaviours were linked to utilitarian motivations and cultural beliefs and include rural support for conservation, compliance to forest rules, sustainable forest use, and participation in forest management. The values linked to dependence on forest resources, low benefits from conservation, and conservation costs, tend to trigger negative conservation attitudes and behaviours. To effectively achieve forest conservation goals, environmental managers, conservationists, and decision-makers should understand the extent and directional influence of value orientations on conservation attitudes and behaviours.

2.2 Keywords: forest values, anthropocentric values, relational values, scoping review, sub-Saharan Africa.

2.3 Highlights

- Value orientations affect forest conservation attitudes and behaviours.
- Anthropocentric and relational value orientations are the most common in sub -Saharan Africa.
- Biocentric value orientations were the least studied.
- Value orientations can have both positive and negative effects.
- The direction of the effect depends on people's perceptions, motivations and goals.

2.4 Introduction

Forest conservation is a human problem, not least via its impacts on livelihoods (Ward et al., 2018). Its effectiveness and successes are also greatly influenced by human behaviour (Reddy et al., 2016). Forest conservation has been defined as the practice of maintaining, protecting, and/or restoring a forest landscape to conserve biological and cultural values, promote sustainable use and equitable distribution of forest goods

and services, and ensure strategic preservation of forest resources for future use (International Union for Conservation of Nature [IUCN], 2008; Pawar and Rothkar, 2015). Implicit in this definition is that forest conservation has multiple goals. However, attempts to achieve these goals through conservation approaches like community forestry or the establishment of protected areas, have not always been successful (Wade et al., 2020). For instance, about one-third of global protected forest areas are undergoing various levels of degradation as a result of intense human pressure (Jones et al., 2018). In sub-Saharan Africa (SSA), a region that hosts about 25% of the world's remaining forest, and where the livelihoods and culture of millions of people are directly or indirectly dependent on the forest, human behaviours and actions have continued to play a significant role in distorting the integrity of protected forest biodiversity (Djenontin et al., 2018). This raises a critical question regarding what elements of human cognition influence people's behaviour and interactions with the conservation of natural resources, as well as knowledge gaps in terms of the geographies that have been covered by values research linked to forests.

Human values, which have been defined as motivational concerns or goals and guiding principles that influence individual or group attitudes and behaviours, are the foundational basis upon which other human cognition (orientations, attitudes, norms, intentions, and behaviour) are built (Reser & Bentrupperbäumer, 2005; Fulton et al. 1996). Human cognition depicts the diverse ways in which people perceive and think about their environment, and the ways the environment influences their perceptions and thinking (Jones et al., 2016). As the most stable form of human cognition, values underpin individual and group decisions (Cetas & Yasu, 2016). According to Ansong & Røskaft (2011), forest attitudes and behaviour are more driven by values than by sociodemographic factors. Values here, however, do not refer to the assigned monetary or financial worth of forest resources, rather they represent inherent perceptions/ideas or beliefs which people hold of the forest, forest resources, and forest conservation. They can therefore provide insight into people's diverse viewpoints regarding how they interact with and manage the natural world (Ives & Kendal, 2014).

Human value discourses in forest conservation management have often been presented as dualistic: conserving forest for nature's sake, i.e., preservation (intrinsic values), or human use i.e., utilization (instrumental or utilitarian values) (Tallis &

Lubchenco, 2014; Milfont & Duckitt, 2010). Intrinsic values are non-material values and represent the human belief that a forest or forest species should exist for its own sake, independent of its use or function (Fritz-Vietta, 2016). A cluster of these values can lead to biocentric or biospheric value orientations defined as nature-centred values (De Groot and Steg, 2008). Such value orientations are therefore expected to support forest conservation practices (Batavia and Nelson, 2017). Instrumental or utilitarian values are the human belief that forests should be used to satisfy human needs or to achieve a predetermined end (Fritz-Vietta, 2016). It is this kind of value that leads to the concepts of provisioning ecosystem services like timber and firewood extraction or medicinal forest use. It is egoistic, and a cluster of these values can lead to anthropocentric value orientations (Rickenbach et al., 2017). Although this value orientation has been criticized for tending to commodify forest resources (Rickenbach et al., 2017), divergent opinions and evidence remain regarding whether it supports or conflicts with forest conservation.

A third, more recent class of value discourse, is relational value, which has to do with preference judgment in how people relate with the natural world (Chan et al., 2016). This value type is premised on the fact that people rarely make conservation choices solely based on forests' inherent worth (intrinsic value) or on what they stand to gain from the forest (instrumental value) (Jones et al., 2016). This is because human conservation choices are also influenced by the perception of the appropriateness of one's relationship with the forest and with other forest users. A cluster of these value types can, therefore, give rise to another distinct but related value orientation, known as social altruistic values (Ives and Kendal, 2014). When social altruistic values are related to traditional ecological knowledge, practices, norms, and beliefs, as in the case of sacred forest conservation, it can lead to cultural values (Sinthumule and Mashau, 2020), which provide untapped opportunities for conservation (Cocks et al., 2012).

Several studies have examined human value-attitude-behaviour relationships under different contexts (Sugandini et al., 2017; Jones et al., 2016; Karki & Hubacek, 2015; Dietz et al. 2005; Ajzen; 1991). For example, Ajzen (1991) identified subjective norms, a form of social value, as one of the factors that determine intention to perform a particular behaviour. Dietz et al. (2005) examined values under different disciplinary perspectives and established that values are related to environmentalism. Following

the recognition of the importance of human values in environmental conservation, it is therefore important to analyze and synthesize what is known about how values are influencing forest attitudes and behaviours in order to provide a more robust knowledge base that will inform forest conservation policies and programmes. This paper, therefore, aims to examine the extent of evidence and knowledge gaps in the relationship between human values and forest conservation attitudes and behaviours, using the sub-Saharan Africa (SSA) region as a case study. Specifically, we ask: (i) what are the human value orientations influencing forest conservation attitudes and behaviour? (ii) how have human values influenced forest conservation attitudes and behaviours? and (iii) what are the geographic characteristics of forest conservation and human value evidence from SSA?

2.5 Methodology

We followed the established methodology for scoping reviews in the conservation and environmental literature (Peters et al., 2015; Pullin et al., 2018). A scoping review is a systematic literature review approach that seeks to map, analyze, and explain the wide range of available studies within a particular research area, thereby helping to identify relevant research gaps within a subject of study (Arksey and O'Malley, 2005). It is therefore a suitable approach to examine the extent of evidence and knowledge gaps regarding how human values influence forest conservation attitudes and behaviours.

A systematic search process was carried out using the framework for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which requires initial development of a review protocol (see appendix B). The protocol outlines the basic rationale and research questions for the review, conceptual definition of key terms (Table B.1 in the appendix B), literature search strategy development, data screening, and eligibility criteria, data extraction process, and quality assessment process for selected studies.

Two electronic databases relevant to environmental studies were searched, namely Web of Science and Scopus. We did not set a restriction on the earliest publication date, and all searches were conducted through to 5th November 2020. Search queries targeted three key concepts relevant to this study, (i) forest, (ii) value, and (iii) conservation, in SSA. The alternative terms and synonyms for these key concepts

were developed based on their reviews/conceptual framings in related institutional documents and extant literature (see Table B.2 in the appendix B).

2.5.1 Inclusion and Exclusion Criteria

To be included in the review, studies must have been published in English in a peer-reviewed journal. We included only original studies, so reviews, editorials, book chapters, and opinion discussions were excluded. Only studies that wholly or in part indicated a quantitative or qualitative relationship between human values (beliefs, motivational concerns/goals, perceptions) and forest conservation attitudes and behaviours were included. Quantitative studies here refer to those that used inferential statistics to determine the relationship or association between motivational concerns/goals and forest conservation attitudes and behaviours. Therefore, quantitative studies that employed a survey approach but used only descriptive statistics in analyzing and reporting their findings were excluded. Studies that used mixed-methods with descriptive analysis and qualitative analysis components were categorized as qualitative studies. However, only results from their qualitative analysis were extracted into our synthesis. Studies that examined attitudes or behaviours towards forest conservation without identifying the underlying values were excluded. We included all types of forest conservation following the IUCN (2008) guidelines for protected area management categories. These include all forms of protected forest areas such as national parks, forest reserves, community forestry including culturally protected forests, and other protected forest landscapes. Since our interest is in human values, we included only studies that defined value from the social science perspective, as a human-generated cognition (Reser and Bentrupperbäumer, 2005). Thus, we excluded studies that defined value solely from an ecological perspective because under this perspective, value is conceptualised as the natural properties, intrinsic features, attributes, or qualities inherent in a specific species or the natural environments, independent of humans. This, according to Reser & Bentrupperbäumer (2005) should not be referred to as environmental values, but should rather be reframed as environmental properties or attributes. Consequently, studies that examined animal behaviour rather than human behaviour within the context of forest conservation were excluded. Studies that solely focused on assigned economic or monetary valuation of the forest, or direct payments for ecosystem services, without including other non-monetary and indirect values were excluded, because they do not

represent the totality of inherent motivations, perceptions/ideas, or beliefs that people hold about the forest, forest resources, and forest conservation.

2.5.2 Data Screening and Extraction

A two-stage screening was independently carried out by two researchers (EJI and LS). First, studies were screened for suitability for inclusion using their titles and abstracts. Second, full-texts of the studies were screened. Inter-rater reliability was high (Cronbach's alpha = 0.97; a value >0.70 indicates a very good level of reliability (Taber 2018), indicating that the inclusion and exclusion criteria were clear and unambiguous. Disagreements during screening were discussed between the researchers until an agreement was reached.

Using a data extraction form (see Table B.3 and B.4 in the appendix B), six types of data were extracted, which covered: 1) The article (title, author, year of publication, and study location); 2) Background/contextual (objective of the study); 3) Methodology (study design, study population, sample size, data collection, and analysis); 4) Forest conservation (conservation strategy, and conservation attitudes and behaviours); 5) Value (subject/object of value, and motivational concerns/goals); 6) General results indicating how humans influenced forest conservation attitudes and behaviours.

2.5.3 Quality Assessment

Included studies followed many different research designs (e.g. quantitative, qualitative, mixed methods). This heterogeneity precludes carrying out a formal meta-analysis (Popay et al., 2006). Consequently, we used a narrative synthesis approach, which brings together pieces of evidence that tell a convincing story about the current state of knowledge regarding a research question, or about the effect of a particular intervention, or the need for policy response (Ryan et al., 2013). Although the use of vote counting in this approach can ignore the magnitude of effect size thereby tallying studies with varied sample sizes and valid statistical significance (Melendez- Torres et al., 2015), we mitigated some of these weaknesses by carrying out a critical appraisal, also known as a quality assessment, of the selected studies. This not only reduced the risk of using low-quality data in our synthesis but also enhanced the strength of our evidence (Haddaway et al., 2020).

We used two approaches to assess the quality of the reviewed studies. For quantitative studies, we used the Environmental-Risk of Bias tool and the Environmental-Grade tool for assessing the internal and external validity of environmental studies (Bilotta et al., 2014) (see Table B.5 and B.6 in the appendix B). The tools were adapted from the bias domains in the Cochrane Risk of Bias Assessment Tool originally designed for clinical and health studies. For a detailed definition of all the bias domains and an explanation of the criteria for judgment, see Bilotta et al. (2014). Using the 7-item Environmental-Risk of Bias tool, papers were judged as Low risk when all sources of bias are assessed as low risk, High risk when one or more sources of bias are assessed as high risk, and Unclear risk when one or more sources of bias are assessed as low risk and unclear risk (Bilotta et al., 2014). The result of the Environmental-Risk of Bias assessment fed into the 7-item Environmental-grade tool, which was used to produce the final score and determine the quality of the quantitative papers. The highest total possible score for cross-sectional and cohort studies was 9 and 10 respectively. Following the Cochrane Collaborations for Systematic Reviews, papers were graded into three quality categories: low quality (score: 1- 3), medium quality (score: 4 - 6), and high quality (7-9/10).

Qualitative studies were assessed using the 10-item Critical Appraisal Skill Programme (CASP, 2018) tool (see Table B.7 in the appendix B). To obtain a quality score for each study, we rated each item using a numeric score gradient: 0 for ‘No’, 1 for ‘Unclear’, and 2 for ‘Yes’. The highest total possible score for a study was 20. Using the total score for each study, we classified the studies into three quality categories: low quality (score: 1-7), medium quality (score: 8-14), and high quality (score: 14-20).

Quality assessment was carried out by two independent reviewers (EJI and MN). We compared the scores and discussed differences until a consensus was reached. The level of agreement between the two reviewers was calculated using Cohen’s Kappa inter-rater reliability test. For both quantitative and qualitative studies, we included only high- and medium-quality papers for our synthesis and excluded the low-quality papers. However, we carried out a sensitivity analysis to ascertain if the exclusion of low-quality papers would alter the result of our synthesis. Sensitivity analysis not only allowed us to confirm that the exclusion of studies perceived to be low quality will not

affect the generalizability of our review synthesis (Carroll & Booth, 2015) but also ensured that we did not include studies that will bias our findings or limit our recommendations (Soilemezi & Linceviciute, 2018). By repeating the analysis before and after removing the low-quality studies, sensitivity analysis allowed us to know to what extent removing the low-quality studies would alter the initial result from analysis. Details of excluded low-quality studies are in Table B.3 and B.4 in the appendix B.

2.5.4 Data Analysis

To identify the human value orientations influencing forest conservation attitudes and behaviours in SSA, we thematically mapped the different motivational concerns/goals that influenced people's interaction with the forest and their protection in the various studies into value types and categorized them into different value orientations. Three broad human value orientations emerged from the analysis: anthropocentric, biocentric, and relational value orientations. These value orientations correspond with Chan et al.'s (2016) three broad domains of the human value system in environmental conservation. We defined the value types using the motivational concerns/goals emanating from the studies.

To understand how human values have influenced forest conservation attitudes and behaviours, we carried out a sentiment analysis using the quantitative studies to ascertain how motivational concerns/goals (independent variables) have influenced forest conservation attitudes and behaviours (dependent variables) as positive (significant positive relationships), neutral (no significant relationship), or negative (significant negative relationships). Motivational concerns/goals are the underlying reasons, belief systems, and perceptions that depict an individual's value system (Reser & Bentrupperbäumer, 2005).

Following the approach used by Soilemezi et al. (2017), data from the qualitative studies were inductively analyzed to further understand the influence of human values on forest conservation attitudes and behaviours. Data here refers to texts described as 'results' or 'findings' in the qualitative studies (Thomas & Harden, 2008). Positive influences are results that show that value orientations supported or encouraged positive attitudes and behaviours towards forest conservation. Contrarily, negative influences are results which indicate that value orientation provided the basis for negative attitude or behaviours towards conservation.

Finally, to explore the geographic characteristics of forest conservation and human value evidence from SSA, we mapped how studies were distributed across the countries and sub-regions within SSA. Where a study was carried out in more than one country, we counted the countries where data was collected as individual study sites. Our review also included studies from non-independent territories that are geographically part of SSA. We examined how the proportion of forest area (% of land area) varies across the countries where the studies were carried out. We also examined the methodological details of the reviewed studies such as study design (cross-sectional study or cohort/longitudinal study), sample size, study population, data collection and analysis.

2.6 Results

Search from the Web of Science and Scopus electronic databases yielded 2,339 and 1,766 hits respectively. Reference lists of these papers were searched, and an additional six studies that met the inclusion criteria were identified, giving a total of 4,111 papers (Figure 2.1). Duplicates were removed and studies were screened using titles and abstracts. This resulted in 124 papers being taken forward to the full-text screening. The majority of the studies excluded at full-text screening did not wholly or in part indicate a quantitative or qualitative relationship between human values (beliefs, motivational concerns/goals, perceptions) and forest conservation attitudes and behaviours. Others were reviews, i.e., not original research (n=3), book chapters, i.e., not published in peer-reviewed journals (2), and not published in English (2). Full-text screening using other eligibility criteria such as relationships and conceptual definitions of human values and forest conservation reduced the number of papers to 23 and 25 quantitative and qualitative studies respectively.

Cohen's Kappa inter-rater reliability values for the quality of quantitative and qualitative studies were 0.679 ($p < 0.05$) and 0.711 ($p < 0.05$) respectively, which implied a good and significant level of agreement between the two reviewers. The outcome of environmental-risk of bias assessment showed that sixteen (70%) of the quantitative studies had unclear risk, four (17%) were of high risk, while three (13%) were of low risk (see Table B.8 in appendix B). The final outcome of quality assessment for quantitative studies using environmental-grade assessment tool showed that sixteen (70%) of the quantitative studies fall within the category of medium quality, five (22%) were of low quality, and only two (9%) were of high quality

(see Table B.9 in appendix B). For the qualitative papers, 15 (60%) were of high quality, eight (32%) were of medium quality, and two (8%) were of low quality (see Table B.10 in appendix B). The outcome of the sensitivity analysis showed that the low -quality studies contributed minimally to the formation of themes (value types) in the review synthesis and our final results.

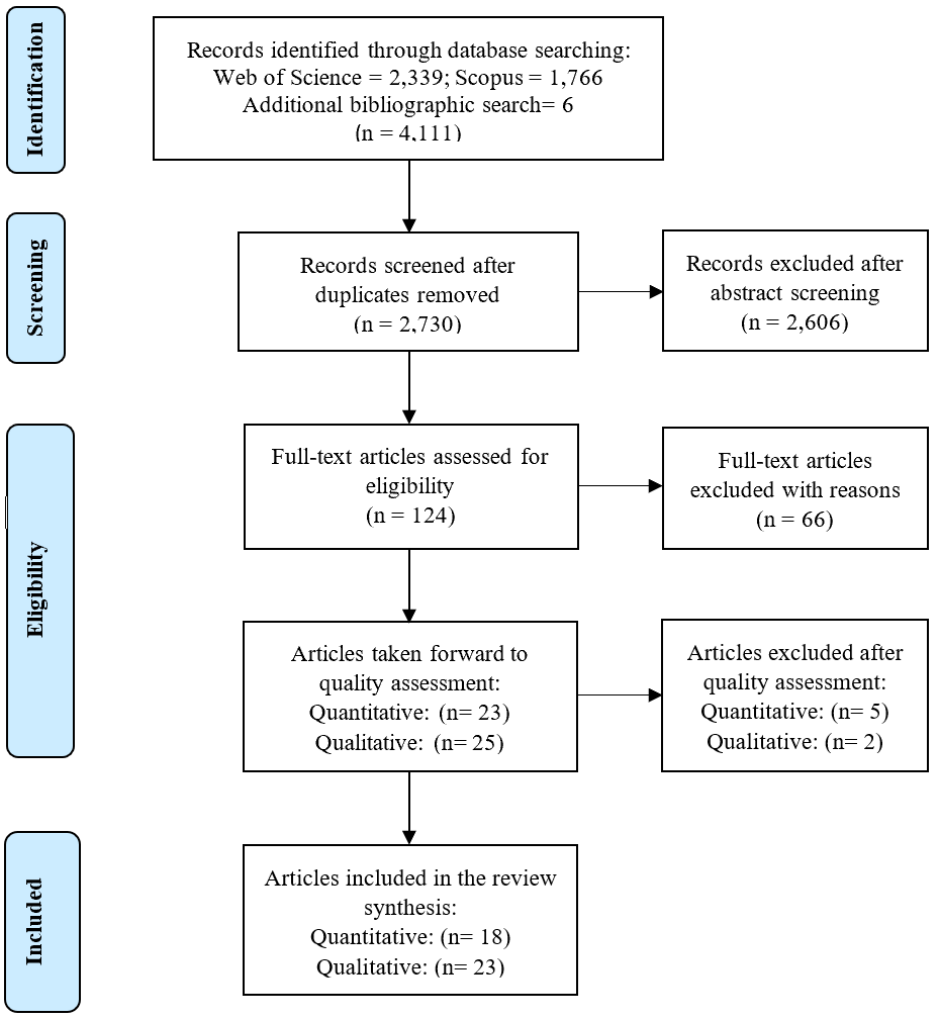

Figure 2.1: PRISMA flow chart for reporting systematic search process and results.

2.6.1 Study methodology

Almost all studies, both quantitative and qualitative, employed a cross-sectional study research design. Only two (one quantitative and one qualitative) were cohort studies. The sample size of quantitative studies ranged from 78 to 446 with a median of 226, while the sample size of qualitative studies ranged from 6 to 157 with a median of 44. While all quantitative studies used a questionnaire survey to collect data on human

values and forest conservation attitudes and behaviours, a majority (24) of the qualitative studies used interviews with a variety of other approaches such as focus group discussions (8), participant observation (2), oral histories (1), participatory mapping (1), participatory rural appraisal (1), and rapid rural appraisal (1). Study participants were drawn from a wide range of populations including forest and rural households (32), community leaders (9), farmers (8), clergy (3), hunters (2), traditional healers (2), shrine priests (1), ta ecotourists (1), and conservation experts (1).

2.6.2 Human value orientations influencing forest conservation attitudes and behaviour

Table 2.1 summarizes the value types deduced from the motivational goals/concerns influencing forest conservation attitudes and behaviour. Details of the motivational goals/concerns extracted from each study are presented in Table 2.2 and 2.3.

Table 2.1: Value types and value orientations deduced from motivational goals/concerns influencing forest conservation attitudes and behaviours in SSA.

Motivational goals/concerns	Value types	Value orientation
Perceived forest provisioning ecosystem services such as food, fuelwood, fruits, timber, medicinal uses	Subsistence/Economic forest values	Anthropocentric value orientations
Perceived impact of conservation on livelihoods		
Perceived and derived economic benefits from conservation such as income, employment, infrastructure.		
Perceived and derived economic costs from conservation such as human-wildlife conflict		
Perception of forest landscape as community heritage for livelihood support		
Access to the use forest resources in protected areas		
Dependency on forest resources		
Perceived forest regulatory ecosystem services such as climate regulation, rain formation, erosion control	Environmental forest values	
Perception of the forest as being beneficial for agriculture		
Perception of forest as being important for watershed protection		

and soil conservation		
Perception of protected areas as ecological entities		
Recreational forest uses	Recreational forest value	
Perception of the forest as a place of worship or spiritual protective covering (religious beliefs)	Cultural forest values	Relational value orientations
Perception of forest as ancestor abode and burial sites (traditional practices)		
Perception of forest as spiritual and cultural identity		
Traditional customs, rituals, taboos and norms		
Traditional totems, metaphors, folklores, proverbs, and myths		
Strength of forest conservation rule	Management forest values	
Level of involvement in forest management		
Subjective norms i.e., social pressure to perform a specific behaviour such as compliance with forest rules	Social forest value	
Sense of wellbeing from forest existence	Existence forest value	Biocentric value orientations
Respect, concern, and admiration for forest		
Protection of endangered species and forest wildlife habitat		
Preservation of forest for future generations	Bequest forest value	
Perception of forest aesthetics	Aesthetic forest value	

Table 2.2: Motivational goals/concerns and deduced values influencing forest conservation attitudes and behaviours in sub-Saharan Africa (SSA), extracted from 18 quantitative studies. Full details extracted from studies, including study objectives and methodologies, are provided in Table B.3 in appendix B.

Study (Year of publication)	Study location	Conservation attitudes and behaviours	Motivational concerns/goals	Deduced value types	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Araia & Chirwa (2019)	Thathe Vondo Forest Reserve and Mafhela Forest Reserve, South Africa	Compliance behaviour	1) Utility values and perceived impact on livelihood, 2) Watershed protection, 3) Strength of conservation rule, 4) Traditional norms, 5) protection of endangered species and forest wildlife habitat	1) Subsistence/Economic value, 2) Environmental value, 3) Management value, 4) Cultural value, 5) Existence value	People who perceived the utility values of forest, watershed protection, cultural values and protection of endangered species and forest wildlife habitat appeared to have positive compliance behaviour	There was no consensus on the strength of enforcement of rules		Medium quality (5)
Gebregziabher & Soltani (2019)	Tigray region in northern Ethiopia	Support exclosures in protected areas	1) Perceived and derived economic benefit from conservation e.g. employment, 2) Perceived forest benefit on reducing erosion	1) Subsistence/Economic value, 2) Environmental value	Local communities support exclosures if they perceive tangible economic and environmental benefits			Medium quality (5)
Abukari & Mwalyosi (2018)	Mole national park, Ghana and Tarangire National Park, Tanzania	Attitude towards national parks	1) Because of access to the use forest resources, and benefit from conservation project e.g. employment, 2) Perception of PAs as ecological entities	1) Subsistence/Economic value, 2) Environmental value	1) Respondents who have access to NTFPs have less negative attitude towards Mole national park, 2) Perception of PAs as ecological entities influenced positive attitudes	In Tarangire NP, access to forest resources had no significant effect on attitude	Low perception of benefits from conservation projects influenced negative attitudes towards PAs	Medium quality (5)
Nsonsi et al. (2017)	Nouabalé-Ndoki NP Northern Congo, Lobéké NP Cameroon, and Dzanga-Ndoki NP Central African Republic	Attitude towards forest elephant conservation	Perception of benefits from conservation e.g. employment, and perception of costs that comes with the conservation of elephant e.g. human-elephant conflict	Subsistence/Economic value	Benefits from conservation influenced positive attitudes towards the conservation of forest elephants		Conservation costs influenced negative attitudes	Medium quality (6)
Ofoegbu & Speranza (2017)	Vhembe district, South Africa	Intention to adopt sustainable forest management practices	Subjective norm i.e. social pressure to perform a specific behaviour	Social value	Subjective norms or beliefs about the approval or disapproval of sustainable forest management (SFM) practices by other relevant people mainly influenced the strong intention to adopt such practices.			Medium quality (5)

Study (Year of publication)	Study location	Conservation attitudes and behaviours	Motivational concerns/goals	Deduced value types	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Garekae et al. (2016)	Chobe enclave communities, Botswana	Attitude towards forest conservation	Knowledge of forest trees and dependency on forest resources	Subsistence/Economic value	Knowledge of forest trees and dependency on forest resources influenced positive attitudes towards forest conservation			Medium quality (5)
Meijer et al. (2016)	Mzimba and Chiradzulu districts, Malawi	Attitude towards cutting down forest trees	Subjective norm due to prevalent communal value which makes individuals have less control over the behaviour	Social value	Subjective norm influenced positive attitudes by reducing intention towards cutting down forest trees			Medium quality (6)
Dewu & Røskaft (2016)	Mole National Park and Digya National Park, Ghana	Attitude towards protected area	1) Perceived benefit from protected areas, 2) Perceived cost from conservation such as conflicts and losses which affects livelihood conditions	Subsistence/Economic value	Perceived benefit from conservation influenced positive attitude towards PA		Perceived cost from conservation influenced negative attitude towards PA	Medium quality (5)
Cobbinah (2015)	Kakum Conservation Area, Ghana	Attitude and involvement in forest management	1) Derived benefits from conservation such as employment and income, 2) Involvement in management	1) Subsistence/Economic value, 2) Management value	Positive attitudes and increased participation in conservation were largely influenced by derived economic benefits and involvement in forest management.			Medium quality (6)
Baker et al. (2014)	Akpugoeze Enugu State, and Lagwa Imo State, Nigeria	Behaviour towards conservation of monkey	1) Traditional belief, 2) perception of wildlife as a threat to farms	1) Cultural value, 2) Subsistence/Economic value	The traditional belief associated with monkey influenced their protection		Monkeys crop and garden raiding activities encouraged the killing of monkeys	Medium quality (6)
Hartter et al. (2014)	Kibale National Park, Uganda	Attitude towards protected area	Perceived regulatory ecosystem services such as climate regulation, rain formation	Environmental value	Perceived regulatory ecosystem services from national park influenced positive attitudes towards protected area			Medium quality (5)
Nielsen & Meilby (2013)	Udzungwa Mts, Tanzania	Illegal hunting	Perceived benefit from a conservation program	Subsistence/Economic value			Perceived low benefit from conservation motivated continued illegal hunting	High quality (9)

Study (Year of publication)	Study location	Conservation attitudes and behaviours	Motivational concerns/goals	Deduced value types	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Ramcilovic-Suominen et al. (2013)	Dormaa, Begoro, and Juaso in the High Forest zone, Ghana	Compliance to tree felling rule	1) Extraction of timber, cash crops, earnings from selling forest products, household items, firewood, 2) Clean and healthy air, water, soil, rainfall, shade, animal habitat, 3) Preservation of forest by future generations, 4) Perception of the forest as a place of worship	1) Subsistence/Economic value, 2) Environmental value, 3) Bequest value, 4) Cultural value	Farmers who ascribe high importance to economic forest values and religious forest values are more likely to comply with the tree-felling rule	The study found no association between compliance and subsistence forest values, environmental forest values, and bequest forest values		Medium quality (5)
Sharaunga et al. (2013)	KwaZulu-Natal, South Africa	Participation in community forestry	1) Extraction of firewood, medicinal uses, 2) Preservation of forest by future generations, 3) Sense of wellbeing from forest existence, 4) Recreational uses, 5) Forest uses as a place of worship, burial sites, and ancestor abode	1) Subsistence/Economic value, 2) Bequest value, 3) Existence value, 4) Recreational value, 5) Cultural value	People who hold bequest forest value, existence forest value, recreational forest value, religious/spiritual forest values, and traditional forest value are likely to participate in managing the community forest		People who hold subsistence forest values and medicinal forest values are less likely to participate in managing the community forest	Medium quality (6)
Ezebilo (2012)	Cross River National Park, Nigeria	Satisfaction with community forest project	Contribution of forest project to income from cash crops	Subsistence/Economic value	Respondents who feel that the forest project contributes to their income are satisfied with the forest project			Medium quality (5)
Tesfaye et al. (2012)	Dodola woreda district, Ethiopia	Intention and attitude towards tree planting	1) Forest dependence 2) Subjective norm i.e. perceived behavioural control	1) Subsistence/Economic value, 2) Social value		Subjective norm had no significant effect on intention and attitude towards participation in forest management	One of the factors that negatively influenced intention and attitude to participate in forest management is forest dependence.	Medium quality (6)
Ansong & Røskaft (2011)	Subri Forest Reserve, Ghana	Attitude towards forest reserve	1) Dependence on the forest for livelihood, 2) Preservation of forest for the future generation, 3) Respect, concern, and admiration for forest	1) Subsistence/Economic value, 2) Bequest forest value, 3) Existence value	Respondents who are concerned about the forest or for a future generation had higher attitude score		Respondents who depend on the forest reserve for their livelihood had lower attitude score than those who not derive benefit	Medium quality (6)
Morgan-Brown et al. (2009)	Msasa and Kwezitu in the East Usambara Mountains, Tanzania	Participation in a conservation project	Contribution of the forest to the success of butterfly farming.	Environmental value	Farmers believed butterfly farming would be impossible if local forests were cleared, and butterfly farmers reported significantly more participation in forest conservation behaviours			High quality (8)

Table 2.3: Motivational goals/concerns and deduced values influencing forest conservation attitudes and behaviours in sub-Saharan Africa (SSA), extracted from 23 qualitative studies. Full details extracted from studies, including study objectives and methodologies, are provided in Table B.4 in appendix B.

Study (Year of publication)	Study location	Conservation attitudes and behaviours	Motivational concerns/goals	Deduced value type	General result	Quality score
Rafidison et al. (2020)	Eastern side of the Malagasy Highlands, Madagascar	Compliance to forest rule	1) Because of the usefulness to Ficus species to livelihoods, 2) watershed protection, soil conservation, 3) Spiritual and cultural identity, 4) protection of forest wildlife habitat	1) Subsistence/Economic value, 2) Environmental value, 3) Cultural value, 4) Existence value	The protection of the nine Ficus species is driven by their multiple uses and varies depending on their distribution in social–ecological facets. Ficus trees that grow from self-sown seedlings near social–ecological facets such as tombs, steles, abandoned ancient villages or elements of landscapes such as large rocks, are systematically protected.	High quality (14)
Sinthumule & Mashau (2020)	Thathe Vondo sacred forest, South Africa	Compliance to forest rule	Traditional Ecological Knowledge (TEK)- Belief (Religious/Spiritual), customs, rituals, myths (Traditional roles)	Cultural value	The key TEK that is used to conserve sacred forest in the study area includes rituals and customs for the protection of ancient burial grounds. The positive attitudes equated to compliance as local communities were found not to harvest fuelwood or hunt in the sacred forest because of TEK.	High quality (16)
Mavhura & Mushure (2019)	Nharira communal lands of Chikomba district, Zimbabwe	Promote natural resource conservation	Indigenous knowledge customary rules and regulations, rituals, taboos, totems, metaphors, and proverbs	Cultural value	Indigenous knowledge constitutes the social and religious values of the Nharira community that are used in conserving the human-environment system. However, shifting values resulting from change of faith from traditional belief to Christianity are eroding indigenous practices used for forest and wildlife conservation.	High quality (17)
Mmahi & Usman (2019)	Kainji Lake National Park, Kaiama; Nigeria	Compliance to forest rule	Perception of forest landscape as community heritage for livelihood support	Subsistence/Economic value	Findings from the study showed that community rationalization and justification of hunting as their heritage, and perception of the establishment of KNP as an incursion on their heritage was a major force propelling illegal hunting and pressure on the park.	Medium quality (13)
Ruelle et al. (2017)	Debark District, Ethiopia	Conservation of indigenous forest tree species	Knowledge about customs and traditional ethos of tree planting	Cultural value	Ethiopia's church forests nurture the knowledge necessary to promote plant diversity in the rest of the landscape and serve as archetypes for community-driven conservation.	High quality (15)
Costa et al. (2017)	Tombali region, Cantanhez Forest National Park, Guinea Bissau	Attitude towards conservation	Perception of conservation as a threat to people's welfare	Subsistence/Economic value	Women felt the Park was responsible for malnutrition in the communities due to damage of crops by wildlife.	High quality (19)
Asante et al. (2017)	Ashanti Region, Ghana	Protection of indigenous forests	Traditional practices and religious belief	Cultural value	Beliefs, taboos, myths, proverbs, and songs were vital traditional systems used by the Ashantis to effectively conserve their forests. Cultural practices and traditional beliefs were found to be more useful in conserving forests more than the government-controlled forests	High quality (16)

Study (Year of publication)	Study location	Conservation attitudes and behaviours	Motivational concerns/goals	Deduced value type	General result	Quality score
Klepeis et al. (2016)	South Gondar Administrative Zone of the Amhara Regional State, Ethiopia	Protection of sacred church forest	Belief and traditional roles such as burial sites	Cultural value	Church forests represent an unusual form of community-based protection that integrates locally controlled common property with external institutional arrangements: this hybrid system is highly effective at protecting the forest while maintaining cultural practices	Medium quality (13)
Fritz-Vietta (2016)	Mananara-Nord, and the SahamalazaIles-Radama Biosphere Reserves, Madagascar	Achievement of wellbeing	1) Use of forest woods, medicinal plants, food, 2) Protection against erosion, 3) Forest aesthetics	1) Subsistence/Economic value, 2) Environmental value, 3) Aesthetic value	The local population's views on valuable natural elements serve to indicate what they consider important for the achievement of well-being	High quality (16)
Fraser et al. (2016)	Gbarpolu, Bong, Lofa, and Nimba in Northwestern, Liberia	Attitude towards agroforestry	Ancestor worship and ritual	Cultural value	Sacred agroforests are shaped and conserved by local cultural institutions revolving around ancestor worship, ritual, and the metaphysical conceptual category. However, the practice of sacred agroforestry is under threat from a generational shift in cultural valuation as youths have begun to challenge cultural worldviews such as sacredness of forests.	High quality (15)
Irakiza et al. (2016)	Buhanga sacred forest in Musanze District, Rwanda	Protection of sacred forest	1) Traditional norms, 2) the use of medicinal plants	1) Cultural value, 2) Subsistence/Economic value	Cultural norms and values associated with the sacred forest has led to non-exploitation.	Medium quality (13)
Ouma et al. (2016)	Kakamega Forest, Kenya	Sustainable forest use	Beliefs, practices, and norms	Cultural value	The local community applied various beliefs, practices, and norms to regulate the use of Kakamega Forest.	High quality (14)
Mariki (2013)	Kiliimanjaro National Park, West Kilimanjaro Forest Plantation, Tanzania	Attitude towards conservation	1) Benefits from conservation (income, employment, infrastructure), 2) Involvement in park management	Subsistence/Economic value	The extent of participation and amount of benefits accrued are found to have a paramount role in determining local people's attitude to conservation.	High quality (14)
Baker (2013)	Akpugoeze, Enugu State and Lagwa Imo State, Nigeria	Support for the conservation of Sclater's monkeys	Belief, taboos, folklores	Cultural value	Folklore contributed to the continual observance of the taboos against harming monkeys. However, support for the taboos is weakened by the monkeys' crop- and garden-raiding activities and, due to widespread adoption of Christianity by residents.	High quality (16)
Cocks et al. (2012)	Grahamstown, Alice, and Peddie districts of the Eastern Cape Province, South Africa	The wellbeing of local people	Perception of the forest as a spiritual protective covering	Cultural value	Maintenance of biodiversity and natural vegetation is as much in the interest of the local community's well-being as it is in the interest of conservation planners. This is because of the local peoples' perception of the forest as a spiritual protective covering, a place that bestows spiritual health and well-being	Medium quality (13)

Study (Year of publication)	Study location	Conservation attitudes and behaviours	Motivational concerns/goals	Deduced value type	General result	Quality score
Scales (2012)	Central Menabe, Madagascar	Sustainable forest use	1) Perception of the forest as inexhaustible material and beneficial for agriculture, 2) Perception of the forest as an abode of spirits and ancestors	1) Subsistence/Economic value, 2) Cultural value	There is a misunderstanding of the values and beliefs of rural households. The forest is not seen as something to be protected but to be respected and used responsibly according to *fady* and the ancestors.	High quality (16)
Fournier (2011)	Bondoukuy region, Burkina Faso	Protection of forest vegetation	Beliefs and ritual practices	Cultural value	Ritual practices are much more diverse and fluid than might have been supposed. Protection 'by tradition' is thus rather different from what we call conservation. While vegetation does matter, its presence on sacred sites is not essential. It shows the inadequacy of sacred forests as a category of forest conservation	Medium quality (12)
Tabuti et al. (2009)	Nawaikoke Sub-county, Uganda	Willingness to conserve forest woody species	Economic uses of forest woody species	Subsistence/Economic value	The study shows that community members are interested in conserving prioritized trees with utility values and ignore others	Medium quality (13)
Jones et al. (2008)	Fianarantsoa province, Madagascar	Protection of endemic forest species	Taboos, norms	Cultural value	Taboos reduced pressure on some economically important endemic species by preventing their sale or limiting the harvest season	High quality (16)
Tengö et al. (2007)	Southern Androy, Madagascar	Protection of endemic forest species and conservation of forest landscape	Taboos, sanctions	Cultural value	Over 90% of the total remaining forest cover is protected through taboos, these informal institutions represent an important, and presently the only, mechanism for conservation of the highly endemic forest species.	Medium quality (12)
Ormsby& Kaplin (2005)	Masoala National Park in north-eastern, Madagascar	Perception of a national park	Derived or perceived benefits from the park	Subsistence/Economic value	One of the factors found to influence the perceptions of the park is actual or potential benefits received from the park	High quality (16)
Marcus (2001)	Masoala, Ranomafana, and Andohahela National Parks, Madagascar	Support for a conservation project	Perception of benefit and cost of conservation, e.g. impact on the livelihood	Subsistence/Economic value	Focus group responses, however, indicate that while some people may feel they are benefiting from land-use change initiatives, they do not associate these with the park	Medium quality (12)
Lykke (2000)	Fathala Forest, Senegal	Attitude towards conservation	1) Material benefits derived from woody forests such as timber, medicinal forest uses, 2) Belief that the forest brings rain.	1) Subsistence/Economic value, 2) Environmental values	The study shows that local people expressed concern about the status of the woody vegetation and a wish for its conservation. However, their positive attitude towards conservation is motivated by the material benefits they derive from the woody forests	High quality (15)

2.6.3 Anthropocentric value orientation

Fourteen (from 18) quantitative studies identified subsistence/economic values which are motivated by human dependence on the use of forest resources or the perceived/derived impacts of conservation on individual/household income and livelihood. Subsistence/economic value was associated with factors such as benefits of forest provisioning ecosystem services (e.g. extraction of firewood, timber, fodder, food, fruit, meat, medicinal forest uses), benefits of conservation projects (e.g. employment, road construction), and cost of conservation projects (e.g. human-forest conservation conflict, loss of livelihood due to conservation). Eleven out of the 23 qualitative studies also identified this subsistence/economic value. Environmental value was another type of anthropocentric value orientation that is relatively common in many studies. Six and three quantitative and qualitative studies respectively identified this value type, motivated by the ecological functions of the forest or the derived/perceived benefits of forest regulatory ecosystem services such as watershed protection, rain formation, soil protection, erosion control, provision of clean and healthy air. Only one quantitative study identified recreational value, which is the human value that seeks to use the forest for recreational pursuits. Overall, more studies (66%) identified anthropocentric value orientations than any other value orientation.

2.6.4 Relational value orientation

The most common relational value type found in the reviewed studies was cultural value. Most (15 out of 23) of the qualitative studies identified this value type, while four quantitative studies identified it. The motivational goals/concerns associated with cultural values are linked to traditional practices, customs, religious beliefs, and perceptions about the forest and forest resources. Many local people who hold this value perceive the forest either as a place of worship or as an ancestral abode that offers some sort of spiritual protection. Traditional tools used to protect such forests include norms, sanctions, taboos, myths, folklores. Another relational value type identified by only three quantitative studies was social value, motivated by subjective norms, i.e., social pressure to perform specific behaviour that affects forests or forest conservation. Management value, which relates to people's perception of forest management strategies, level of involvement and

participation in conservation management, or strength of conservation rules, was identified by only two quantitative studies and one qualitative study. Overall, many studies (56%) identified relational value orientation after anthropocentric value orientation.

2.6.5 Biocentric value orientation

We identified three value types that fall under the category of biocentric value orientation. The first was existence value which is motivated by a sense of wellbeing, respect, concern, and admiration for forest existence. However, only three quantitative studies and one qualitative study identified this value type. Bequest value was another biocentric value type motivated by the preservation of forests for future generations. Only three quantitative studies identified this value type. Aesthetic value is the human value motivated by the intrinsic attraction to the beauty of the forest landscape or forest resources. Only one quantitative study identified this value type in our review. Overall, biocentric value orientation was the least covered of the value types identified by studies in SSA (12%).

2.6.6 Influence of human values on forest conservation attitudes and behaviours

Studies identified different forest conservation attitudes and behaviours (Tables 2.2 and 2.3) such as compliance to forest rules, sustainable forest use, participation in forest management, support for protected areas, local acceptance of conservation projects, attitudes towards protected areas or towards conservation practices, preference for forest conservation, intention to adopt sustainable forest practices, and satisfaction with forest projects, and willingness to pay for conservation. Out of the 18 quantitative studies, 11 that identified anthropocentric value orientations highlighted positive influence on one or more forest conservation attitudes and behaviours, while eight studies identified negative influences. Only two studies reported neutral (no effect) influence of anthropocentric values on forest conservation attitudes and behaviours.

We found that anthropocentric value orientation linked to the perception of forest provisioning ecosystem services, benefits from conservation projects (subsistence/economic values), perception of forest regulatory ecosystem services (environmental value), and recreational forest values, positively influenced people's

support for conservation, willingness to pay for conservation, involvement and participation in conservation management and practices, and compliance with forest rules. Anthropocentric values linked to dependence on forest resources, low benefits from conservation projects, and costs of forest conservation such as human-wildlife conflicts (subsistence/economic values), influenced negative attitudes and behaviours like disobedience of forest rules resulting in increased hunting and poaching, pressure on protected areas, less support for or unwillingness to participate in conservation, and generally negative attitudes towards protected areas. The results from qualitative studies also supported those of the quantitative studies. Out of the 11 qualitative studies that identified anthropocentric values, eight reported that several positive conservation attitudes and behaviours such as willingness to conserve forest species, sustainable forest use, participation in conservation projects, and protection of forest landscapes were motivated by utility values of forest resources (e.g. medicinal uses, food, timber), derived conservation benefits (e.g. income, employment, infrastructure), and perceptions of forest as being beneficial for agriculture (e.g. the forest brings rain).

Cultural values were the dominant relational value identified by the studies. All four quantitative studies that identified cultural value highlighted its positive role in the preservation of forest and forest species with sacred status. Out of the 15 qualitative studies that identified cultural values, 13 reported that cultural practices, traditional religious beliefs, rituals, customs and taboos have played a key role in preserving forest landscapes and forest species with sacred status.

Two out of the three quantitative studies that identified social value highlighted its positive effect to influence intention to comply with forest rules, while only one study highlighted a neutral effect. The studies that identified management value highlighted that forest management strategies that involve local people or are perceived as strong, positively influenced participation and preference for conservation.

Although few studies identified biocentric value orientation, both the quantitative and qualitative studies that highlighted existence, aesthetic, and bequest values show that they positively influenced attitudes towards forest conservation. People who hold such values are more likely to participate in and support forest conservation practices.

However, two out of the three quantitative studies that identified bequest values reported a neutral effect. No record of negative influence on forest conservation attitude and behaviour was associated with the biocentric value orientation.

2.6.7 Geographic characteristics of forest conservation and human value evidence in SSA

The 41 included studies were conducted in 19 of the 52 countries in SSA (Figure 2.2). Madagascar (n=7), South Africa (n=5), Ghana (n=5), Ethiopia (n= 4), Nigeria (n=4), and Tanzania (n=5) hosted the most studies. The proportion of forest area (% of land area) varies across these six countries, with Tanzania having the most at 52% and Nigeria the least, with 7%. Except for Guinea Bissau (70% forest area) and Congo (65% forest area) where we found one study each, we did not find studies in the top 10 countries with the largest forest area in the SSA, such as Gabon (90% forest area), Seychelles (88% forest area), Democratic Republic of the Congo (67% forest area), and Zambia (65% forest area). We found two different studies carried out in more than one country (Nsonsi et al., 2017; Abukari & Mwalyosi, 2018). However, no single study was carried out across the entire region.

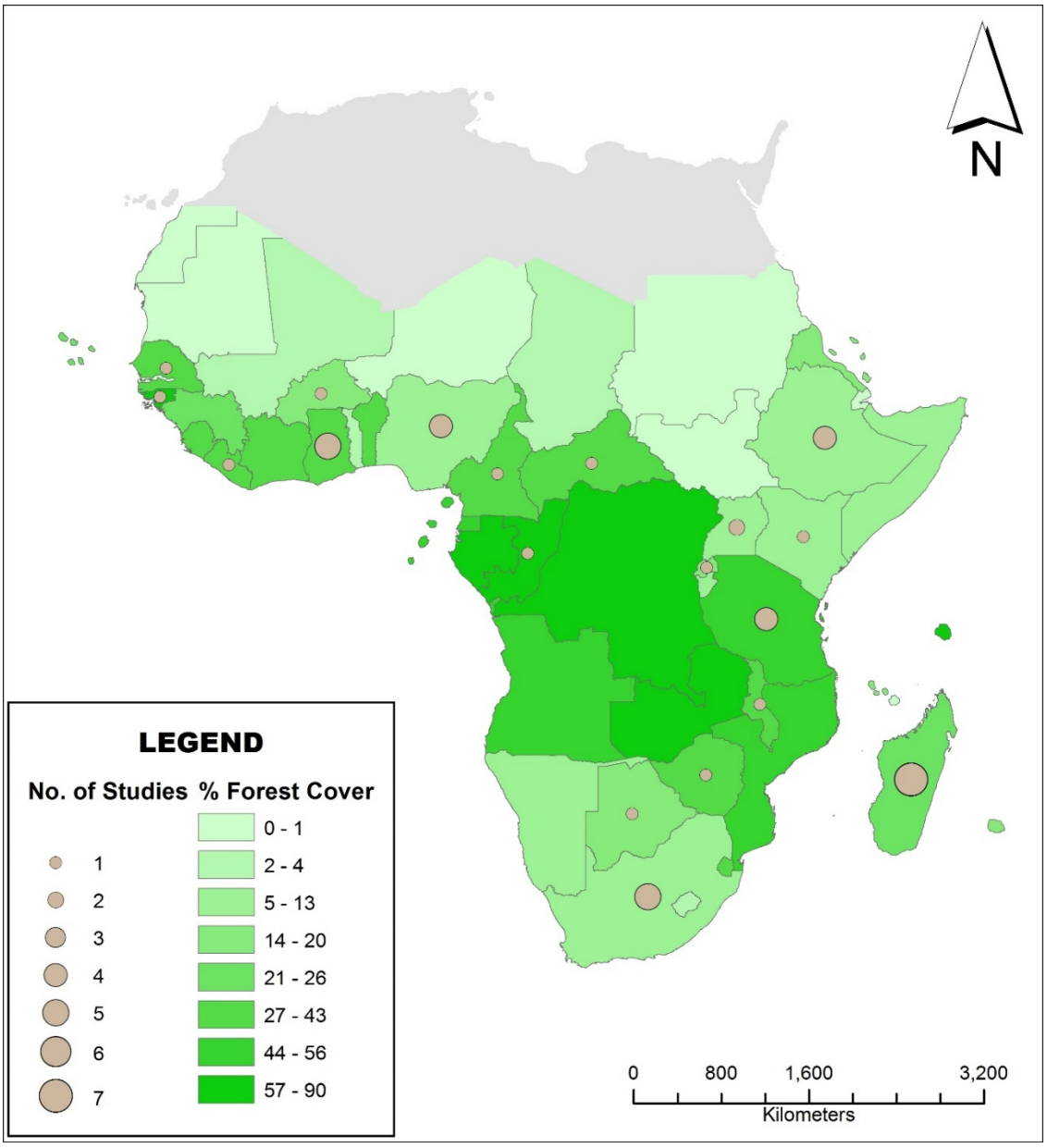

Figure 2.2: Map of Africa showing 19 countries in the sub-Saharan region where the selected studies for the review were carried out. The bubble sizes represent the number of studies selected from each country. The deeper green shades show countries with a higher proportion of forest area (% of land area), while the lighter green shades are countries with a smaller proportion of forest area (FAO, 2016).

2.7 Discussion

The concept of value is multifaceted and can influence human attitude and behaviour towards forest conservation in many ways. This scoping review identified the range of human values influencing forest conservation and provides novel insight into the directional influence of value orientations on forest conservation attitudes and behaviours. The findings suggest that anthropocentric and relational value orientations can both positively and negatively influence a number of forest conservation attitudes and behaviours, albeit with more evidence for positive influence, which depends on the perception or motivational goal/concern driving the value.

2.7.1 Anthropocentric value orientation

Regarding anthropocentric value orientation, the perception of forest provisioning and regulatory ecosystem services (economic/subsistence and environmental values), benefits from conservation projects, and knowledge of other non-use forest values, generated instrumental value systems. Such systems provided the basis for positive attitudes and rural support for conservation and contributed to the protection of endemic forest species. As reported by Störmer et al. (2019), high conservation benefits trigger positive attitudes towards conservation. This confirms the evidence from previous studies that conservation projects designed to provide economic benefits, support livelihoods, and build local capacities are more successful than those that strictly focus on biodiversity conservation (Brooks et al., 2012, Nilsson et al., 2016). This suggests that conservation initiatives that incorporate economic and social development components are more likely to lead to positive attitudes and behaviours towards forest conservation.

On the contrary, anthropocentric values linked to dependence on forest resources, low benefits from conservation, or associated conservation costs, tend to trigger negative conservation attitudes and behaviours. Several studies from other developing countries have shown that high dependence on natural resources is associated with individuals and households of low-income status who also lack alternative means of livelihood (Abdullah et al., 2016; Hussain et al., 2019). This is very common in SSA where over 70% of the rural population directly or indirectly depend on the forest for their livelihood (World Bank, 2017). Such people may perceive conservation efforts such as forest reserves as a threat to their livelihood, especially when the conservation strategy restricts their access to

forest resources (Tesfaye et al., 2012). One way to accommodate people with such anthropocentric values is to design and follow conservation strategies that not only engage and involve local people in conservation management, but also allow them to sustainably use forest resources (Sharaunga et al., 2015; Garekae et al., 2016).

The overall review of anthropocentric values shows that, contrary to arguments that anthropocentric values can be in opposition to environmental conservation, (Kopnina et al., 2018; Sharaunga et al., 2013), it appears that such values can also be a powerful source of motivation to draw support for conservation. People who hold anthropocentric value orientations can participate in forest conservation especially when conservation efforts involve local participation and are beneficial to humans. This, however, should not be mistaken for biocentric value because of the difference in their motivational goals or concerns. While support for conservation emanating from biocentric values is motivated by intrinsic concern for nature, the support emanating from anthropocentric values is motivated to use and material benefits, a philosophy known as shallow ecology (Gaia & Jones, 2017).

2.7.2 Relational value orientation

Relational value orientation was dominated by cultural values in SSA. We found evidence suggesting that the perceptions of the forest through a cultural lens positively influenced a number of conservation attitudes and behaviours, although this seems to be limited to forest landscapes with sacred/religious status. Studies showed that people with cultural values revere the forest and seek to achieve a feeling of transcendence through interaction with it. This type of value elicits a kind of cultural-ethical concern regarding the use of forest resources, thereby conferring a moralistic value on the forest (Kellert 1996; Herrmann et al., 2013). This value not only promotes its sustainable use but has also led to the conservation of indigenous forest species. For instance, several forest trees like the African Yellowwood Tree (Afrocarpus falcatus) in South Africa and Ethiopia, forest animals like Sclater's Monkey (Cercopithecus sclateri) in Nigeria, Mona Monkey (Cercopithecus mona) and Patas Monkey (Erythrocebus patas) in Ghana, all owe their continued existence to the traditional beliefs and customs associated with them (Ormsby, 2012; Baker et al., 2014).

In some cases, traditional systems and knowledge-bases were found to be more useful in conserving forests than government rules. The maintenance of forest biodiversity is also as much in the interest of the local people as it is in the interest of conservationists, due to local people's perceptions of the forest as a place that provides spiritual well-being or communal identity. Some studies from other parts of the world have shown that the perception of the forest as a sacred geographical space, a place of worship, and an abode of ancestral spirits, confers a spiritual and symbolic value on the forest (Kellert 1996; Huang et al., 2020). These values have served as a crucial instrument for the conservation of such forests. Reflecting on the cultural value approach to conservation, Infield et al. (2017) noted that cultural values can enhance efficacy, equity, and acceptability of conservation projects. In comparison to other protected forest landscapes, it appears that forest loss or forest exploitation is lower in forests considered sacred than those not linked to any form of cultural value (Asante et al, 2017). In India, Ambinakudige & Sathish (2019) reported that species richness and diversity were greater in sacred forest landscapes than in other landscapes without sacred status. Similarly, Araia & Chirwa (2018) found that compliance behaviour was more positive in culturally protected forests than in state-protected forests which recorded more non-compliance to forest rules. Sacred forests, therefore, act as shadow conservation sites by maintaining and preserving forest biodiversity as a by-product of their religious and cultural roles (Cardelús, et al., 2015). Various international bodies such as the United Nations Convention on Biological Diversity (UNCBD), Fauna & Flora International, World Bank, and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) all recognized this cultural dimension of human values in forest conservation. For example, Article 8 (j) of the UNCBD notes the need to recognize and preserve indigenous practices related to the sustainable use of forest biodiversity among local communities (United Nations, 1992).

Despite the positive effects of cultural values, reliance on them for sustainable forest conservation should be approached with caution, because of their vulnerability to the influence of stronger external factors and socio-cultural changes occurring within rural communities such as spread of foreign religions like Christianity and Islam, rapid population growth, globalization, and the diminishing regard for culture and tradition

among young people (Mavhura & Mushure, 2019). These factors pose a threat to the potency of cultural values to sustain local conservation norms and cultural practices and have contributed to their gradual decline within the SSA region. The erosion of cultural values and practices used for forest conservation also points to the inadequacy of cultural values to support conservation. Further, some cultural practices have been perceived as inimical to modern society due to their restrictions on human freedom (Cardelús, et al., 2015), while others such as the *hatsake* (slash-and-burn agricultural practice) in Madagascar has been described as destructive and unsustainable, and detrimental to forest conservation by conservation experts (Scales, 2012). Other studies have revealed that the strong cultural attachment to some forests has made it difficult for local people to accept some conservation efforts, especially those limiting their access to the forest (Nkemnyi et al., 2013). Consequently, cultural value can be a weak and inadequate value system for conservation (Jones et al., 2008; Sinthumule & Mashau, 2019).

2.7.3 Biocentric value orientation

Unlike in many developed countries where different studies have shown that biocentric value orientation is fast gaining prominence (Bengston et al., 2004; Taylor et al., 2020), we found very few studies that identified the presence of this value orientation in SSA. While this may be a result of the lack of studies focusing on biocentric value orientation, it may also be connected to the poor economic status of the region. As posited by Bettin & Wollni (2018), low-income populations who are still grappling with basic livelihood needs may find it difficult to appreciate the forest for its intrinsic values. This does not mean that people of low-income status do not care about the environment. On the contrary, they have a stronger basis to be concerned about environmental issues because of their high vulnerability to the effects of environmental disasters (Eisenstadt & Jones, 2017). The challenge, therefore, may likely be that their poor economic status acts as a barrier by offering them limited opportunity to appreciate the forest without attaching any utility value. One possible way to flatten the effect of this economic barrier is to intensify environmental education efforts within the region. According to Chen (2019), irrespective of economic status, people's biocentric value increases when they are aware of the impact of their environmental decisions and behaviours.

2.7.4 Geographic characteristics of forest conservation and human value evidence in SSA

Geographically, the body of evidence from the southern Africa sub-region concentrated in Madagascar and South Africa, neglecting other southern African countries with greater proportions of forest areas such as Zambia, Angola, and Mozambique. As is standard practices, our scoping review was restricted to the peer-reviewed literature, which is largely written in English. This may mean that some findings from Francophone and Lusophone countries were not included. However, a substantial number of studies were carried out in Madagascar, which illustrates that language is not necessarily a primary driver of the geographic patterns we observe. The dominance of studies in Madagascar may be related to the unique biodiversity in the country which has attracted substantial research and conservation interest and investment. For instance, Madagascar has a network of over 100 protected areas. Furthermore, of its 10,000 tree species, 90% are endemic (Waeber et al., 2019). Previous studies have shown that research efforts in a particular area lead to more research (Lima et al., 2011). The dominance of studies from South Africa may be related to the fact that the country has the most developed research-base in SSA. A breakdown of research collaborations and publications in Africa by Adams et al. (2014) shows that research outputs from southern Africa are dominated by South Africa. Overall, studies from southern Africa sub-region show that forest conservation has been largely influenced by cultural values linked to the protection of sacred forests and bio -cultural forest species and utilitarian values linked to the protection of forest trees with economic benefits.

In East Africa, while the majority of studies from Ethiopia were around the conservation of church forests associated with the Ethiopian Orthodox Christian religion, studies from Tanzania focused more on conservation around national parks and forest reserves. In West Africa, the majority of the studies which came from Ghana and Nigeria focused on the conservation of bio-cultural forest species, sacred forests, and also conservation around national parks. Central Africa, despite being the sub-region with the highest proportion of forest area in SSA, had the least number of studies, although this may be attributed to the fact that the majority of countries in this sub-region are French-speaking

and so most likely to publish in non-English journals. Further, research may be difficult given political situations and conflicts in several Central African countries, resulting in a lower number of published papers.

2.8 Conclusion

Effective forest conservation requires in-depth knowledge and understanding of the values that drive attitudinal and behavioural preferences towards forests and their protection. In this review, nine value types that fall within three broad human value orientations influencing forest conservation attitudes and behaviours in SSA emerged. Using a pluralist approach to examine human values influence, we provide novel insight into how value orientations can positively or negatively influence several forest conservation attitudes and behaviours. Unlike the unidimensional approach which measures human values using a single scale such as the monetary worth of forest resources (e.g. D'Amato et al., 2016), thereby providing a partial view of people's forest values, we employed a multidimensional scale which recognizes the diverse values people hold of the forest and its conservation.

While several studies recognized the potential of cultural values to support the conservation of community forests, especially those with sacred status, there are still mixed conclusions regarding the sustainability and effectiveness of this value orientation to achieve conservation goals in the face of multiple challenges. There is, therefore, a need for more in-depth studies to understand the broader values of culturally protected sacred forests. More studies are also needed to examine the status of biocentric values, especially in SSA and factors affecting such values, considering the low number of studies that have identified this value orientation in the region. Finally, considering the significant effects of human values on forest conservation, further research in this area may usefully examine how various national forest conservation policies have integrated the concept of human values.

Conservation activities can restrict local people's value of the forest to only the utilitarian dimension (Rickenbach et al., 2017). However, the attitudes and behaviours of most local people towards forests and their conservation is influenced by both anthropocentric (especially utilitarian, economic/subsistence values) and relational values (especially

cultural values). Forest conservation can be both a means of preserving their source of livelihood and also a mechanism for maintaining their source of spiritual connection and traditional practices. This understanding is critical for successful conservation because, one of the common features of human values is that they are contextually specific and most times embedded within a culture (Jones et al., 2016). As noted by Manfredo et al. (2016), they are also unlikely to change for the sake of conservation. Conservation managers should therefore first understand the prevalent and dominant contextual values guiding people's perception and interaction with the forest, and design their management strategies to fit into the existing value structure. For example, a utilization-oriented strategy and community development approach may be more successful in a locality dominated by anthropocentric values, whereas a strategy that recognizes traditional beliefs and practices and links them up with forest conservation may be more effective in a locality dominated by cultural values.

2.9 Authorship contribution statement

EJI: conceptualisation, methodology, investigation, formal analysis, writing – original draft preparation. MN: methodology, formal analysis, writing – reviewing and editing. LS: investigation, writing – reviewing and editing. LCS: conceptualisation, methodology, writing – reviewing and editing. MD: conceptualisation, methodology, writing – reviewing and editing. All authors contributed critically to the drafts and gave final approval for publication.

2.10 Acknowledgements

EJI was supported by Commonwealth Scholarship Commission UK. MD was funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Consolidator Grant No. 726104).

2.11 Declaration of competing interest

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.

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Chapter 3: Understanding the diversity of values underpinning forest conservation

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Manuscript published as:

Ihemezie, E.J., Stringer, L.C. and Dallimer, M. (2022). Understanding the diversity of values underpinning forest conservation. *Biological Conservation*, 274. https://doi.org/10.1016/j.biocon.2022.109734

3.1 Abstract

Values are the motivational goals that underpin individual and group decisions, attitudes, and behaviours, and often influence the success of conservation. Existing studies have provided insight into the perceptions and attitudes of stakeholders towards forest conservation values. However, there are still contentions among different stakeholders regarding the values underpinning conservation policies and programmes. It is still unclear what values matter most to people in forest conservation. Moreover, the specific values that can motivate and empower people to participate in conservation remain poorly understood. We examined these issues using the human value orientation lens, a framework that captures the features of human relationships and interactions with forests and with other forest users. Given the need for conservation policies and programmes to align with the priorities of local people, characterising multiple stakeholder perspectives can help us to better understand and untangle the conflicting interests and diverse motivating values influencing conservation policies and programs. Working in Nigeria, a

country with one of the highest rates of global deforestation, we use the Q-methodology to capture and describe the viewpoints of multiple stakeholders regarding the values that underpin forest conservation. We identify three factors representing these values, and show heterogeneity in the viewpoints held by different stakeholders. The first factor explained 24% of the study variance and identified environmental and management values as essential. This viewpoint was largely held by hierarchical stakeholders, forest experts, and forest staff. The second factor explained 12% of the study variance, and identified cultural values that were predominantly held by forest users. The third factor explained 13% of the study variance, and identified economic values that were mostly held by forest experts and forest users. Our study shows a diversity of value types held for forest conservation and that there are broad differences between stakeholders regarding their viewpoints. To enhance conservation success, in addition to focussing on consensus values, decision- and policy-makers should better differentiate value types that target the specific needs of stakeholders.

3.2 Keywords: Conservation values, forest values, perceptions, conservation policies and programs, Q-methodology, Nigeria.

3.3 Introduction

Forest conservation pursues multiple environmental, economic, social, recreational, aesthetic, and cultural objectives. Achieving these objectives is challenging and has been described as a 'wicked problem' due to different stakeholders' conflicting values, interests, and goals regarding the focus of conservation (Mazziotta et al. 2017; Redpath et al. 2018). Resolving conservation conflicts using conventional conservation approaches has proved difficult and ineffective (Mason et al. 2018). Given the multiple goals of forest conservation and the complex nature of conservation conflicts, it becomes crucial to design and implement conservation policies and programs that can deliver needs-specific and relevant projects and attract public support. One way to achieve this is for conservation policies and programs to capture multiple human values and the contrasting interests of different stakeholders. According to Engen et al. (2019), conservation values often differ between stakeholder groups. This is important because the perceptions held by different stakeholders will affect conservation management approaches (Joa &

Schraml 2020). As found by Hoel et al. (2022), one of the social complexities linked to the degradation of natural resources is the clash of perceived conservation values by different stakeholders.

Evidence from most studies that have attempted to evaluate the effectiveness of forest conservation policies and programs, especially in the tropics, suggests that despite the proliferation of policies and programs, many have been unsuccessful in achieving their objectives (Börner et al. 2020). For instance, while Magessa et al. (2020) found that low public engagement in forest management is responsible for the failure of participatory forest management policy, Höhl et al. (2020) attributed poor equitable benefit sharing as one of the factors that generate failure in forest conservation. Similarly, the dominance of economic agendas within government institutions can often sideline other concerns (Fatem et al. 2018). Moreover, when narratives in forest conservation policy and program documents are at variance with the values held by stakeholders, conservation efforts can be weakened, resulting in policy failure. According to the latest assessment report on the diverse values and valuation of nature from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] (2022), only 2% out of over 1,000 reviewed studies consulted stakeholders on nature valuation and only 1% of the studies involved stakeholders in the step-by-step process of valuing nature. This disconnection between how nature is valued in policy, and the values that stakeholders might hold is likely to result in policies that are not consistent with local realities and viewpoints.

Conservation policies and programs and their intended and unintended behavioural outcomes are intrinsically social phenomena (Mascia et al. 2003). As social phenomena, they are heavily influenced by human values. Human values have been defined as motivational goals or concerns that influence an individual or institutional attitude, behaviour, and actions towards the environment (Ives and Kendal, 2014). Value defines what is important and determines the worth/importance of an object or subject for the well-being of a people. Value concepts used in forest conservation studies can be categorised under three broad orientations: anthropocentric value, biocentric value, and relational value orientations (Ihemezie et al. 2021). While anthropocentric value orientation is a

cluster of instrumental or utilitarian human values that seeks to use forest and forest resources to satisfy human needs or achieve a pre-determined end, biocentric value orientation is a cluster of nature-centred and intrinsic values that seeks the existence of forest resources independent of use or function (Fritz-Vietta 2016; Rickenbach et al. 2017). Relational value orientation is a cluster of social and cultural values that considers the appropriateness of one's relationship with the forest and other forest resources users (Chan et al. 2016; Jones et al. 2016). This is because people do not always make conservation choices solely based on forests' utilitarian or intrinsic values. Understanding the values underpinning most national conservation policies and programs could help explain why many national conservation efforts have not been able to address the problems they intended to solve.

In many developing countries, particularly those lacking a tradition of societal engagement in informing policy, policymakers give little consideration to the values and opinions of stakeholders (Badiora 2020). In addition, analyses are lacking regarding the values underpinning forest conservation and how national forest conservation policies and programs have integrated human values. Here, we characterise the values presented in Nigeria's forest conservation policy and program documents and examine different stakeholders' viewpoints regarding the values that they think are important in underpinning forest conservation. The overarching aim is to explore the values underpinning forest conservation in order to better understand what should constitute the most important values in forest conservation. Specifically, we ask i) what are the viewpoints of different stakeholders regarding the values underpinning forest conservation? ii) and how do the values of the different stakeholders compare and contrast with each other?

3.4 Methodology

3.4.1 Study area

Nigeria (Figure 3.1) has a population of 206.4 million (Nigerian Bureau of Statistics 2020) and has a total land area of 923,770km^2 (Food and Agricultural Organization [FAO] 2015). Nigeria was considered suitable for this study because, apart from being a natural

resource-based economy (Inuwa et al. 2022), Nigeria's forest is a unique part of the Guinean Forests of West Africa Biodiversity Hotspot (Luiselli et al. 2019). Forests play a critical role in livelihood sustenance, contributing about 2.5% to Gross Domestic Product (National Forest Policy 2020). However, according to the Global Forest Watch report (2018), the country has experienced one of the highest deforestation rates globally. The 2020 Global Forest Resource Assessment Report places Nigeria's forest cover at below 8% of the country's landmass. Over 5 million ha (6% of forest area) have been lost in the last 30 years (World Bank 2020), and the rate of deforestation still stands at between 3.7% to 4% per annum (National Forest Policy 2020). Previous studies have provided proximate causes of deforestation in Nigeria, such as agriculture, logging and timber extraction, charcoal production and fuelwood collection, livestock grazing, and uncontrolled fire (Adetoye 2019; Hosonuma et al. 2012). However, one underlying reason that is largely unexplored could be the lack of understanding of the role of human values in influencing policy uptake and enforcement.

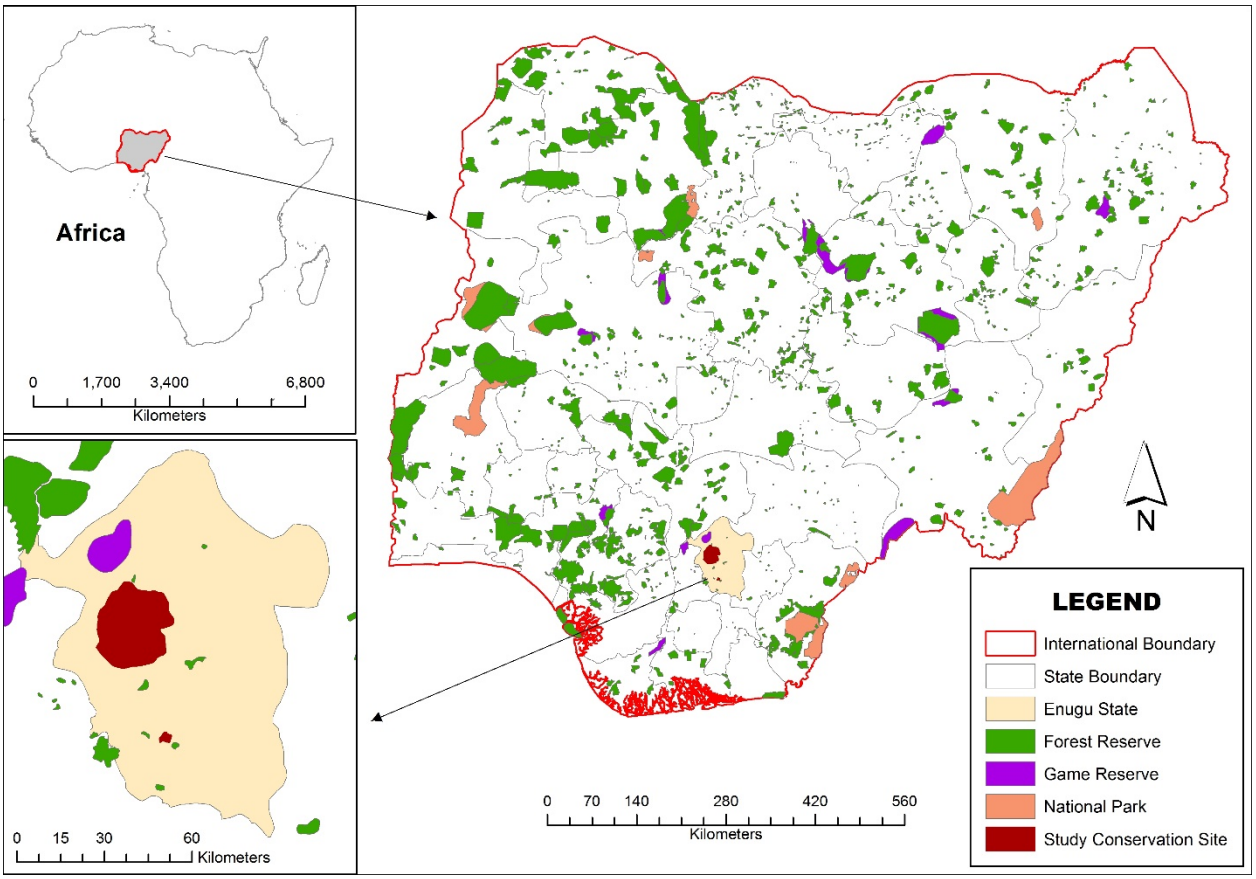

Figure 3.1: The location of Nigeria in Africa (upper inset), the distribution of different forest conservation areas across the country and the location of Enugu state and the study conservation sites (lower inset).

Within Nigeria, forests play a substantial role in supporting household income and economic prosperity, something that is particularly true of states in the southeast of the country, such as Enugu state (Nze et al. 2015). However, Enugu state has forest reserves that have been subject to some of Nigeria's highest levels of deforestation (Mba 2018). The state has 12 government forest reserves with a land area of about 35,000ha, but these forest reserves experience an annual deforestation rate of about 5.7% (Enugu State Forestry Commission 2020). This rate is relatively high compared to the national average of 4% (Orji, 2021). Furthermore, deforestation has been cited as one of the major causes of frequent flooding, erosion, and siltation of water bodies (Nzeh et al. 2015). These necessitate improvement in the state's conservation and management strategies of protected forest areas. The two largest forest reserves in Enugu state (Enugu and Akpakume Nze Forest Reserves) were selected because of their high potential for ecotourism revenue generation (Amalu et al. 2018; Eboh and Ujah 2005). These forest reserves are currently under threat due to pressure from urbanisation and industrial development. Enugu and Akpakume Nze Forest Reserves have areas of 1,139ha and 911ha respectively (Enugu State Forestry Commission 2020).

In terms of conservation efforts, Nigeria has 986 government forest protected areas, comprising 925 forest reserves, 32 game reserves, seven national parks, two wildlife sanctuaries, and one strict nature reserve (World Database on Protected Areas [WDPA] 2018). Several policies and programs have been set up to support biodiversity conservation, including the National Biodiversity Strategy and Action Plan (2016 - 2020), National Forest Policy (2020 and 2006), National Park Service Act (1999, amended 2006), and the National Policy on the Environment (1989, amended 1999). However, the country's forest conservation policies and programs have not reduced forest biodiversity loss or achieved other conservation objectives (Enuoh and Ogogo 2018).

3.4.2 Methods

We employed Q-methodology to examine the viewpoints of different stakeholders regarding the values underpinning forest conservation. Q-methodology is exploratory and semi-quantitative, and provides a coherent and structured means of eliciting diverse viewpoints from different stakeholders on various social issues (Zabala et al. 2018). It allows the categorisation of discrete viewpoints into groups/clusters of value stands using a bottom-up approach (McKeown and Thomas, 2013). Q-methodology is an effective way to explore human perspectives (Watts & Stenner 2012). It is most suitable for this study because, unlike other unidimensional approaches that measure human values using single scales like monetary value or market worth, Q methodology captures multiple values, including intangible values that cannot be easily quantified in monetary terms, such as cultural identity, spiritual existence and social relations (Pike et al., 2015). It does this by combining qualitative techniques to elucidate subjective viewpoints, with the statistical robustness of quantitative analysis (Watts, 2015).

Q methodology follows a systematic approach that starts with collecting the whole spectrum of subjective opinions/statements, representing a comprehensive viewpoint around the subject of study (Zabala et al. 2018). We followed the four-stage process of Q-methodology (Zabala et al. 2018) which involves i) research design (concourse development, Q-set, ranking grid, and p-sample); ii) data collection (sorting a set of 40-60 statements by participants, from the most to the least agreed, and post-sort interview); iii) data analysis (factor extraction, factor rotation, and (flagging of factors); and iv) factor interpretation.

3.4.3 Statement creation

We constructed 45 statements (concourse) relating to perspectives on the values underpinning forest conservation, using a combination of value narratives identified from 12 forest conservation policy and program documents from the Nigerian government, 11 peer-reviewed papers, and 10 online media (see Table C.1 in appendix C). Through this approach, we identified a wide range of forest value statements and value types covering

all sections of the human value orientation framework (i.e., anthropocentric, relational, and biocentric value orientations) (Ihemezie et al. 2021). Duplicate statements were removed, leaving 45 forest value statements (Q-sets) that included 30, ten and five statements for anthropocentric, relational, and biocentric value orientations, respectively. Pilot testing was carried out with four respondents to confirm that statements were easily understood. Following the pilot, some statements were slightly rephrased for clarity and conciseness.

3.4.4 Stakeholder identification

To identify participants (P set), a systematic inventory of potential stakeholders whose viewpoints matter in forest conservation was put together using four categories: hierarchy, knowledge, function, and user (Nkiaka and Lovett 2019; Ballejos and Montagna 2008). These categories represent different levels of interest, goals, influence, and knowledge in forest conservation (Table 3.1).

Table 3.1: Classification and selection of participants in different stakeholders categories

Category	Definition	Number
Hierarchical	These are stakeholders with influence and authority on Nigeria's forest conservation policies and programs. They include government commissioners of the environment, heads of environmental institutions, departments, parastatals, and agencies. Their interest in forest conservation is expected to be high but can also be affected by other factors such as politics. Here, decision makers were interviewed, two each from Enugu State Forestry Commission, Enugu; Department of Forestry Ministry of Environment, Abuja; National Parks Services, Abuja; and National Agency for Great Green Wall, Abuja.	8
Knowledge	These are expert stakeholders with relevant knowledge and skills in forest conservation in Nigeria. They include conservation researchers in universities and research institutes, international organisations, environmental consultants, and NGOs. They have a high level of interest in forest conservation, but their level of influence is limited. Here, three forestry researchers were interviewed from the University of Nigeria, Nsukka, Enugu state and two from the University of Abuja. Also interviewed under this category are Coordinators from Nigerian Conservation Foundation, Abuja; Forestry Research Institute of Nigeria Abuja; and Nigerian	8

	Society for Conservation of Biodiversity.	
Functional	These are stakeholders who are formally responsible for forest conservation issues in Nigeria. They include field staff working in institutions, departments, parastatals, and agencies of forestry who prepare and implement forest policies and programs. They are also expected to have a relatively high level of interest and influence on forest conservation. Here, field staff were interviewed, two from the Department of Forestry Ministry of Environment, Abuja; National Agency for Great Green Wall, Abuja; National Parks Services, Abuja; and three field staff from Enugu State Forestry Commission, Enugu.	9
User	These are local people living around protected forest areas who are directly or indirectly dependent on forest resources and are also affected by forest conservation. Their level of interest in forest conservation varies depending on their conservation goals. But they have the least influence on conservation.	10
Total		35

Following Watts and Stenner's (2012) recommendation to select fewer participants than the number of items in the Q set, we interviewed 35 people from the four stakeholder categories (Table 3.1). Given that the aim of Q-methodology is to establish, understand, explicate and compare the existence of a particular viewpoint, this number of participants (p-set) is considered adequate considering that they only represent the study variables while the items (Q-set) constitute the study sample (Watts and Stenner, 2012). This implies that the issue of information saturation does not apply with the P-set as what matters is assembling a diversity of heterogenous participants whose viewpoints matter in relation to the subject of study. As study variables, a larger number of participants is therefore not required to arrive at a valid conclusion. While this peculiar nature of Q-methodology precludes it from generalising to a population of people (which is one of the limitations of Q-methodology), it allows it to make conceptual generalisations about a particular viewpoint (Zabala et al. 2018).

To identify participants under hierarchical, knowledge and functional categories, we selected relevant institutions responsible for forest conservation at the national level for Nigeria and for Enugu state. These include the Department of Forestry Ministry of

Environment, Abuja; National Agency for Great Green Wall, Abuja; National Parks Services, Abuja; Forestry Research Institute of Nigeria, Abuja; Enugu State Forestry Commission, Enugu; and key forest conservation NGOs in Nigeria, such as Nigerian Conservation Foundation and Nigerian Society for Conservation of Biodiversity. Participants under the hierarchical, knowledge and functional categories were identified by visiting their offices in Abuja, the capital territory of Nigeria, and in Enugu, Southeast Nigeria. We then employed non-probability snowball sampling to select participants, whereby selected participants provided referrals to recruit other participants suitable for the study within their category. At each of the institution visited, we first identified the head, who then pointed us towards other relevant staff within different categories. Interviews with participants in hierarchical, knowledge, and functional categories were conducted in English. Following a reconnaissance survey, participants under the user category were identified from households around two threatened forest reserves in Enugu: Enugu and Akpakume Nze Forest Reserves.

3.4.5 Data collection

Data were collected using the Q-Method software- a web-based platform, which was physically presented to the participants on a tablet in their offices and households. Before starting the sorting process, an information sheet addressing ethical issues was presented, explaining the participant's involvement and activity, free and informed prior consent, voluntary participation and withdrawal from the study, anonymity and confidentiality, and data access and protection. The information sheet also explained the purpose of the study, including the meaning of key terms like values and forest conservation in the context of this study. This was to ensure an understanding of the subject matter and to verify the consistency of definitions. Participants read all 45 statements (or where they were unable to read, the statements were read to them). They then indicated whether they agreed with, disagreed with, or were neutral/uncertain about each statement. Participants then sorted all statements into a quasi-normal distribution grid ranging from +4 (most agreed) to -4 (least agreed) (see Figure C.1 in appendix B). Sorting was immediately followed by the collection of participants' socio-demographic data (gender, age, level of education, income, and household cooking energy source).

These demographic data were used to understand other variables that influenced participants' viewpoints during factor interpretation. A post-sorting conversational interview followed this. Post-sorting interviews allowed us to understand the motivations behind sorting patterns, especially statements placed at the extremes of the ranking grid (Guenat et al., 2019). Interviews were recorded with the participants' permission and later transcribed, coded, and analysed. Data collection followed the same process for all stakeholder categories. Ethical approval for the work was granted by the University of Leeds Research Ethics Committee (Reference Number: AREA 21-002). Interviews with the forest users were conducted in English or Igbo according to their preferences. Interviews conducted in Igbo were translated to English during data analysis.

3.4.6 Q Analyses

Q-sorts were analysed using the PQMethod 2.35 software. A 35 x 35 correlation matrix was produced from our Q-sort and subjected to Centroid Factor Analysis (CFA). Our first CFA extracted seven factors, which were rotated using the Varimax method. The following decision criteria were used to determine the eventual number of factors to analyse and interpret: i) Kaiser-Guttman criterion, which states that only factors with an Eigenvalue (EV) of 1.00 or above should be retained; ii) accept factors that have two or more significant factor loading following extraction (Watts and Stenner, 2012); iii) Humphrey's rule which states that a factor is significant if the cross-product of its two highest loadings (ignoring the signs) exceed twice the standard error (SE) (Brown 1980). Significant factor loading at $p < 0.01$ significant level was calculated using the equation: 2.58 x (√no of items in Q-set). Standard errors were calculated using the formula: 1÷ (√no of items in Q-set). We used the calculated significant factor loading to determine i) Q-sorts that load significantly on a single factor, ii) confounded Q-sorts (that load significantly on more than one factor), and iii) non-significant Q-sorts (those that did not load significantly on any factor).

Out of the seven extracted factors, 5, 6, and 7 were dropped because they did not satisfy the three decision criteria above. Thus, four factors were extracted and rotated again. We examined the correlation between factor arrays and found that factors 1 and 3 were significantly positively correlated with a value of 0.49 ($p < 0.01$) while factors 1 and 4 are

correlated with a value of 0.46 ($p < 0.01$). These are highly statistically significant correlations in the context of our study. The implication is that the two factors are too similar to be interpreted as different and may be better understood as alternative manifestations of the same factor or viewpoint. We reduced the number of extracted factors to 3 and rotated again to address this problem. A three-factor solution was, therefore, the focus of our final interpretation. Factor arrays were created by flagging the factors in the Q-method software.

The viewpoints were interpreted by examining each factor's statement scores (z scores) (using the factor arrays in Table 3.2). Factor interpretation focused not only on the absolute ordering of the statement scores but also on the statement position in one factor relative to other factors. For instance, a statement ranked +2 by one factor is seen as relatively less important if other factors ranked the same at +3 to +4. We used the crib sheet system of Watts and Stenner (2012) in factor interpretation to identify important issues about which a particular factor viewpoint is polarised and how that viewpoint is polarised relative to other factors. The factors were named according to the most dominant value types or the most central idea expressed by each factor viewpoint. Narrative analysis was used to evaluate patterns and gain insight from the post-sort interviews. The patterns/insights were then linked to the factor viewpoints of individual Q-sorts to understand why participants who loaded significantly to the factors had sorted the items the way they did and what extreme sorted items meant to them.

3.5 Results

The three extracted factors explained 49% of the study variance, with 16 out of 35 Q-sorts loading significantly on a factor (Table 3.2). The three extracted factors also satisfied the requirements of the Kaiser-Guttman criterion, Humphrey's rule, and had two or more significant factor loading following extraction. Our significant factor loading at $p < 0.01$ significant level was ±0.38, while the standard error was 0.15. Table 3.3 provided the basis for our final factor interpretation. It outlines the factor arrays for each of our study factors, the statement wordings numbers, and the value types associated with each statement.

Table 3.2: Participant loading for each rotated factor matrix, showing significant sorts, non-significant sorts, and confounders.

Participant Number	Participant identity	Factors		
		Factor 1	**Factor 2**	**Factor 3**
P1	M42TGEK*	0.6327	0.0611	0.3934
P2	M55TGfEK	**0.4525X**	-0.0570	0.1435
P3	M31TGfEU**	-0.0444	0.0182	-0.3636
P4	M59TGEK	0.2703	0.1427	**0.4137X**
P5	F47TFEK	**0.5935X**	-0.1430	0.0822
P6	M40TGDH	**0.4316X**	-0.0624	0.0635
P7	M53TGDH**	0.3482	-0.1622	0.2496
P8	M59TGEU**	-0.0893	0.1791	0.0080
P9	F55TGDH*	0.4780	-0.1092	0.4852
P10	M60TFFF*	0.5694	-0.1978	0.4319
P11	M44TGkDH*	0.4752	-0.0516	0.3937
P12	F22SKfFU**	0.1390	0.2248	0.0658
P13	M63TKfU*	0.0516	0.5360	0.4793
P14	F65PKfFU	0.1901	0.3691	**0.7778X**
P15	F35TGEK**	0.3126	-0.0993	0.2869
P16	M41TGEK	0.3510	**0.4519X**	0.1376
P17	M52TGCH	**0.5031X**	-0.1821	0.0591
P18	F29TGkFU**	0.2854	-0.2382	0.3264
P19	M56TGkEK	0.1289	0.1949	**0.6323X**
P20	F57TGDH*	0.4882	0.1997	0.6151
P21	M64TGDH*	0.5064	0.2432	0.5580
P22	F69NFFU*	0.0053	0.7484	0.4345
P23	F66PKfFU	-0.0552	**0.7980X**	0.3732
P24	F70NKfFU	0.0000	**0.7436X**	-0.0249
P25	M73NKfFU	-0.0269	**0.6923X**	-0.0435
P26	F26SKfFU	0.2001	**0.7951X**	0.1015
P27	M42TGEF*	0.7025	0.2022	0.4449
P28	F30TGkEF	**0.8504X**	-0.0299	0.0016
P29	M36TGkEF	**0.8311X**	0.0227	0.1270
P30	F47TGEF	**0.8505X**	0.0489	0.0838
P31	F60TGEF	**0.7864X**	0.2651	0.3242
P32	M29TGEF*	0.7725	0.1726	0.4649
P33	F43TGEF*	0.7711	0.2587	0.3968
P34	M58TGkEF*	0.6821	0.2998	0.3923
P35	M35TGEK**	0.3270	-0.3190	0.1529
	Eigenvalues	8.4	4.20	4.55
	% study variance	24	12	13

* Confounder; ** non-significant sorts. Bold numbers with X indicate significant factor loadings of 0.38 above at P< 0.01 level of significance. Factor 1: (8) 2, 5, 6, 17 ,28, 29, 30, 31; Factor 2: (5) 16, 23, 24, 25, 26; Factor 3: (3) 4, 14, 19; Confounders: (12) 1, 9, 10, 11, 13, 20, 21, 22, 27, 32, 33, 34; Non-significant sorts: (7) 3, 7, 8, 12, 15, 18, 35. Table C.3 in appendix C for participants' demographic information and identity code meaning.

Table 3.3: The 45 statements sorted by the participants. The statements are linked to their corresponding value type. The factor arrays are the statement scores for each factor which provide the basis for factor interpretation

Value type	Statement number	Statement wording	Factor arrays		
			Factor 1	Factor 2	Factor 3
Economic values	1	Forest management or conservation may restrict access to the forest to harvest wild foods for human food security.	2	3	3
Economic values	2	Forest management or conservation may restrict the harvesting of forage to feed domestic animals.	-1	0	2
Economic values	3	Forest management or conservation will enhance wood and timber production.	1	1	3
Economic values	4	Forest management or conservation may restrict the use of non-wood raw materials like bamboo, fibers, and raffia.	-1	0	4
Economic values	5	Forest management or conservation may reduce fuelwood production.	-4	0	3
Economic values	6	Forest management or conservation will enhance the provision of biochemical and genetic materials for production.	-1	-1	0
Economic values	7	Forest management or conservation will enhance forest contributions to government revenue.	1	-4	-2
Economic values	8	Forest management or conservation will support income generation for forest-dependent communities.	1	3	4
Economic values	9	Forest management or conservation will enhance job creation and employment in the forest sector.	3	4	4
Economic values	10	Forest management or conservation preserve medicinal plants.	2	4	3
Health values	11	Forests should be managed to support mental health and well-being.	-3	-3	-3
Health values	12	Forests should be managed to help relieve stress and anxiety.	-3	-2	0
Health values	13	Forests should be managed to provide natural space for rest and relaxation.	-2	-1	-2
Educational values	14	Forests should be managed to provide a natural environment for conducting research.	0	-3	-3
Educational values	15	Forests should be managed to provide a natural environment for outdoor teaching/learning and hands-on experience.	1	-3	-3
Creative values	16	Forests should be managed to provide a natural environment for artistic and technological inspiration.	-3	-2	-1
Creative values	17	Forests should be managed to provide a natural environment that stimulates thinking and mental development.	-2	-2	-1
Recreational values	18	Forests should be managed to provide a natural environment to go for a leisure nature walk.	-1	-2	-2
Recreational values	19	Forests should be managed to support ecotourism development.	2	2	1

Recreational values	20	Forests should be managed to provide a natural environment for hunting for enjoyment.	-3	0	-2
Aesthetic values	21	Forests should be managed to enjoy their beautiful scenery.	0	1	2
Aesthetic values	22	Forests should be managed to preserve an attractive natural environment.	-1	1	1
Cultural values	23	Forests should be managed to preserve cultural identity.	-2	3	-1
Cultural values	24	Forests should be managed to preserve heritage values.	0	4	0
Cultural values	25	Forests should be managed to support spiritual experiences.	-4	2	-3
Cultural values	26	Forests should be managed to maintain a natural environment for traditional practices.	-4	3	-4
Social values	27	Forests should be managed to provide natural environments where people can bond and connect (social cohesion).	-2	2	-4
Social values	28	Forests should be managed to provide natural environments for communal interaction.	-2	2	-1
Social values	29	Forests should be managed in order to align, comply, or contribute to international regulations and obligations on conservation.	0	-4	-4
Management values	30	Forest management or conservation will promote equitable sharing of benefits of forest resources.	3	1	0
Management values	31	Forests should be managed to promote private sector involvement in its management.	3	-4	-1
Management values	32	Forests should be managed to promote community participation in its management.	3	1	0
Bequest values	33	Forest management or conservation will ensure that the forests are preserved for future generations.	2	2	-1
Environmental values	34	Forests should be managed to serve as carbon stocks/ carbon sinks for climate change mitigation.	4	-2	1
Environmental values	35	Forest management or conservation will support desertification control.	1	-1	0
Environmental values	36	Forest management or conservation will support erosion control.	1	-1	1
Environmental values	37	Forest management or conservation will improve protection against storms.	0	0	2
Environmental values	38	Forest management or conservation will reduce deforestation occurring from land-use change.	2	-1	2
Environmental values	39	Forest management or conservation will support climate regulation such as cool temperatures.	4	1	1
Environmental values	40	Forest management or conservation will support agriculture through pollination and insect control.	-1	1	0
Environmental values	41	Forest management or conservation will support rain formation.	-1	0	2
Environmental values	42	Forest management or conservation will support ecosystem functions such as species diversity.	4	-1	-1
Environmental values	43	Forest management or conservation will improve air quality.	0	-1	1
Existence values	44	Forest management or conservation will ensure the continued existence of wildlife even though I will	0	-3	-2

		never use or see them.			
Existence values	45	Forest management or conservation will protect the existence of native and endangered species.	1	0	1

3.5.1 Factor 1: Environmental and management values

Factor 1 had an eigenvalue of 8.40 and explained 24% of the study variance. Eight participants' sorts loaded significantly on this factor. These participants include forest experts (knowledge n= 2), forest stakeholders with influence and authority (hierarchical n=2), and stakeholders formally responsible for forest conservation issues (functional n=4). They are all educated up to the tertiary level and use gas as their major source of household cooking energy. The income class varies but is dominated by lower-class income (n=6), followed by the lower middle class (n=1) and upper-middle class (n=1). These stakeholders agreed more with statements suggesting that environmental and management values are the most important values underpinning forest conservation. They showed a strong agreement that environmental values such as climate change mitigation (no 34, +4), climate regulation (no 39, +4), species diversity (no 42, +4), and reduction in deforestation (no 38, +2), are the most important motivations why forests should be conserved/managed. One of the experts highlighted that forest conservation should seek to promote a hospitable environment: "*Forest trees are the lungs of the earth. They provide us with oxygen and absorb carbon dioxide from the environment. Therefore, without forests, life will be unbearable. This, for me, is the most important reason for forest conservation.*" Therefore, forest conservation was seen as a way to promote a sustainable environment and address some environmental challenges facing the country: "*Various environmental problems are currently threatening Nigeria. Soil erosion is ravaging the southeastern part of the country. There is a high rate of deforestation in the southwest and South-South, while desertification is gradually turning northern Nigeria into barren land. Forest conservation is the only way through which we can tackle these problems and preserve our biodiversity.*"

Stakeholders sharing this viewpoint also related more to statements linked to management values in forest conservation. Here, management options such as equitable sharing of benefits of forest resources (no 30, +3), private sector involvement in forest

management (no 31, +3), and community participation in forest management were highly ranked. Functional stakeholders noted that one of the challenges of effective forest conservation in Nigeria is poor stakeholdership and engagement with the public: "*when we carry out afforestation or reforestation projects without involving the local people, they tend to fight the project. So, what we have done to make them have a sense of stakeholdership is to engage them in planting, maintaining, and watching over the forests. We even go as far as asking them what trees they want us to plant. We also train and pay them to collect these plant seeds for us. This way, they feel that the project is their own.*"

Conversely, the participants that loaded significantly onto this factor do not consider cultural value an important motivation for forest conservation. For instance, they mostly disagreed with managing forests to support spiritual experience (no 25, -4), traditional practices (no 26, -4), or to preserve cultural identity (no 23, -2). One functional stakeholder asked: "*Why should forests be managed for religious reasons while more important issues face our country? Do not get me wrong, religion and culture are important, but other avenues are to achieve that.*" Other forest values considered non-essential for forest conservation by these stakeholders include recreational values such as supporting hunting experience (no 20, -3) and non-material health values like managing forests to reduce stress and anxiety (no 12, -3).

3.5.2 Factor 2: Cultural values

Factor 2 had an eigenvalue of 4.20 and explained 12% of the study variance. Five participants (four forest users and one expert) loaded significantly onto this factor, agreeing more with statements suggesting that cultural values are essential values underpinning forest conservation. Their level of education varies from tertiary (n=1), secondary (n=1), primary (n=1), to no formal education (n=2). The major source of household cooking energy is kerosene and fuelwood. The income level varies but is dominated by the poor income class (n=4), with one lower class income. Participants sharing this viewpoint showed a preference for forest conservation that will preserve heritage values and cultural identity (no 24, +4; no 23, +3): "*This forest is our ancestral heritage which our community is known for. Many people in this country know about the Udi community because of Akpakume Nze Forest*." The cultural value discourse also

raised the issue of equity and indigenous rights in forest conservation: "*There are some trees and animals in this forest that cannot be touched because we believe they are sacred to this community…No matter what the government people are doing, we expect them to respect our culture."* Similarly, this category of stakeholders values forest conservation, supporting traditional practices (no 26, +3) and spiritual experiences (no 25, +2): "*We have a deep spiritual connection with this forest. Some of us go there to pray and commune with our ancestors. We also use the forest when preparing for the new yam festival. Our chief priest goes there with the elders to perform some traditional rituals so that we can have a bountiful harvest during the next planting season.*" Participants sharing this viewpoint also recognised the value of the forest is the preservation of medicinal plants (no 10, +4): "*You see this Akpakume Nze Forest, one of the unique things about it is that it harbours many medicinal plants and herbs which herbalists and traditional medicine men use for their practice.*"

The statements that were least agreed upon under this factor showed that despite people's preference for economic values from forest conservation, they might not support any forest conservation effort that does not have direct and individualistic value. For instance, they disagreed with forest management or conservation goals that focus on enhancing forest contributions to government revenue (no 7, -4), aligning or complying with international regulations/obligations on conservation (no 29, -4), ensuring the continued existence of wildlife without use (no 44, -3), conducting research (no 14, -3) or outdoor teaching and learning (no 15, -3). They questioned forest conservation that does not have a direct economic benefit: "*I believe the forest is meant to provide for us,…give us money. What use is protecting the forest if it does not benefit us or improve our welfare?"*

3.5.3 Factor 3: Economic values

Factor 3 had an eigenvalue of 4.55 and explained 13% of the study variance. Three participants (two forest experts and one user) loaded significantly onto this factor. The two forest experts are educated up to the tertiary level while the forest user stopped at the primary school level. Forest experts are also in the lower-class income group and use gas as their source of household cooking energy, while the forest user is within the poor

income class and uses kerosene and fuelwood for household cooking. These stakeholders showed a high preference for forest conservation that provides economic values, agreeing with forest conservation that provides income generation for forest-dependent communities (08, +4): "*This forest is a famous tourist attraction in Enugu state. It has employed some of our youths who earn income by showing people around when they visit the forest."* Similarly, they support forest conservation that enhances wood and timber production (no 3, +3): "*The forest provides valuable commodities like wood and timber which local residents use for housing."* They also strongly agreed with forest conservation or management that may restrict the use of non-wood raw materials like bamboo, fibres, and raffia (no 4, +4), limit access to the forest to harvest forage for animals (no 02, +2), and reduce fuelwood production (no 05, +3). This shows that they are willing to make concessions or give up some values to achieve greater economic values: "*I agree that measures should be taken to control how people enter the forest to harvest or collect things. If not, they will destroy the forest, and we will lose all benefits.*" However, the participants sharing this viewpoint disagree that social values like managing forests for social cohesion (no 27, -4) is an important motivation for conserving forests in Nigeria: "*I do not agree that forests should be conserved for social activities in this country.*"

3.5.4 Consensus statements

Consensus statements did not statistically distinguish between factors and showed no significant difference between any of their factor loadings (Table C.2 in appendix B). For our three-factor solution, nine out of 45 statements were consensus statements (1, 9, 11, 13, 16, 17, 18, 19, and 43; Table C.2). One observation from our consensus statements is the general disagreement with certain forest values that do not have economic or environmental relevance. According to one of the hierarchical stakeholders: "*We have so many environmental and economic challenges in this country. We should tap into proper management of forest resources to address them. So, while issues like recreation and relaxation are important, I disagree that they should be a priority for our country at this point unless they also bring economic value.*" This is the reason for disagreement with some value statements like providing a natural space for rest and relaxation (no 13, -2, -1, -2) and providing a natural environment to go for a leisure nature walk (no 18, -1, -2, -2), supporting mental health and well-being (no 11, -3), supporting artistic and technological

inspiration (no 16, -3, -2, -1), stimulating mental thinking (no 17, -2, -2, -1). Functional stakeholders also concurred with the above viewpoint: "*Some of these issues like using the forest for recreation or aesthetic purposes are important. But they are more suitable for developed countries that have solved most of their basic economic problems, not a country like Nigeria that is still battling basic economic issues."* This also explains why recreational values like supporting ecotourism (no 19, +2, +2, +1) which has a direct bearing on economic welfare, as well as managing forests to enhance job creation and employment (no 9, +3, +4, +4), aligned with the views of all the participants. According to one of the forest users: "*People are hungry and looking for what to do to earn a living. Remember, a hungry man may not think of a beautiful environment*." The expert opinion also sheds more light on this: "*It is not as if conserving forests for recreation or artistic purposes is not important, but when faced with a hierarchical option to choose from, I will rather go for forest conservation that will solve our environmental issues and economic problems first."*

3.6 Discussion

Many studies have identified the multifunctionality of forests and the multiple outcomes of forest conservation (Oldekop et al, 2016; Benz et al, 2020). However, underlying the goals a conservation program can achieve are the values of the people who can affect or be affected by conservation programs. This study used Q-methodology to capture the perspectives of multiple stakeholders regarding the values underpinning forest conservation. Consensus statements showed a low preference for forest values that do not have economic or environmental relevance. There are two possible explanations for this. First, on economic values, many households in developing countries are of low-income status, lack alternative means of livelihood, and heavily depend on natural resources such as forests (Nerfa et al. 2020). This escalates the tendency for forests to be used to generate sources of income, food, building materials and fuel to satisfy human needs. Secondly, environmental values have become crucial in many developing countries, especially at this time when the economy is increasingly burdened by environmental hazards such as erosion, floods, desertification and drought (Amusa et al. 2018; Inman et al. 2020). The absence of environmental safety nets together with scarce livelihood programmes, explains why environmental values matter most in forest

conservation. Overall, environmental, management, cultural, and economic forest values were identified as critical values underpinning forest conservation. Heterogeneity in value viewpoints among diverse stakeholders who hold different levels of interest, influence, and knowledge in forest conservation suggests the need for strategic conservation efforts to address the most important issues to the people. Therefore, national conservation policies and programs should recognise diverse and differentiated value interests in forest conservation. Such understanding can be used to better target conservation efforts to appeal to different stakeholders and/or focus on consensus values.

Statistically, our three-factor solution captured 49% of the total study variance, indicating the strength and potential explanatory powers of the extracted factors. According to Watts and Stenner (2012), any variance in the region of 35-40% or above is considered a sound solution on the basis of common factors. This implies that many stakeholders identified with the claims expressed in the three factors, with each factor highlighting different values underpinning forest conservation. Our result aligned with previous studies that have adopted Q-methodology in environmental research. For example, Vargas et al. (2019) produced a four-factor solution which explained 51% of the total variance in a study that explored public perception on conservation and development in Colombia. Similarly, the studies of Pike et al. (2015) and Nkiaka and Lovett (2019) yielded three-factor solutions, which accounted for 45% and 59% of the study variance, respectively. Environmental value is a type of anthropocentric value orientation that seeks to use forests to address environmental problems like climate change, erosion, flooding and water pollution.

Environmental values refer to the individual or shared belief that concerns itself with the well-being of the natural environment (Ihemezie et al. 2021). Our finding corroborates the result of a study from European Union (Lazdinis et al. 2019) which identified environmental issues such as climate change and forest protection as part of the eight main priorities for sustainable forest management. Similarly, a study from Eastern Himalayas (Dorji et al. 2019) showed that forest experts prioritised regulating and supporting forest values, which reflect their broad interest in climate change mitigation and biodiversity conservation. In Nepal, Paudyal et al. (2018) reported stakeholders'

preference for the establishment of carbon stocks for climate change mitigation as one of the priority values of forest ecosystem services for regional and global benefits. Here we also confirm that environmental value is a priority value in forest conservation in Nigeria. However, this value seems to resonate more with educated people. Their value for the environment is also reflected in their use of gas as a source of household cooking energy, which has a less direct impact on deforestation than fuelwood. Although environmental values feature prominently in the Nigeria's forest policy, our study further revealed specific geographical environmental challenges on which conservation efforts can focus. These include soil erosion in the southeast, deforestation in the southwest and South-south regions of the country, and desertification in Northern Nigeria. Addressing regional environmental challenges can increase the acceptability of conservation projects.

Management value is a type of relational value orientation concerned with how forests are managed in terms of strategies, governance, levels of involvement and participation, and forest resource benefit sharing (Ihemezie et al. 2021). Our findings identified the importance of community participation in forest conservation and the need to partner with the private sector. Chinangwa et al. (2017) noted that to reduce deforestation, the private sector can help provide the funds needed for forest conservation, while local participation has long been essential in determining forest conservation effectiveness and outcomes (Ezebilo 2011). These results point towards the need to bring together community and private sector involvement in forest conservation to help reduce policy failure issues attributed to low public engagement and participation (Magessa et al. 2020). Participation in this sense means being involved both in the decision-making and the implementation of forest conservation plans (Soe and Yeo-Chang 2019). While previous studies (De Royer et al. 2018; Lo 2021) have emphasised the importance of integrating local participation as one way of addressing issues of social justice in forest conservation, the data from our interviews revealed opportunities to involve local people in conservation projects. These include opportunities to decide which trees to plant, seed collection, actual planting of forest trees, and maintenance and protection of forest plantation. Involving people in all these conservation activities can help build local stewardship and ensure continuity even when conservation workers themselves may have left the community (Handberg 2018).

Cultural value is a type of relational value orientation that seeks to protect nature because of what it means and represents to the people (Kenter 2016). It upholds communal identity, preserves heritage values, and recognises nature's spiritual, religious, traditional, and ethical dimensions (Ihemezie et al. 2021). Forests are part of cultural heritage (Eriksson 2018). Our findings suggest that incorporating cultural values in conservation planning and design can make forest conservation a tool to preserve both nature and indigenous cultural identity and heritage. This is also important because when forest values are used to inform conservation decision-making, there is the danger of overlooking intangible and non-material values like culture. Cultural values could also help address the issue of equity in conservation, ensuring that the rights of the local people are respected while implementing conservation programs, supporting the findings of Wells et al. (2021) that integrating equity concerns in ecosystem restoration planning and implementation can enhance conservation outcomes. Our study also showed that local people prefer forest conservation that incorporates and respects cultural values. This aligns with one of the key lessons learned from the two decades of implementing the cultural value approach to conservation by the Fauna and Flora International (Infield et al. 2018). The report showed that cultural values helped align conservation programs with the priorities of the local people, thereby spawning motivation and justification for forest conservation.

Some developed countries have started incorporating cultural values in their national conservation policies and programmes. For example, in the United States, Vucetich et al. (2018) showed how nature conservation conflicts were addressed by incorporating stakeholders' cultural values in conservation policies and programmes. Torralba et al. (2020) reported the high preference and relevance for cultural ecosystem services among forest owners and conservation managers in European forests. Similarly, Soliku and Schraml (2018) found that, unlike in developing countries where economic and livelihood issues are the leading cause of contentions in forest conservation, the cultural value people attach to protected areas is one of the major drivers of conservation conflicts in developed countries. Although our findings provide evidence that cultural values matter to forest users, it was clearly absent in the review of forest conservation policies in Nigeria. This finding aligns with the IPBES Values Assessment (2022), which shows that

conservation policies have predominantly prioritised short-term economic and market-based values such as those associated with forest production, while ignoring non-market values associated with people's relationship with nature such as cultural identity. Mainstreaming cultural values into national forest conservation policies, planning and management will not only ensure that conservation efforts do not undermine cultural heritage, but it will also improve local support for conservation, enhance ownership of conservation projects, and reduce the chances of conservation policies being rejected by local populations.

Economic forest value is the last value type that features prominently in our study. It is an instrumental value under anthropocentric value orientation that seeks to maximise the benefits of forest provisioning ecosystem services (e.g., extraction of timber, food, fruits, fuelwood, meat, medicinal plants) and benefits of forest conservation projects (e.g., income, employment, rural infrastructures like road construction). It is utilitarian and aims to appropriate forest and forest resources to support subsistence livelihoods, improve human welfare, increase household income, and upscale forest contribution to national economic development (Batavia and Nelson 2017). A key reason why forests are degraded, especially in developing countries, is the plethora of economic incentives that make the conversion of forest lands to other land uses appear more beneficial than forest conservation (Pearce 2001). Previous studies have established that conservation projects with apparent economic benefits are usually more successful and attract public support and cooperation than those that focus strictly on environmental protection (Nilsson et al. 2016). Our study provided new insight into the scale of economic values for local livelihood benefits and national revenue. In the context of many developing countries, where there is generally poor public trust in the government to efficiently manage public resources (Msenge and Nzewi 2021; Pillay 2017; Shaaba 2012), forest users seem to prefer the economic values of forests and forest conservation that have a direct impact on their welfare rather than ones that contributes to government revenue. This economic distinction is important when planning for the economic value of forest conservation. Therefore, it means that conservation decision-makers should separate the economic values of the forest at the national level from those at the local level. This is not surprising considering that most of the local forest users are low-income earners who directly rely on

the forest for their livelihood.

The importance of economic values in our study agrees with the 'new conservation science' proposal, which seeks to refocus conservation from one that benefits only nature to one that also benefits humans (Doak et al. 2015). Beyond this, our study also showed that the local people are willing to make some concessions or give up smaller economic values like harvesting forage and fuelwood in favour of greater economic benefits like job creation and income generation from forest conservation.

3.7 Conclusion

Here, we advance knowledge regarding which types of value are most important in forest conservation. Most developing countries have drafted and implemented many forest conservation policies and programs, which have not successfully reduced forest degradation. Understanding how multiple stakeholders perceive the values underpinning forest conservation in Nigeria, one of the countries with the highest rate of global forest degradation, offers insights relevant to other countries struggling to improve the effectiveness of conservation policies and programs.

The results of this study provide empirical evidence of the importance of identifying strategic motivating values in forest conservation. These value perspectives identified by different stakeholders are not necessarily in opposition to each other but instead reveal different ways of valuing forest conservation. Therefore, to enhance the success of conservation projects, conservationists should focus on how contextual motivating values can empower local people to participate in conservation. They can do this by focusing on consensus values or differentiating value interests that target the specific needs of various stakeholders in forest conservation. This is important considering that it is not always realistic to pursue and achieve all of the multiple objectives associated with forest conservation.

3.8 Authorship contribution statement

EJI: conceptualisation, methodology, data collection, formal analysis, writing – original draft preparation. LCS: conceptualisation, methodology, writing – reviewing and editing. MD: conceptualisation, methodology, writing – reviewing and editing. All authors

contributed critically to the drafts and gave final approval for publication.

3.9 Acknowledgements

EJI was supported by Commonwealth Scholarship Commission UK. MD was funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Consolidator Grant No. 726104).

3.10 Data availability

Data for this study is coded to exclude any reference to personal data. It will be made available on the University of Leeds Institutional Repository (http://archive.researchdata.leeds.ac.uk)

3.11 Article impact statement

Recognizing diverse human values in forest conservation can improve the effectiveness of conservation policies and programs.

3.12 Declaration of competing interest

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.

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Chapter 4: Integrating biocultural conservation and sociocultural valuation in the management of sacred forests: what values are important to the public?

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Manuscript accepted with minor revision as:
Ihemezie, E.J., Albaladejo-García, A.A., Stringer, L.C. and Dallimer, M (Under review). Integrating biocultural conservation and sociocultural valuation in the management of sacred forests: what values are important to the public? *People and Nature.*

4.1 Abstract

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 if and how different values are prioritised amongst diverse stakeholders. This is particularly important when indigenous and traditional cultures play a role in how land is managed and protected. 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. 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 socio-demographic profiles. 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. 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.

4.2 Keywords: Conjoint analysis, contingent ranking method, heterogeneity, Nigeria, participatory workshop.

4.3 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, 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-Garcíaa et al., 2023). The existing conservation approach has a dual goal of conserving for nature's sake (instrinsic) 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-Garcíaa 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 socio-cultural 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 non-monetary 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 over-exploitation 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 like 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 is 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 like 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.

4.4 Methodology

4.4.1 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 4.1), 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 7,161 km² 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 compared to 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.

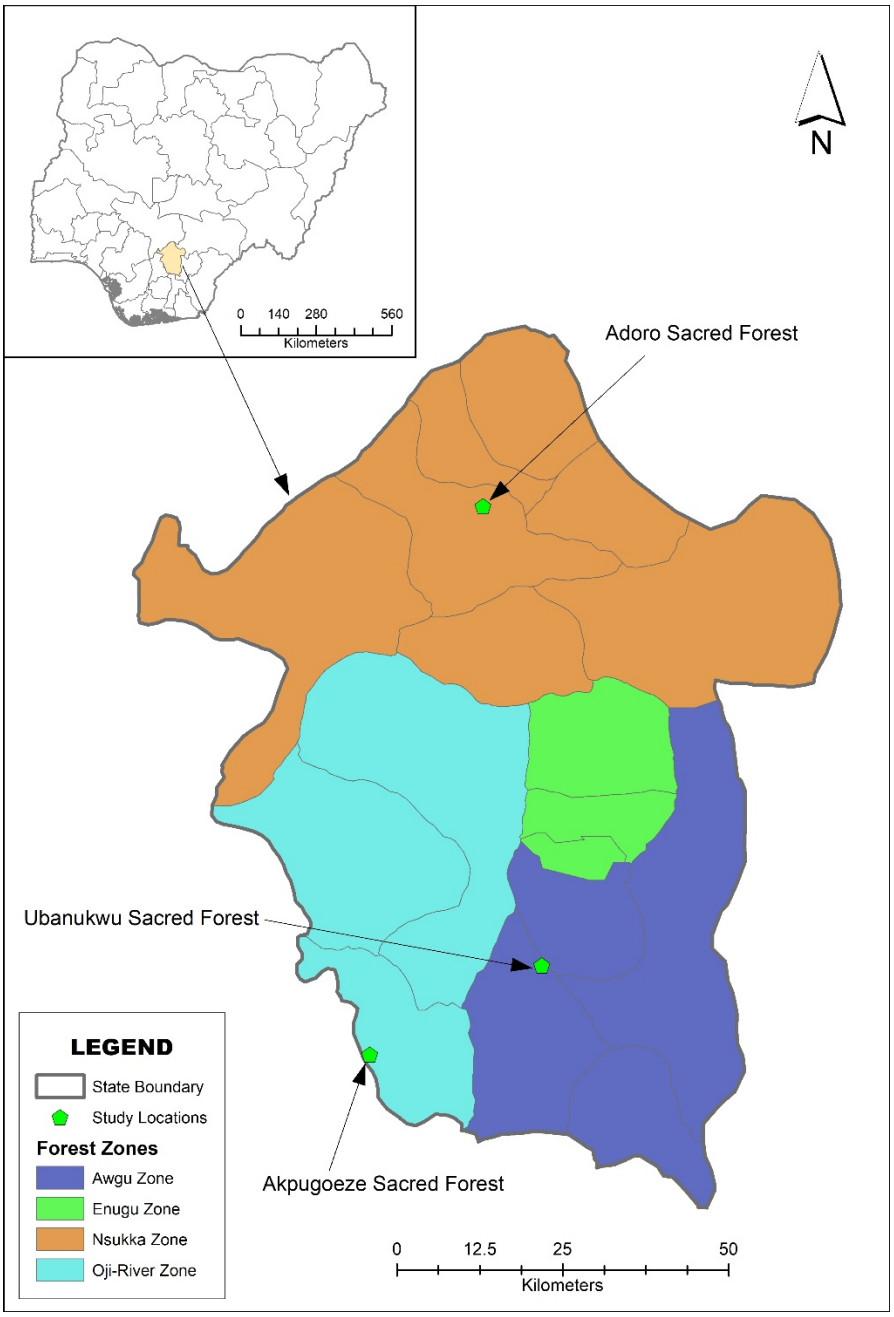

Figure 4.1: The location of Enugu state in Nigeria (upper inset), and the map of Enugu state showing the four forestry zones and studied sacred forest sites.

4.4.2 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, that 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 co-production of knowledge and give the opportunity to balance and mobilize 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 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 non-monetary valuation technique that has been applied in valuing non-market 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 non-use 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 non-market and intangible held values that cannot be quantified in monetary terms (Rode et al., 2015; Ihemezie et al., 2021). 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 sacred forests 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.

4.5 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 4.1). 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 D.4 in appendix D for details). This number is considered adequate, and falls within the range of participants needed to provide a valid result in participatory studies (Six and 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 D4 in appendix D). To reduce the influence of power dynamics, workshop participants were divided into sub-groups according to their stakeholder category. Towards the end of each workshop, there was a joint section where each sub-group'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.

4.6 Conjoint analysis - Methods

4.6.1 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 2,000 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 done with the aid of ranking cards containing visual representations of the different sociocultural values and levels of value provision (Figure 4.2). 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 socio-demographic characteristics (See D2 in the appendix D).

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 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 4.1), which included the status quo as card 2.

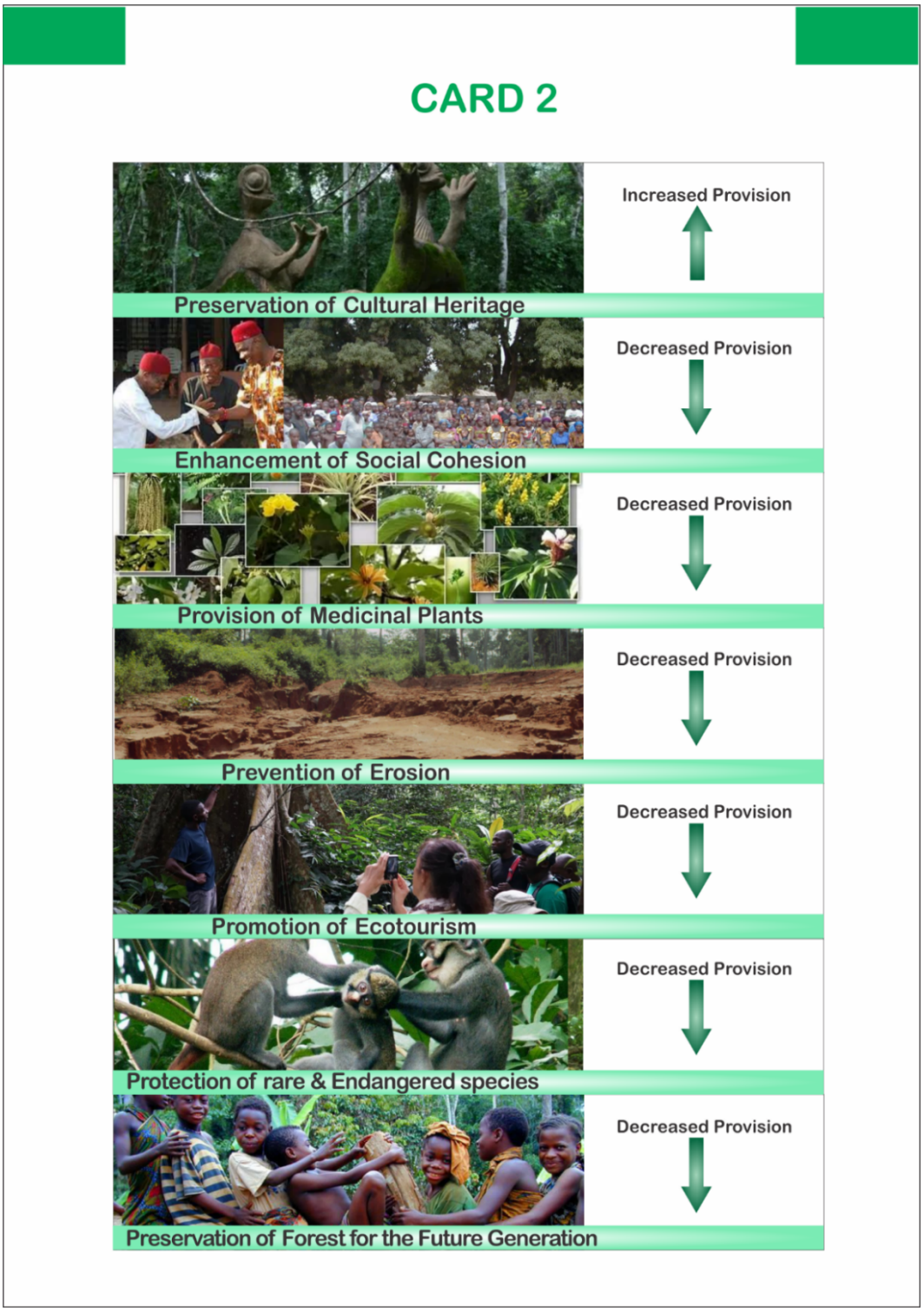

Figure 4.2: Pictorial representation of the ranking cards presented to respondents showing different levels of value provision

Table 4.1: 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								

4.6.2 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:

$$P_{i1} = Pr\ (U_{i1} > U_{i2}\ and\ U_{i1} > U_{i3} \ldots and\ U_{i1} > U_{ij}$$

$$= Pr\ [(e_{i2} - e_{i1}) < (X_{i1}\beta - X_{i2}\beta)\ and\ (e_{ij} - e_{i1}) < (X_{i1}\beta - X_{ij}\beta)] \quad (2)$$

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:

(3)

Where: Y_{ij}= the observed variable, obtained by the ranking of the preference of the *j*th alternatives for the *i*th individual.

α = constant term or the threshold.

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

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

X_{jk} = a dichotomous variable that takes the value of 1 when the *j*th 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 variable is latent and relates to the X_{jk} variable via the following equation:

(4)

Where:

= a continuous latent variable that quantifies the relative rank of the *j*th alternative in the choice set.

β = a vector of unknown parameters.

X_{jk} = a linear combination of the *j*th 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, is expressed as:

$Y_{ij} = 0 \; if \; U_{ij} \leq \mu_{i1,}$

$Y_{ij} = 1 \; if \; \mu_{i1} < U_{ij} \leq \mu_{i2,}$

.

.

.

$Y_{ij} = j - 1 \; if \; U_{ij} > \mu_{ij} - 1$ (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 μ 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:

(6)

Where

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

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 socio-demographic characteristics. Considering the types of variables and their normality distribution, a Kruskal-Wallis test was used to analyse the continuous socio-demographic variables, while chi-square (χ^2) was used to analyse the categorical socio-demographic 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.

4.7 Participatory workshops - Results

4.7.1 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 4.2) 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 4.2).

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 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 like religious uses or cultural ceremonies may reduce as a trade-off to achieve other non-cultural values.

Table 4.2: 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	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.

	masquerade performances, and serving as a symbol of cultural heritage and identity.	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.

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.

4.7.2 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 4.3). 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 4.3, 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 sacred forests 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, e.g., 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 non-use 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 plant and animal species. However, in the course of achieving the goal of this strategy, environmental values, such as reduced erosion, will also be improved as a co-benefit. 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 4.3: 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)				

4.8 Conjoint analysis - Results

4.8.1 Socio-demographic characteristics of the sampled population

The socio-demographic profiles of the respondents (Table D.1 in appendix D) show that many of the 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).

4.8.2 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 4.4).

Table 4.4: 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)		1,299.14***

***Significant at 1% level. The estimated cut-off point (μ) of the OLOGIT model satisfies the condition that μ1 < μ2 < μ3 < μ4 < μ5 < μ6 < μ7. This shows that the attribute categories in the OLOGIT are ranked in an ordered manner.

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.

Table 4.5: The 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

In both models in Table 4.5, improved provision of medicinal value was most preferred (1.98; p<0.01), while improved provision 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.

4.8.3 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 4.4 and 4.5), we therefore only present the OLS results for clarity (Table 4.6).

Table 4.6: The mean part-worth and relative importance (RI) of different attributes for each cluster of respondents. The socio-demographic characteristics of people in each cluster are provided in Table S1 in Supporting information

Attributes	Levels	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
		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)	

Nine of the 13 socio-demographic 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 D.1 in appendix D show that this cluster of respondents had a high number of older people (median 70 years), and the second-highest number 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 6.00km) 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 least number 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 practice 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 number of respondents (21.0%) and the third-highest number 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 number 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 number of respondents (37.3%) and the highest number of females (60.70%). It also had the second-highest population of young people (median 33 years), and the second-highest number 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 number of those who practice traditional religion (53.60%). Majority (78.60%) of them had visited sacred forests in the past year.

4.8.4 Estimating the utility of management strategies

Table 4.7 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).

Table 4.7: 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

4.9 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 sociocultural 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 propensity for changes in human beliefs, which threaten the conservation of sacred forests (Sinambela et al., 2021), identification of multiple non-religious values provides a basis to galvanise shared and collective responsibility towards sacred forest management and conservation. 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. Amongst 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 which 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 non-material cultural value to material medicinal value. Two factors may be responsible for this shift. First, the polarity of religious faiths and views toward 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. Secondly, many households in developing countries rely on natural resources such as forests for their livelihoods (Nerfa et al., 2020). Even though 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 non-material 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.

Secondly, 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 socio-demographic 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 & 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 and more educated people 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 traditional religion often associated with sacred forests, due to change in religious belief.

At the individual cluster level, it was found that implementing an ecotourism strategy will provide the highest utility to people in cluster two, made up of young, educated people with low income. This is key to the survival of sacred forests. According to Orlowska & 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 non-religious 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.

4.10 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 emphasizes 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 non-material values of nature. We showed what values should be prioritized 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 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.

4.11 Authorship contribution statement

EJI: conceptualisation, methodology, data collection, data analysis, writing – original draft preparation. JAA: methodology, data analysis, reviewing and editing. LCS: conceptualisation, methodology, writing – reviewing and editing. MD: conceptualisation, methodology, writing – reviewing and editing. All authors contributed critically to the drafts and gave final approval for publication.

4.12 Acknowledgements

EJI was supported by Commonwealth Scholarship Commission UK. MD was funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Consolidator Grant No. 726104).

4.13 Statement on research ethics

The study conforms to the research code of ethics, and ethical 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 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.

4.14 Data Accessibility Statement

Data for this study is coded to exclude any reference to personal data. It will be made available on the University of Leeds Institutional Repository (http://archive.researchdata.leeds.ac.uk).

4.15 Conflict of interest

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.

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Chapter 5: Synthesis and Conclusion

5.1 Introduction

Forests are critical in sustaining life on land through their delivery of multiple instrumental and non-instrumental values (Coelho-Junior et al., 2021). Forest conservation is essential to preserve forests and ensure sustainable use (Silva et al., 2019). However, forest conservation is affected by the values of multiple stakeholders, with different and often conflicting interests regarding how forests should be managed and conserved. The values people hold towards forest conservation not only influence attitudes and behaviour towards forest conservation (Rickenbach et al., 2017) but also drive and direct forest use and management (Sharaunga et al., 2015). This makes it necessary to understand the multiple values people hold for forest conservation and how they differ in their value preferences, especially in developing countries where most of the population directly or indirectly depends on forests for their livelihoods. To optimise and achieve the multiple goals of forest conservation, we need to understand the wide range of human values associated with forest conservation. This evidence can then be incorporated into the design of conservation policies and programmes. This thesis uses an interdisciplinary approach to provide empirical evidence regarding the values people hold for forest conservation in a developing country context. This was achieved by employing a mixed-methods approach to address three objectives that make up the three results chapters of this thesis: i) examine the influence of human values on attitudes and behaviours towards forest conservation; ii) understand the diversity of values underpinning forest conservation; and iii) ascertain which values are important to the public in the conservation of sacred forests.

This synthesis chapter discusses the main findings of the three result chapters, the links between them and their contribution to the wider discourse of forest conservation-human value research. It also situates the entire thesis within the broader debates on human-nature relationships and recommends ways through which conservation policy and practice can be improved through the integration of human values. To identify advances, debates, and relevant knowledge gaps in need of further research, Chapter 2 systematically reviewed what is known about how human values are influencing forest

conservation attitudes and behaviours in sub-Saharan Africa, the wider region where this thesis is grounded. Chapters 3 and 4 focused on Nigeria, the largest country in Africa, with a network of formally and informally protected forest areas, but which is estimated to have the highest rate of primary forest deforestation in sub-Saharan Africa and the world at large.

5.2 Contributions to research into human-conservation relationships

This section highlights the contributions of this thesis to the growing field of research in human-conservation relationships. The three research objectives of this thesis were addressed sequentially in the empirical Chapters 2-4. The key findings from these chapters, their importance and policy implications are summarised in Table 5.1. The integration of the findings here enables the consideration of the overall aim of this thesis, which was to advance our understanding of the multiple values people hold for forest conservation.

Table 5.1: Summary of research objectives, the key findings and implications for conservation policies and practice

Chapter	Objective	Justification	Key findings	Importance	Implications for conservation policy and practice
2	Examine the influence of human values on attitudes and behaviours towards forest conservation.	Human attitudes and behaviours have been linked to the degradation of global biodiversity, particularly forest ecosystems. However, attitudes and behaviours are underpinned by the complex concept of human values. There is, therefore, the need to understand which and how human values influence conservation attitudes and behaviour.	• Human values influencing forest conservation attitudes and behaviours can be categorised into anthropocentric, relational, and biocentric value orientations. • Anthropocentric and relational value orientations can positively and negatively influence forest conservation attitudes and behaviours, depending on the value holder's perceptions or motivational goals/ concerns. • Anthropocentric and relational value orientations are dominant in sub-Saharan Africa.	The findings from this chapter highlight the need to understand multiple value-based interests that can trigger positive or negative attitudes and behaviours towards forest conservation.	• Conservation managers should first understand the prevalent and dominant contextual values guiding people's perceptions and interactions with forests and design their management strategies to accommodate the existing value structure. • Economic/material benefits from conservation can trigger positive conservation attitudes and behaviours. • High dependence on forest resources and low benefits from conservation can trigger negative conservation attitudes and behaviours.
3	Understand the diversity of values underpinning forest conservation.	There are specific values that can motivate and empower people to participate in conservation. Different perceptions of these values by diverse stakeholders will influence willingness to engage in and support forest conservation.	• Environmental, management, cultural, and economic values are critical values underpinning forest conservation. • Consensus statements showed a low preference for forest values that do not have economic or environmental relevance. • There is heterogeneity in value viewpoints among diverse stakeholders who hold different	The findings from this chapter show a diversity of value types held for forest conservation and that there are broad differences between stakeholders regarding their viewpoints.	• Conservation efforts should address economic and environmental issues together. • Incorporating cultural values in conservation planning and design can make forest conservation a tool to preserve both nature and indigenous cultural identity and heritage. • Community and private sector involvement in forest conservation is critical to help reduce policy failure.

			levels of interest, influence, and knowledge in forest conservation.		
4	Ascertain what values are important to the public in the conservation of sacred forests	Relying on a single value system of traditional culture is not sustainable in conserving sacred forests due to culture change. There is a need to identify multiple sociocultural values of sacred forests and value preferences and integrate these into conservation policies and planning.	• There are multiple values attributed to sacred forests. However, medicinal values are most preferred, while social values are least preferred, indicating a possible shift in the way people now perceive and relate to sacred forests from non-material value to material value. The current management strategy for the conservation of sacred forests is inadequate to galvanise shared and collective responsibility from diverse stakeholders. • Traditional medicine management and biodiversity management strategies are likely to provide the highest utility to the public. However, socio-demographic factors influence the values that people hold for forest conservation.	The findings from this chapter demonstrate how biocultural conservation approach and sociocultural values can be integrated into sacred forest conservation while identifying the most important values to the people.	• Sacred forests are valued in multiple ways beyond the singular reliance on the traditional belief system. • New management strategies that can incorporate multiple values are needed to effectively manage and conserve sacred forests, and a plural approach to conservation will help to achieve this. • Integrating biocultural conservation and sociocultural valuation is one way to achieve plural approach to conservation.

Some conservation scholars have argued that to achieve conservation goals and to halt the ongoing biodiversity degradation, there is a need for a value shift, i.e., a change in human values, culture and traditions which are partly responsible for the loss of biodiversity (Schultz and Zelezny, 2003; Martin et al., 2016; Ives and Fischer, 2017). Although this might be difficult and slow, they opined that values can be adjusted to achieve conservation objectives. These scholars predicted that the ongoing biodiversity degradation and ecological crisis would worsen without a new set of values, suggesting that a value shift is the only pathway to a sustainable future. Therefore, they recommend that conservation scientists should find out more about how complex human values can be influenced for the sake of conservation.

Contrastingly, several conservation social scientists have doubts about the plausibility of a deliberate human-engineered value shift (Ferkany et al., 2014; Manfredo et al., 2017; Des Roches et al., 2021). This is primarily because of the nature of human values. Values are slow to change and can only evolve over time in response to socio-ecological changes (Ives and Kendal, 2014). According to Manfredo et al. (2017), the process and nature of value formation make it improbable for a rapid shift because values are deeply rooted in cultures, traditions, and institutions, which cannot be easily changed (Kenter, 2016). Based on this, these scholars argue that human values cannot just change for the sake of conservation. They recommend that conservation scientists should seek to understand multiple human values and adapt conservation programmes within people's existing value systems rather than attempting to change them.

This thesis builds on these two scholarly arguments by exploring the values of diverse stakeholders around legally and culturally protected forests. It provides evidence of why it is important to understand the values that people hold regarding forest conservation. In Chapter 2, in a systematic scoping review of sub-Saharan African literature, it found that some anthropocentric values, like economic/subsistence values, may not be entirely detrimental to conservation. In fact, when properly understood, they can be harnessed to draw local support for conservation. This implies that when values cannot be easily changed in the short term, it may benefit conservation to first understand and work within people's existing value systems before attempting to change them. Therefore,

engineering a value shift/change may not be the right first action in resolving human-conservation conflicts, but understanding what values exist and how and why they exist may be the right first point of action. This understanding can then inform appropriate ways through which negative conservation values can be changed or adjusted for the sake of conservation. Overall, effective forest conservation will require an in-depth knowledge and understanding of the values that drive attitudinal and behavioural preferences towards forest conservation.

Chapter 3 used insights from Chapter 2 to inform the design of a Q-methodology study that aimed to explore stakeholders' perceptions of the values underpinning forest conservation. Multiple values underpinning forest conservation in Nigeria were identified. The result suggests that that environmental value, an anthropocentric value that concerns itself with the well-being of the natural environment, may be one of the core values underpinning forest conservation. Most stakeholders showed their preference for this value type to address issues related to climate change, deforestation, and species diversity. However, the underlying motivation for all these environmental concerns is to benefit humans by creating a hospitable environment and addressing environmental challenges threatening socio-economic well-being. This implies that environmental values can benefit both conservation and humans. A human value that supports species diversity may look intrinsic at the surface but is foundationally rooted in instrumental functions. As confirmed by Methorst et al. (2021), species diversity plays a critical role in supporting human well-being. Therefore, instrumental and non-instrumental values can co-exist to support conservation and, at the same time, benefit humans. Values that support conservation need not conflict with values that benefit humans, as some studies posit (Sharaunga et al., 2013; Kopnina et al., 2018; Taylor et al., 2020). Overall, Chapter 4 identified multiple values underpinning forest conservation, focusing on legally or government-protected forests.

Chapter 4 employed the participatory workshop method and conjoint analysis to ascertain which values matter most to the public in sacred forest conservation, a type of informally and community-protected forests, using cultural approaches. By applying the principles of biocultural conservation, I identified seven critical sociocultural values attributed to the

sacred forests in the study area, with the strongest preference for medicinal values. I also observed preference heterogeneity which showed that sacred forests are valued differently among clusters of people with distinct socio-demographic profiles. Comparing the values around government-protected forest reserves and community-protected sacred forests, I found that cultural value is a common and significant value that people hold in different types of forest landscapes. This suggests that cultural value is critical among the values that influence forest conservation, especially in developing countries.

Going forward, I describe other common themes that emerged from the findings of this thesis.

5.2.1 Values are shaped by contextual environmental challenges and experiences

Evidence provided throughout this thesis suggests that contextual environmental challenges and experiences inform the values that individuals or society have. For instance, Chapter 3 showed that the environmental values held by different stakeholders in Nigeria resulted from the peculiar environmental challenges experienced in the country. Similarly, the management value linked to community participation in forest management held by functional stakeholders was due to their experience of how poor public engagement and participation in forest conservation planning and execution has affected effective forest conservation in the country. This implies that values reflect the ways in which individuals and society adapt to their ecological crises or respond to their conservation challenges. As found by Dewey (2021), nature experiences and witnessing degradation are parts of the processes that influence environmental behaviour. The role of human values in conservation should therefore be assessed within particular socio-ecological settings.

5.2.2 Values are influenced by economic and social needs

The findings from this thesis also suggest that economic and social needs may influence the values that people hold for forest conservation. There is an anthropocentric dominance (e.g., economic/subsistence value and medicinal value) amongst the values identified in the three results chapters. These values have one thing in common: they are linked to addressing human economic and social needs. Conservation projects should

therefore take people's socio-economic realities seriously, as these will affect how they respond to conservation initiatives. This thesis re-emphasises the need for conservation projects to incorporate and provide economic and social benefits. This is more important in developing countries where most of the population still grapples with the challenges of poverty and social deprivation (Everard et al., 2021). Any conservation project that improves social and economic welfare may likely receive the cooperation of the local people. This suggests that incentive-based conservation programmes may be more suitable in developing country contexts (Onyekuru et al., 2021) and calls for the need for anthropocentrism in forest conservation.

5.2.3 Lower presence of biocentric values

One of the most striking observations from this thesis is the low presence of biocentric value orientation, as revealed in both the scoping review covering the sub-Saharan African region and the empirical investigations from Nigeria. Biocentric value orientation is a cluster of intrinsic and non-material values that seeks the existence of nature, independent of its use (Fritz-Vietta, 2016). Evidence in this thesis suggested that people in developing country contexts may not hold this value orientation but rather attach more instrumental values to forests and forest conservation. This may not be unconnected to the high dependence on natural resources by the majority of people (Nerfa et al., 2020). This is something conservation planners should be aware of when designing conservation programmes for natural resource-based economies. Advancing the moral argument for an ecocentric value approach in conservation without incorporating perceived human interests (Taylor et al., 2020) may not lead to effective forest conservation.

5.2.4 Values differ amongst groups in a society

One of the major challenges facing conservation is the inaccurate identification of target groups and poor inclusion of marginal populations (Spiteri and Nepal, 2006; Satyal et al., 2020). Chapters 3 and 4 of this thesis found evidence of value heterogeneity among the population, emphasising the need for conservation to identify accurately different target groups with distinct value preferences. For instance, Chapter 4 found that youths have

more preference for ecotourism values of the sacred forests, older people have more preference for cultural values, and women have a higher preference for medicinal values. One way to accommodate all these multiple values from a diverse group of people is to adopt a plural approach to conservation, i.e., conservation that incorporates intrinsic, instrumental and relational values from diverse stakeholder perspectives (Pascual et al., 2017). Value orientation is a critical component of worldviews that forms the foundation of knowledge systems and institutions that manage natural resources (Gavin et al., 2018). Adopting a pluralistic conservation approach will enhance conservation's capacity to accommodate diverse interests, reducing conservation conflicts. As demonstrated in Chapter 4, biocultural conservation that implores indigenous knowledge from diverse stakeholders is one way to achieve pluralistic conservation, especially in landscapes where traditional culture and religious beliefs play a role in how forests are perceived and managed.

Heterogeneity in value preference also indicate that there is no one-size- fits-all solution to conservation challenges. Conservation interests and values can vary between individuals and groups of stakeholders. This calls for the need for conservation to identify consensus values and differentiate values that target different community members. Understanding different stakeholder viewpoints regarding the values they hold for conservation can improve our understanding of how to better engage different stakeholders in conservation (Vande Velde et al., 2019).

5.2.5 Socio-economic characteristics play a key role in the values people hold

One of the findings of this thesis is that socio-economic characteristics may play an important role in the values that people hold towards forest conservation. Socio-economic characteristics like education and income were found to affect the kind of values that people hold. For example, the results from Chapters 3 and 4 suggest that educated people may hold environmental values that tend to care more for the environment than less educated people. This calls for the need to improve environmental education and awareness campaigns, especially in rural areas, offering one way to achieve a shift toward more environmentally friendly values (Levesque et al., 2017). Another socio-economic factor that may influence the value that people hold is income. Similar to

education, higher-income individuals or households may hold environmental value more than low-income individuals, households or groups. Chapter 4 shows that the youths who possess relatively higher education but with low income preferred the ecotourism value of the sacred forest due to the income-earning potential of such value. This suggests that people of low-income status may more likely hold values that depend on natural resources. Again, incentive-based conservation programmes that target low-income households, which can provide alternative means of livelihood, can support a change of value from one that depends on forests to one that seeks forest existence independent of use.

5.3 Directions for future research

Integrating the findings from the three results chapters of this thesis provides new insight into the importance of understanding the multiple values people hold for forest conservation but also highlights opportunities for future research. Although the findings from Chapters 3 and 4 are focused on Nigeria, these recommendations are relevant to other countries, especially developing countries, where forests play a key role in supporting livelihoods.

The findings from this thesis lay the foundation for future research on the opportunities and barriers for integrating biocentric values into forest conservation policies and planning in developing countries, where the majority of the population directly or indirectly depend on forests for livelihood. The scoping review covering sub-Saharan Africa and empirical studies in Nigeria showed that biocentric value orientations are uncommon in the literature. Research opportunity exists to explore the reasons for this and to see how such values can be integrated into conservation policies and programmes. A successful forest conservation approach would not only appeal to human interests but also recognise and prioritise the independent existence of forest and forest species. This is partly because evidence from developed countries has shown that many people concerned about biodiversity degradation are motivated by biocentric values (Taylor et al., 2020; Tourangeau et al., 2021). Beyond anthropocentric and relational values predominant in developing countries, there is a need to combine scales of pluralistic values in order to achieve conservation goals. This cannot be achieved without proper understanding and

integration of biocentric values into conservation policy and programmes, which is currently lacking in Nigerian and sub-Saharan Africa contexts.

The findings from this study have important implications for conservation management strategies. A key finding from Chapter 4 is that the current management strategy for the conservation of sacred forests is inadequate to galvanise shared and collective responsibility from diverse stakeholders. Therefore, future studies should examine how various national forest conservation policies and programmes can effectively integrate the concept of human values into conservation management strategies. As shown throughout this thesis, a value-led approach to conservation management can inform conservation strategies that resonate with the feelings, interests and rationality that guide people's daily decision-making processes. This will give the conservation movement more social relevance and acceptability (Jepson and Canney, 2003; Vande Velde et al., 2019). Relying solely on a scientific approach to conservation risks alienating other diverse human motivations for nature conservation (Bennett et al., 2017). This can entrench apathetic feelings towards conservation projects and fuel the notion that conservation is an imposition by external establishments like the government, NGOs or scientists. In contrast, a value-led approach to conservation is more eclectic and incorporates a holistic blend of indigenous knowledge, traditional culture, and scientific worldviews (Musavengane and Leonard, 2019). Explicit recognition of multiple human values in conservation can revitalise conservation as a movement concerned with social equity, cultural respect, and indigenous rights (Wallace et al., 2016). It would push conservation practitioners and managers to engage more with local people and guard against acting as external contractors of national or international government institutions. This is why it is important to explore how national forest conservation policies and programmes can integrate the concept of human values by highlighting what conservation goals are pursued by various national governments and which values are associated with them.

Building on the findings of this study, future research can begin to examine pragmatic ways to influence value shifts in favour of conservation. According to Ives and Fischer (2017), the biodiversity degradation crisis cannot be resolved by the same set of values that created it. Chapter 2 of this thesis found evidence that human values can positively

and negatively influence attitudes and behaviour towards forest conservation. Indeed, the Anthropocene era has come with values that tend to dominate and exploit natural resources (Linnell et al., 2020). A society that relies mostly on natural resources like forests for livelihoods may find it difficult to uphold existence or bequest values where forests can exist and be appreciated without direct use. While understanding the multiple values people hold for conservation is the first and right step towards establishing a value-led approach to conservation, future studies should go further to examine how negative human values that are antithetical to conservation goals can be changed. It would also be useful for future research to highlight shared values that can promote collective efforts to conserve and sustainably manage forests. As noted by Kenter (2016), assessing and cultivating shared values will lay the foundation for effective conservation action. Furthermore, Manfredo et al. (2020) contend that conservation scientists should embrace new strategies to influence and promote mutualism values where natural species are viewed as social networks that deserve care and compassion.

One prominent finding from this thesis is that different stakeholders have contrasting values towards forest conservation. Future studies can extend this by examining how contrasting values of different stakeholders affect collaboration to achieve conservation goals. Previous studies have identified value conflicts as a barrier to effective public participation in conservation (Toomey et al., 2017; Chapman et al., 2019). It is recommended that this issue be looked into from two perspectives, first via intra-conflicting values, i.e., when there are conflicting values within members of a cultural society, and secondly via inter-conflicting values, i.e., when the values of conservationists or government conflict with the values of the local people. These two dimensions of value conflicts have been underexplored in the value-conservation literature. While intra-conflicting values can reduce the impacts of conservation benefits amongst the people, inter-conflicting values can threaten the values of the local people, reduce local cooperation, and eventually lead to perverse conservation outcomes. It is still unclear how potential conflicts that arise when conservation programmes misalign with the values of the local people can be addressed or mitigated in order to achieve overall conservation objectives.

While this thesis highlights and identifies the need to understand and integrate human value concepts into conservation, there is still the need to strengthen this by documenting real-life examples and case studies of where and how the integration of human values into conservation has helped to achieve overall conservation objectives. In particular, future studies can demonstrate case studies where human value analysis has been used to improve conservation practice or construct novel solutions to conservation problems. It can also address specific questions such as 'what values are associated with deforestation or illegal hunting?', 'how do human values influence conservation governance arrangements?' or 'when does financial incentive influence pro-conservation attitudes and behaviour such as participation in conservation'? It would also be instructive for future studies to document and analyse failed attempts to integrate human values into conservation, particularly when the analysis is accompanied by explanations of why the attempts were unsuccessful.

Lastly, it has been established that values influence human behaviour towards the environment and that it is important to understand existing values that people hold for conservation. However, it is also noteworthy to recognise that values often do not always translate to behaviours, specifically pro-environmental behaviour (Kennedy et al., 2009; Segev, 2015; Hill et al., 2015). Despite the abundance of multiple values, including environmentally friendly values, not many studies have reported commensurate behaviour. Similarly, while this thesis has identified a diversity of values, research opportunity exists for future studies to explore the factors responsible for the value-behaviour gap. Modelling a value-behaviour pathway will help to understand further many moderating factors that can influence or shape pro-conservation behaviours. Specifically, future studies can explore the extent to which conservation benefits or lack of conservation benefits moderate or translate human values into behaviours. This will be the next appropriate step towards ensuring that human values support conservation.

5.4 Implications for policies and practice

This research has implications for conservation policies and practice. While the research is focused on sub-Saharan Africa and Nigeria, these recommendations are also relevant for advancing effective conservation in other countries.

It has been recognised that to produce effective, legitimate, and robust conservation outcomes, conservation policy and practice must be guided by empirical evidence that engages with human and social dimensions of conservation (Mascia et al., 2003; Bennett, 2016; Bennett et al., 2017; Mori et al., 2017; Teel et al., 2018). Historically, natural and biological sciences have tended to be the primary and often the only guide to conservation actions (Bennett et al., 2017). Consequently, this produces conservation actions that misalign or conflict with local priorities, culture and traditions (Engen et al., 2019). This thesis contends that understanding diverse human values embedded within conservation social science will facilitate conservation policies and practices and contribute to improving conservation actions and outcomes. The failure of human values to be mainstreamed in conservation stems partly from the lack of clearly and empirically articulated evidence that can guide conservation actions- an issue that this thesis contributes to addressing.

The knowledge gained from this thesis shows that the integration of human values to improve conservation policy and practice can be applied at different scales, from individual and local to national and sub-national to global and regional (Figure 5.1). The scales will involve different actors and units of analysis (i.e., object of study) and focus on different issues and topics (i.e., subject of study). For example, at the individual scale, one might want to understand value perceptions, or the multiple values people hold for forest conservation around different types of protected forest landscapes (which is the focus of this thesis). This will involve empirical evidence from protected forest areas, with community people, local leaders and individual groups or households. The knowledge gained at this level can greatly improve conservation practice by aligning it with local interests. At the national scale, conservation scientists and researchers can engage with national policymakers and legislators to ensure that diverse human values are reflected and integrated into national conservation policies and programmes. This can happen through the analysis of conservation policy documents and national workshops. It can also involve negotiating, engaging, and deliberating with local conservation actors and stakeholders in order to establish a robust national value formation process (Kenter et al., 2016). This will enhance the effective integration of plural values and conservation decision-making (Martín-López and Montes, 2015; Arias-Arévalo et al., 2017; Allen,

2019). At the global scale, international and intergovernmental organisations such as the International Union for Conservation of Nature (IUCN), IPBES, and United Nations Environmental Programmes (UNEP) can focus on conceptualising value and valuation ideas by performing a regular scientific and peer-reviewed assessment of multiple values of nature and valuation methodologies. This can strengthen the integration of values into conservation decision-making and provide national governments with scientifically credible information on different value word views, value typology, and guidelines for embedding diverse values into decision-making and designing and implementing valuation processes and methods. A recent example of this is the IPBES global assessment report on diverse values and valuation of nature (IPBES, 2022).

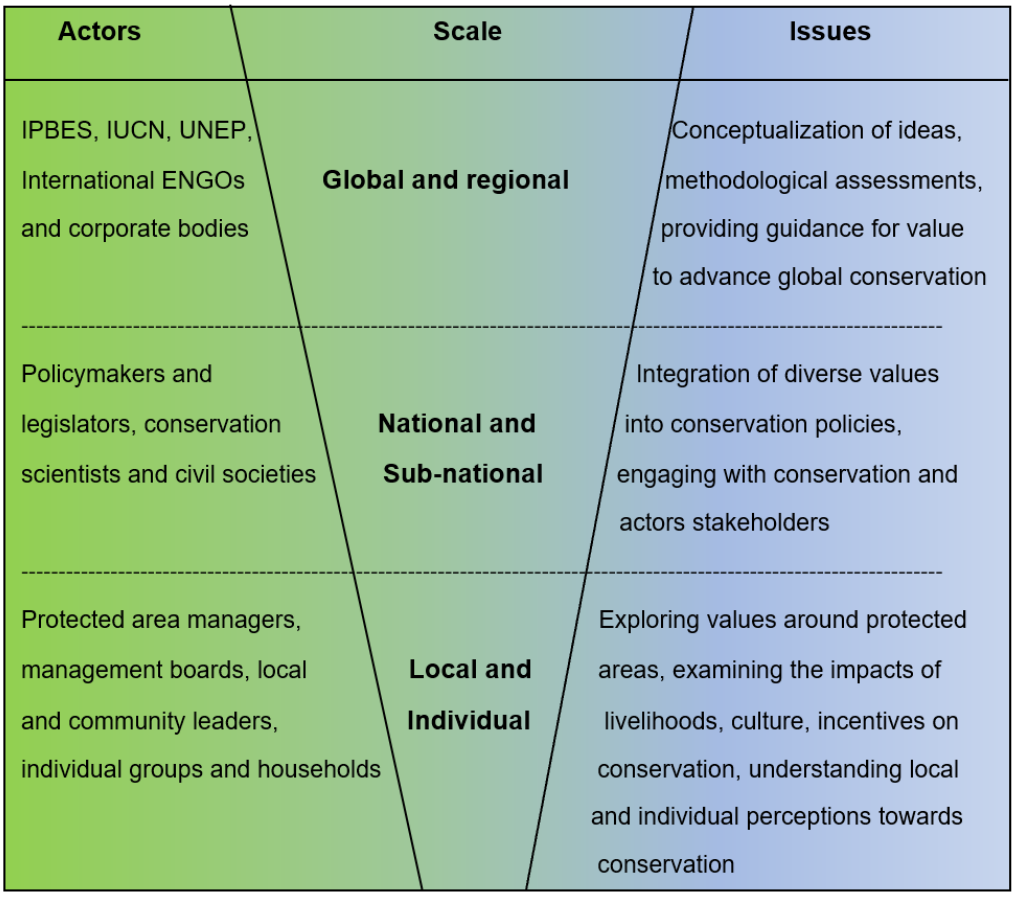

Figure 5.1: Integration of human values in conservation policy and practice at different scales. The light green shaded part on the left highlights the unit of analysis or the actors that will be involved in integrating values into conservation policy and practice, while the light blue shaded part on the right highlights the issues that will be focused on at

different scales.

Traditionally, there are two perspectives that mark nature valuation discourse: the positivist-realist perspective, which emphasises the use of scientific knowledge to value nature (Dayton, 2003; Rodger et al., 2010; Evans, 2021); and the constructivist perspective, which emphasises the use of social interaction to understand the value of nature (Bennett et al., 2017; Massarella et al., 2021; Sanborn and Jung, 2021). While this thesis leans towards the latter, there is a need to move beyond this dichotomy towards a more nuanced understanding of the role human values play in nature conservation. Drawing from the findings of the three empirical chapters, I discuss five functions that understanding human values can contribute to, and improve, conservation policies and practices.

i. Values as indicators of human interest

Value indicates human interests (Vucetich et al., 2018). The findings from this thesis indicate the multiple interests and contexts in which conservation occurs. This knowledge can guide conservation policy and practice in investing in programmes and activities that align with diverse local interests.

ii. Values diagnose why people support conservation

The understanding of diverse human values exposes knowledge of conservation challenges. In Chapter 3, the environmental values held by the different stakeholders reveal the environmental challenges in Nigeria that require conservation attention. Human values, therefore, diagnose and tells us why people support conservation or not, why conservation is failing or succeeding, and which areas conservation policies and programmes can focus on.

iii. Values help conservation reflect on responsible and ethical actions

The findings from this thesis provide the basis for conservation to reflect on what constitutes responsible and ethical conservation action. By examining how cultural traditions around sacred forests affect how people think about forest and forest conservation, it is shown why conservation practices should respect people's culture and traditions. A conservation that embeds cultural value is one that respects the rights of

local people (Rodriguez, 2017) and incorporates concerns for social justice (Martin et al., 2016). The dominance of economic value in the findings from this thesis also suggests that it may be unethical to impose conservation policies on local people without considering their economic well-being. It calls for the need for conservation to pause and consider how various interventions might affect local people, especially economically disadvantaged and forest-dependent communities.

iv. Values help to interrogate conservation assumptions

The findings from this thesis further provide the basis to interrogate some assumptions and models of conservation. For example, one of the basic assumptions of conservation practice before now is to prioritise species or habitat protection over humans living around them (Kopnina et al., 2018; Taylor et al., 2020). However, human values will influence attitudes and behaviour towards species or habitat protection. This, therefore, points to the need for conservation to prioritise humans as much as it prioritises species and habitats.

v. Value identification can enhance the acceptability of conservation projects

Identifying multiple values that matter most to people can increase the acceptability of conservation. As shown in Chapter 4, increasing the provision of values provided by the sacred forests increases the probability of local people preferring the conservation of sacred forests, albeit with varying levels of the utility of each of the values. Identifying multiple values that people hold for conservation can therefore facilitate the design of conservation initiatives that match different cultural, economic, environmental, and social contexts.

In summary, based on the knowledge gained from this thesis, the following five sequential steps are recommended to incorporate human values in conservation policy and practice.

i. *Identify the contextual range of values before starting a conservation project*. Conservation can be much more effective when we first understand and acknowledge multiple human values and make plans and decisions to either work with them in the short term or change them in the long term when they are detrimental to conservation. This is because values reveal human motivations

towards conservation (Manfredo et al., 2017). Understanding these motivations is a way to engage with local interest. This can guide conservation policy and programmes in deciding which objectives to pursue, and what strategies should be adopted.

ii. *Identify value differences and heterogeneity amongst different stakeholders and make plans to accommodate them*. Following the identification of the contextual range of values, the next action is to ascertain how people differ in their value preferences. As shown in Chapters 3 and 4 and supported by other recent studies, people differ in their preferences according to their socio-demographic profiles (Perni et al., 2020; Zabala et al., 2022). Taking this on board could help in more equitable resource allocation and in targeting conservation interventions suitable for a particular group of stakeholders.

iii. *Determine the most important and consensus values:* In addition to identifying value heterogeneity amongst different stakeholders and groups of a population, there is also a need to ascertain the most important values as well as shared values that can promote collective efforts to support conservation projects. Identifying consensus can engender inclusive decision-making in conservation and bolster support and acceptability of conservation projects, especially in potentially contentious contexts (Kenter et al., 2015). The example of forest reserves in Enugu, Nigeria, shows the power of consensusvalues expressed as stakeholders' perceptions of values that should underpin forest conservation in Nigeria. Stakeholder consensus values revealed a low preference for forest values that do not have economic or environmental relevance. Determining the most important and consensus values is also particularly relevant in designing conservation projects for culturally and religious sensitive landscapes like sacred forests where there is a polarity of faiths, perspectives, and interests. To achieve all these, deliberative value elicitation methods such as the participatory workshops used in this thesis should be integral to conservation policy development. It is a bottom-up approach that engages local communities in co-producing and designing conservation policies and programmes, According to Kenter et al. (2016), this can provide a greater understanding of potential public reactions to conservation

projects, and reduce the chances of proposing inappropriate and non-inclusive conservation strategies.

iv. *Build on consensus values:* Once the most important and consensus values have been identified using a participatory and deliberative approach, the next step is to use those consensus values to design management strategies or conservation solutions that everyone supports – or at least accepts. This is probably a difficult step especially considering heterogeneity in value preferences among a population, but it is also the most important step if inclusive conservation must be achieved. It will involve exploring why different values are more preferred than others for different people and use this as a way to seek more widespread agreement and support for conservation projects. Here, we can ask, what kinds of management strategies can incorporate consensus values? For example, which management strategy can incorporate medicinal (anthropocentric) and cultural (relational) values? As shown in Chapter 4 of this thesis, a conservation strategy that combines the most important values to the people is likely to yield a higher utility to the public.

v. *Value re-assessment:* The last step in incorporating human values in conservation policy and practice is to re-assess the consensus values against other conservation criteria and see where there are gains and losses, and if there will be need to revisit values over time. For example, examining if the consensus values from the previous steps work against conservation objectives such as habitat or species protection. Value re-assessment will involve asking critical questions such as, do the identified values represent conservation ideals? Are the values sustainable? If they are not, how can they be influenced to change to become pro-conservation via education, campaigns, and incentives, especially in the long term?

This last step is also particularly important because human values are dynamic and can change over time in response to socio-ecological changes (Ives and Kendal, 2014). One important lesson from sacred forest conservation is that values that once supported conservation may become inadequate over time to continue supporting conservation. For example, in Chapter 4, the cultural value upon which

the conservation of sacred forests relies seems no longer adequate, resulting in the gradual degradation of its biodiversity, thereby necessitating the need to identify and incorporate other multiple values types that can galvanise shared and broad support to reduce degradation and conserve sacred forests. Also, the implication of this, especially for other protected forest types, is to periodically re-assess the values people hold for conservation to determine value change and interests and adjust the conservation development plan accordingly. Again, just like the previous steps, this final step should engage local communities or the public to ensure inclusiveness and public stakeholdership in conservation.

5.5 Conclusions

The call for an inclusive approach to conservation that considers both people and nature requires an understanding of the multiple values that drive attitudinal and behavioural preferences towards conservation (Lele et al., 2010; Bennett et al., 2017; Musavengane and Leonard, 2019). This thesis has advanced understanding of the multiple values people hold for forest conservation and shown the need to integrate human values in conservation policy and practice . It has clearly shown that understanding human values is critical to achieving conservation goals. Human values can positively and negatively influence conservation attitudes and behaviours and, ultimately, the success or failure of conservation outcomes. While previous studies highlight the need to understand and integrate plural values in conservation, especially in developed countries (Kenter, 2016; Cooper et al., 2016; Arias-Arévalo et al., 2017), this thesis explores those plural values that people hold for forest conservation in the understudied context of Nigeria and sub-Saharan Africa. Evidence has been provided of the values that matter most in the conservation of both government/legally protected forests and community/culturally protected sacred forests. While the need for context-specific research on human values is highlighted before implementing a conservation project, findings provide an empirical evidence base to inform future research on integrating human values in conservation.

This thesis makes a specific contribution to improving forest conservation policy in Nigeria. Currently, the country has no management strategies to protect sacred forests. Using a value-based model, this thesis designed high-utility management strategies that can be adopted to conserve sacred forests. The thesis has also provided empirical

evidence that can support the improvement of forest conservation policy in Nigeria. The National Forest Policy in Nigeria has undergone three transitional adjustments in its objectives from the first edition in 1988. While the first version of forest policy in Nigeria under the Agricultural Policy focused on supporting food security and the production of raw materials for national development, the second in 2006 focused on addressing the problems of deforestation, overexploitation, and illegal exportation of Nigeria's forest resources (Ujor, 2018). The latest 2020 version of the National Forest Policy aims to ensure sustainable management of forest resources for increased economic, social, and environmental benefits (National Forest Policy, 2020). This thesis provides evidence that economic and environmental values matter to different forest stakeholders and also provides new insight into the importance of cultural and management values for the country's forest policy.

Overall, the work presented has built on the landmark IPBES Values Assessment report (2022) which confirmed that nature loss and biodiversity degradation are underpinned by human values and behaviours. By exploring the multiple values people hold for forest conservation, different perceptions, interests, and motivations affecting the success of forest conservation were highlighted. This knowledge can facilitate the uptake of value-based forest management strategies that align with shared public values and those that align with different group members of society. By understanding and integrating multiple human values in conservation, the debate over whether nature should be conserved for intrinsic or utilitarian reasons becomes more nuanced as both intrinsic and utilitarian human values play a vital role in influencing conservation outcomes. The challenge of halting the ongoing biodiversity degradation requires an urgent consideration of all values that have contributed to the decline and those that will support its conservation. The findings of this thesis could be harnessed by conservation managers and policymakers striving to address biodiversity loss and conservation conflicts, as well as those attempting to draw more support for conservation projects.

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Appendix A1: Ethics Clearance for Chapters 3 and 4

Business, Environment and Social Sciences joint Faculty
Research Ethics Committee (AREA FREC)

02 September 2021

Dear Eberechukwu

Title of study: **The Values of Forest Conservation in Nigeria**
Ethics reference: **AREA 21-002**

I am pleased to inform you that the above research ethics application has been reviewed by the School of Business, Environment and Social Services (AREA) Committee and on behalf of the Chair, I can confirm a favourable ethical opinion based on the documentation received at date of this email.

Please notify the committee if you intend to make any amendments to the original research as submitted and approved to date. This includes recruitment methodology; all changes must receive ethical approval prior to implementation. Please see https://ris.leeds.ac.uk/research-ethics-and-integrity/applying-for-an-amendment/ or contact the Research Ethics Administrator for further information researchethics@leeds.ac.uk if required.

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, risk assessments and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.

Yours sincerely

Rachel Prinn, the Secretariat
On behalf of Dr Matthew Davis, Chair, AREA Faculty Research Ethics Committee

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Appendix A2: Information Sheets for Chapters 3 and 4

Appendix A2.1: Project Information Sheet using Q-methodology

30th August 2021

Specific project title: Understanding the diversity of values underpinning forest conservation in Nigeria

Introduction: My name is Eberechukwu Ihemezie. I am a PhD student in the School of Earth and Environment, at the University of Leeds, UK. I am conducting a study on the multiple values people hold for forest conservation in Nigeria. In this particular study, I will be focusing on the diversity values underpinning forest conservation. Before you decide to participate, it is important that you understand why I am doing this project and what taking part might involve for you.

Please carefully read the information contained in this sheet before making your decision to participate. Feel free to talk to other people about it or ask me any question if there is something you don't understand. Take time to decide if you wish to take part/not in this research.

What is the project about?

I want to find out what you think about the underlying motivations or goals for conserving forests (i.e., why should forests be conserved or protected?). These underlying motivations and goals are what I called values. The conserved forests include the following:

National Parks

Forest Reserves

Nature Reserves

I hope this project will show what different people think should be the most important reason for conserving forests so that their ideas can be included in future forest conservation policies and programmes.

How will I do this?

You will be provided with value statements on forest conservation in software called Q-method software to sort and rank them. The Q-method software is installed on a tablet which will be presented to you in person by the researcher or the link sent to your email. After you finish sorting the statements, you will be asked questions about why you ranked them in the way you did, as well as providing some socio-demographic information.

Do I have to take part?

Your participation in this research is voluntary, and it is completely up to you to decide if you wish to take part or not. If you decide to take part and eventually change your mind along the line, you can withdraw anytime during the research and for a period after the research is concluded. You also don't have to tell me why if you don't want to. Take time to decide if you wish to take part/not in this research and get back to me within 2 days. My contact number is provided at the end of this document, and you can call me in case you wish to withdraw anytime up to the end of 10 February 2022. If you decide to withdraw all information provided by you will be deleted.

What will happen to the data I provide?

Once I receive your response after you have submitted it, all names and locations will be changed so as to afford you full anonymity. Data collected will be protected and will only

be used for academic purposes. Data will be kept confidential and no other persons beyond the research team will have access to this information. The data will be saved in a secured cloud system for 10 years after the research has been published. The data can only be accessed by the researcher and my supervisors. After the project finishes, the research report with anonymous names will be published in an academic journal and shared on a university site.

Will taking part be good or bad for me?

There will be no direct benefits from participating in this study. Taking part in this study will take up some of your time, and I can't pay you for it. However, if you use your data to access the link and participate in this study, I will reimburse the cost of the data at a flat rate of 2,000 naira.

After the study, I will tell the government people responsible for forest conservation what I have found out. This will help them to better plan the objectives of forest conservation to meet local needs.

Thank you.

Contact information

Eberechukwu Johnpaul Ihemezie

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Email: ee15eji@leeds.ac.uk

Appendix A2.2: Project Information Sheet using Participatory Workshop Method.

30th August 2021

Specific project title: Multiple values of sacred forests

Introduction

My name is Eberechukwu Ihemezie. I am a PhD student in the School of Earth and Environment, at the University of Leeds, UK. I am conducting a study on the multiple values people hold for forest conservation in Nigeria. In this particular study, I will be focusing on the multiple values of sacred forests.

Before you decide to participate, it is important that you understand why I am doing this project and what taking part might involve for you.

Please carefully read the information contained in this sheet before making your decision to participate. Feel free to talk to other people about it or ask me any question if there is something you don't understand. Take time to decide if you wish to take part/not in this research and get back to me within 2 days.

What is the project about?

You will be invited to an in-person workshop where you will help to build future alternative scenarios about how you want the sacred forest to look in the future and the values you want to obtain from them. This will help me to identify actions and approaches that can be taken so that the sacred forest ecosystem can be preserved to meet local needs.

A sacred forest

Why do you want me to take part?

You have been recognized as a key stakeholder in the sacred forest landscape either because you influence or can be influenced by changes in the landscape. Since I am trying to find out the values of sacred forests, the people who are in the best position to determine this are those people who use the forest or can be affected by how the forest is used.

What will I be doing in this research?

You will be involved in discussions and ranking exercises about the values and outcomes of sacred forest conservation. I or my research assistants will be on the ground to facilitate and also interpret anything for you in the Igbo language if you need such assistance. The workshops will be divided into two, each lasting for about half a day. A sample of those who participated in the first one workshop will be selected to participate in the second one. During the workshop, you can take a break at any time and you can also choose to answer which questions you want and not answer a question you don't want to /do not have answers to. Lunch break/refreshments will be provided during the workshop.

Do I have to take part?

Your participation in this research is voluntary, and it is completely up to you to decide if you wish to take part or not. If you decide to take part and eventually change your mind along the line, you can withdraw anytime during the research and for a period after the research is concluded. You also don't have to tell me why if you don't want to. Take time to decide if you wish to take part/not in this research and get back to me within 2 days. My contact number is provided at the end of this document, and you can call me in case you wish to withdraw anytime up to the end of Tues 30 November 2021. If you decide to withdraw all information provided by you will be deleted. You will tick a box to say you have given verbal consent to participate in the study.

Will I be recorded and what will happen to the data I provide?

I will come with a digital voice recorder to use to record our meeting. This is just to ensure that I will not be distracted during the meeting by trying to remember what you said! I will only use the audio recording to help me to write up what we talked about. No one else will

listen to it. I may also take pictures for reference purposes during the workshop, and only the research team will have access to the pictures. The data collected will only be used during this study and for the purpose of analysis. All your responses will be anonymized so that your identity will be protected. Data will be kept confidential and no other persons beyond the research team will have access to this information. All data and pictures will be stored in a secured cloud-based system for 10 years after the research is published. After the project finishes, the research report with anonymous names will be published in an academic journal and shared on a university site.

Will taking part be good or bad for me?

There will be no direct benefits from participating in this study. Taking part in this study will take up some of your time, and I can't pay you for it. The workshop will take place in a central location in your community. I will cover your travel expenses if it cost you anything to come to the workshop.

After the study, I will report my findings to those responsible for forest conservation, so that they can see how they can support conservation of the sacred forest and its values.

Thank you.

Contact information

Eberechukwu Johnpaul Ihemezie

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Appendix A2.3: Project Information Sheet using Household Questionnaire and Conjoint Analysis

30th August 2021

Specific project title: Multiple values of sacred forests

Introduction

My name is Eberechukwu Ihemezie. I am a PhD student in the School of Earth and Environment, at the University of Leeds, UK. I am conducting a study on the multiple values people hold for forest conservation in Nigeria. In this particular study, I will be focusing on your preference for the multiple values of sacred forests.

Before you decide to participate, it is important that you understand why I am doing this project and what taking part might involve for you.

Please carefully read the information contained in this sheet before making your decision to participate. Feel free to talk to other people about it or ask me any question if there is something you don't understand. Take time to decide if you wish to take part/not in this research.

What is the project about?

I want to find out your preference on how you want the sacred forests to look in the future. Sacred forests, sometimes called sacred groves, are forest areas protected primarily because of their cultural values such as religious beliefs and traditional practices. In Igbo culture, they are sometimes called 'evil forests'. I want to find out what these types of forests mean for you, and what you expect out of their conservation so that they can be better protected now and in the future.

A sacred forest

Why do you want me to take part?

Your household has been randomly selected because your community has a sacred forest. Since I am trying to find out the conservation values of sacred forests, the people who are in the best position to determine this are those people living around sacred forest areas.

What will I be doing in this research?

You will be involved in a survey using questionnaires and ranking cards. If you need assistance reading the questionnaire, I or my research assistant will help to interpret it for you in the Igbo language. The survey should last for about 40-60 min maximum. During the survey, you can take a break at any time and you can also choose to answer which questions you want and not answer a question you don't want to /do not have answers to.

Do I have to take part?

Your participation in this research is voluntary, and it is completely up to you to decide if you wish to take part or not. Take time to decide if you wish to take part/not in this research and get back to me within 2 days. My contact number is provided at the end of this document, and you can call me in case you wish to withdraw anytime up to the end of Tues 30 November 2021. If you decide to withdraw all information provided by you will be deleted. You will tick a box to say you have given verbal consent to participate in the study.

Will I be recorded and what will happen to the data I provide?

There may not be a need to record your survey exercise as you will have to tick or write in the questionnaire or rank the cards that will be provided based on your preference. You will tick a box to say you have given verbal consent to participate in the study. The data collected will only be used during this study. All your responses will be anonymized so that your identity will be protected. Data will be kept confidential and no other persons beyond the research team will have access to this information. Data will be stored in a secured cloud-based system for 10 years after the research is published.After the project finishes, the research report with anonymous names will be published in an academic journal and shared on a university site.

Will taking part be good or bad for me?

There will be no direct benefits from participating in this study. Taking part in this study will take up some of your time, and I can't pay you for it. The survey will take place in your household and so not expected to cost you extra money. The survey can also be arranged at your convenience.

After the study, I will report my findings to those responsible for forest conservation, so that they can see how they can support conserving the sacred forest and its values.

Thank you.

Contact information

Eberechukwu Johnpaul Ihemezie

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Appendix A3: Consent to take part in the study "Understanding the multiple values people hold for forest conservation"

Name of Researcher: Eberechukwu Johnpaul Ihemezie	Tick (√) next to the statements you agree with
I confirm that I have read (or have been read to) and understood the information sheet explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw at any time up until the end of Tues 30 November 2021 without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential and have been told how the data will be stored.	
I agree for the anonymised data to be used in relevant future research.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant	
Date	
Tick (√) here to give verbal consent to participate in this study.	
Name of lead researcher [or person taking consent]	
Signature	

Date*	

*To be signed and dated in the presence of the participant.

Copies:

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

Appendix B: Supplementary material Chapter 2

Title: The Influence of human values on attitudes and behaviours towards forest conservation

B.1 Protocol for scoping review

B.1.1 Review rationale

A number of past forest conservation reviews have examined the relationship between forest conservation and environmental management (Chaudhary, 2000; Pagdee et al., 2006). Others have examined factors influencing the success of forest conservation such as socioeconomic factors (Malkamaki et al., 2018). However, empirical studies have shown that forest conservation attitudes and behaviours are more driven by values than by socioeconomic factors (Ansong & Røskaft, 2011). The few available reviews that have attempted to examine the relationship between forest conservation and human attitudes and behaviours have typically limited their review to a single conservation strategy such as community biodiversity conservation (Brooks et al., 2013) or national parks (Muhumuza & Balkwill, 2013), while also ignoring the underlying value concerns that produced or motivated the attitudinal and behavioural outcomes. To date, no systematic review exists which follows a pluralist approach to examine the human value orientations influencing people's attitudes and behaviours towards forest conservation. Unlike the unidimensional approach which measures human values using a single scale such as the monetary worth of forest resources (e.g. D'Amato et al., 2016), thereby providing a partial view of people's forest values, we employed a multidimensional scale which recognizes the diverse values people hold of the forest and its conservation. Since our interest was to map, explain, and identify relevant research gaps in the wide range of studies examining the relationship between forest conservation and human values, we found the scoping review approach to be an appropriate methodology. We, therefore, followed Arksey & O'malley's (2005) framework for conducting scoping reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Moher et al., 2015).

B.1.2 Research questions

The overarching aim of this study was to examine the extent of evidence and knowledge gaps in the relationship between human values and forest conservation attitudes and behaviours in SSA. The following research questions were addressed:

i. What are the geographic characteristics of forest conservation and human value evidence from SSA?
ii. What are the human value orientations influencing forest conservation attitudes and behaviour in SSA?
iii. How have human values influenced forest conservation attitudes and behaviours?

B.1.3 Conceptual definition of key terms

We provide the conceptual definition of key terms in this review in Table B.1.

Table B.1: Conceptual definition of key terms used in the study

Term	Definition	Source(s)
Forest	A land area of more than 0.5ha and chiefly covered with tree grown cover of over 10% and 5m height. The definition excludes lands that are predominantly under agricultural and urban use.	Food and Agriculture Organization [FAO], 2018.
Forest conservation	The practice of planting, maintaining, and protecting forest landscape for the purpose of conserving biological/natural and cultural values, sustainable use and equitable distribution of forest goods and services, and strategic preservation of forest resources for future use.	International Union for Conservation of Nature [IUCN], 2008; Pawar and Rothkar, 2015.
Human value	Motivational concerns or goals, multiple perceptions/ideas or beliefs which people hold of the forest, forest resources, and forest conservation.	Reser & Bentrupperbäumer, 2005; Sharaunga et al., 2015; Manfredo et al., 2017.

B.1.4 Literature search strategy development

We started by identifying the four key concepts relevant to this study and articulated them in a logic grid (Table B.2) as follows: forest, value, conservation, and sub-Saharan Africa (SSA) as the geographical scope. The alternative terms and synonyms for the identified key concepts were developed based on their reviews/conceptual framings in related institutional documents and extant literature. For instance, the term ‘forest’ and its synonyms were extracted from the Food and Agriculture Organization’s (FAO) global

forest resources assessments (FAO, 2018). The FAO definition of the forest was selected because of its dominant use in literature amongst other forest definitions. Alternative terms for conservation were extracted from the International Union for Conservation of Nature and Natural Resources [IUCN] guidelines for applying protected area management categories (IUCN, 2008). The IUCN document not only classified and defined different categories of protected forests but also described other conserved forests whose primary management objective conceptually differed from the conservation of biological and cultural values, to include broader economic (e.g., timber plantation) and ecological (e.g. watershed protection) functions. Alternative terms for values were extracted from the review of relevant articles addressing forest values, attitudes, and behaviours (Sweikert and Gigliotti 2019; Manfredo et al., 2017; Sharaunga et al., 2015), while the alternative terms for SSA were adopted from a search strategy used by Ndarukwa et al. (2019). The combination of these produced a logic grid and search string used for literature searches.

B.1.5 Database search process

Two databases relevant to environmental studies were searched namely Web of Science (a comprehensive citation database), and Scopus (covers publications in life sciences, physical sciences, social sciences, etc.). Relevant search filters for the advanced search were used. For instance, an asterisk (*) was used as a wildcard operator for the truncation of words with multiple endings. This returned all words with a similar root stem. Question mark (?) was used for spelling variants, e.g. behaviour (UK) vs behaviour (US) spelling variants. Double quotation marks "…" were used to search for word combinations instead of single words. Other word variants and misspellings such as "Sub-Saharan Africa" and "Sub Saharan Africa" were considered. Boolean operators OR and AND were used for the search. There was no restriction on publication date, and all searches were conducted in the English language.

Table B.2: Key concepts, logic grid, and search strings

Forest	Conservation	Value	Sub-Saharan Africa
Forest* OR woodland* OR	Conservation OR	value* OR belief*	"Sub-Saharan Africa" OR "Sub Saharan Africa" OR Angola OR Benin OR Botswana OR "Burkina

timberland* OR mangrove* OR bamboo* OR "plant* forest" OR "exotic plantation*"	"protected area" OR "nature reserve*" OR "wilderness area*" OR "national park*" OR "natural monument*" OR "habitat area*" OR "protected landscape*"	OR attitude* OR behavio?r* OR perception* OR motivation* OR orientation* OR knowledge OR cultur*	Faso" OR Burundi OR Cameroon OR "Cape Verde" OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Democratic Republic of Congo" OR Djibouti OR "Equatorial Guinea" OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR "Guinea Bissau" OR "Ivory Coast" OR "Cote d'Ivoire" OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR "Sao Tome" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "South Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR "Western Sahara" OR Zambia OR Zimbabwe OR "West Africa" OR "Western African" OR "East Africa" OR "Eastern African" OR "Southern African"

B.1.6 Data screening and eligibility criteria

A two-stage screening was independently carried out by two researchers (EJI and LS). In the first stage, articles were screened for suitability for inclusion in the study, using their titles and abstracts, while in the second stage, full-text of the articles were screened. To be included in our review, studies must meet the following eligibility criteria:

i. The study must be published in English in a peer-reviewed journal.
ii. The study must be original hence reviews, editorials, book chapters, and opinion discussions were excluded.
iii. The study must include only studies that wholly or in part indicated a quantitative or qualitative relationship between human values (beliefs, motivational concerns/goals, perceptions) and forest conservation attitudes and behaviours.
iv. Include all types of forest conservation studies following the IUCN (2008) guidelines for applying protected area management categories.

v. Include only studies that defined value from the social science perspective, which views value as a human-generated cognition (Reser and Bentrupperbäumer, 2005). Thus, exclude studies that defined value solely from an ecological perspective, where value was perceived to reside in the natural environment independent of humans.
vi. Exclude studies that examined attitudes or behaviours towards forest conservation without identifying the underlying values that influenced the attitude and behaviour.
vii. Exclude studies that examined animal behaviour rather than human behaviour within the context of forest conservation.
viii. Exclude studies that focused on assigned economic or monetary valuation of the forest, or payment for ecosystem services, because they do not represent inherent motivations, perceptions/ideas, or beliefs which people hold of the forest, forest resources, and forest conservation.

B.1.7 Data extraction process

Using a designed data extraction form, six types of data were extracted from quantitative (Table B.3) and qualitative (Table B.4) studies, which covered:

i. Study information (title, author, year of publication, and study location)
ii. Background/contextual (objective of the study)
iii. Methodology (study design, study population, sample size, data collection, and analysis)
iv. Forest conservation (conservation strategy, and conservation attitudes and behaviours)
v. Value (subject/object of value, and motivational concerns/goals)
vi. General results indicating how humans influenced forest conservation attitudes and behaviours.

Table B.3: Summary of data extracted from quantitative studies included in the review

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Kibru et al. (2020)	Tigray region in northern Ethiopia	Assesses farmer's perception and reasons to practice Farmer Managed Natural Regeneration	Cross-sectional	Farmers (90)	Questionnaire survey, (Pearson's chi square test, non-parametric test)	Agroforestry	Involvement in forest regeneration	Farmer-managed natural regeneration practice	1) Because of the use of fuelwood, food, fodder, timber extraction, and medicinal uses, 2) Perceived benefits of forest on soil conservation and soil fertility	Perception of forest provisioning and regulatory services influenced farmers' involvement in forest regeneration practices.			**Low quality (3)**
Araia & Chirwa (2019)	Thathe Vondo Forest Reserve and Mafhela Forest Reserve, South Africa	Analysed the compliance behaviour of local communities towards culturally protected areas and state-protected indigenous forests	Cross-sectional	Forest households (135)	Questionnaire survey, (non-parametric tests, chi square and binary logistic regression)	Community forestry	Compliance behaviour	A culturally protected forest, and a state protected forest	1) Utility values and perceived impact on livelihood, 2) Watershed protection, 3) Strength of conservation rule, 4) Traditional norms, 5) protection of endangered species and forest wildlife habitat	People who perceived the utility values of forest, watershed protection, cultural values and protection of endangered species and forest wildlife habitat appeared to have positive compliance behaviour	There was no consensus on the strength of enforcement of rules		**Medium quality (5)**
Gebregziabher & Soltani (2019)	Tigray region in northern Ethiopia	Examine the perceptions and attitudes of local people living next to nine exclosures in the Tigray Region in Ethiopia	Cross-sectional	Rural households (446)	Questionnaire survey, (Factor analysis, linear and binary logit regression)	Community forestry	Support exclosures in protected areas	Conservation of a protected area	1) Perceived and derived economic benefit from conservation e.g. employment, 2) Perceived forest benefit on reducing erosion	Local communities support exclosures if they perceive tangible economic and environmental benefits			**Medium quality (5)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Abukari & Mwalyosi (2018)	Mole national park, Ghana and Tarangire National Park, Tanzania	Compared factors that influence the attitudes of local communities toward the conservation of two national parks	Cross-sectional	Households around protected areas (365)	Questionnaire survey, (Chi-square, t-test, step-wise regression)	National Park	Attitude towards national park	Two national parks	1) Because of access to the use of forest resources, and benefit from conservation project e.g. employment, 2) Perception of PAs as ecological entities	1) Respondents who have access to NTFPs have a less negative attitude towards mole national park, 2) Perception of PAs as ecological entities influenced positive attitudes	In Tarangire NP, access to forest resources has no significant effect on attitude	Low perception of conservation benefits influenced negative attitudes towards PAs	**Medium quality (5)**
Nsonsi et al. (2017)	Nouabalé-Ndoki National Park Northern Congo, Lobéké National Park Cameroon, and Dzanga-Ndoki National Park Central African Republic	Understand the factors shaping attitudes towards forest elephants	Cross-sectional	Rural households (314)	Questionnaire survey, (Multivariate analysis, generalised linear model)	National Park	Attitude towards forest elephant conservation	Forest elephant conservation	Perception of benefits from conservation e.g. employment, and perception of costs that comes with the conservation of elephant e.g. human-elephant conflict	Benefits from conservation influenced positive attitudes towards the conservation of forest elephants		Conservation costs influenced negative attitudes	**Medium quality (6)**
Ofoegbu & Speranza (2017)	Vhembe district, South Africa	Examine rural peoples' intention to adopt sustainability practices in communally managed forests	Cross-sectional	Rural households (155)	Questionnaire survey, (Structural equation modeling)	Community forestry	Intention to adopt sustainable forest management practices	sustainable forest management practices	Subjective norm i.e. social pressure to perform a specific behaviour	Subjective norms or beliefs about the approval or disapproval of sustainable forest management (SFM) practices by other relevant people mainly influenced the strong intention to adopt such practices.			**Medium quality (5)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Rickenbach et al. (2016)	Bantu and Yaka Pygmy forest in Northan Congo	Understand the values of forest dwellers and assess the usefulness of value orientations in predicting attitudes towards wildlife management interventions	Cross-sectional	Forest households (200)	Questionnaire survey, (Cluster analysis, factor analysis, Poisson regression analysis)	Community forestry	Support for forest wildlife conservation	Wildlife species	1) Perception of forest wildlife as livelihood source, 2) Perception of wildlife as a threat to life and property, 3) Attraction to forest wildlife	Attraction to forest wildlife influenced support for wildlife conservation		Perception of forest wildlife as a livelihood source increased hunting and poaching, while the perception of wildlife as a threat to life and property encouraged the killing of wildlife	**Low quality (4)**
Garekae et al. (2016)	Chobe enclave communities, Botswana	Examine attitudes towards management of Forest Reserve and explored factors influencing conservation attitudes	Cross-sectional	Rural households (183)	Questionnaire survey, (Pearson correlation, logistic regression)	Forest reserve	Attitude towards forest conservation	A forest reserve	Knowledge of forest trees and dependency on forest resources	Knowledge of forest trees and dependency on forest resources influenced positive attitudes towards forest conservation			**Medium quality (5)**
Meijer et al. (2016)	Mzimba and Chiradzulu districts, Malawi	Examine farmers' attitudes and behaviour in relation to cutting down forest trees	Cross-sectional	Farmers (200)	Questionnaire survey, (Structural equation modeling)	Community forestry	Attitude towards cutting down forest trees	Forest trees	Subjective norm due to prevalent communal value which makes individuals have less control over the behaviour	Subjective norm influenced positive attitudes by reducing intention towards cutting down forest trees			**Medium quality (6)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Dewu & Røskaft (2016)	Mole National Park and Digya National Park, Ghana	Understanding community attitudes towards protected areas	Cross-sectional	Forest communities (364)	Questionnaire survey, (Multiple regression analyses)	National park	Attitude towards protected area (PA)	Two national parks	1) Perceived benefit from a protected area, 2) Perceived cost from conservation such as conflicts and losses which affects livelihood conditions	Perceived benefit from conservation influenced positive attitude towards PA		Perceived cost from conservation influenced negative attitude towards PA	**Medium quality (5)**
Amin et al. (2015)	Forêt marécageuse de Tanoe-Ehy and National Park of Azagny, Côte d'Ivoire	Understand local perceptions of and preferences for protected areas	Cross-sectional	Rural households (301)	Questionnaire survey, (Multinomial regression models and content analysis)	National park	Preference for forest conservation	A national park	1) Because of the use of medicinal forest plants, and dependence on natural resources, 2) Perception of conservation management rules	Use of medicinal forest plants, conservation management rules, and level of dependence on natural resources influenced preference for forest conservation			**Low quality (4)**
Cobbinah (2015)	Kakum Conservation Area, Ghana	Examine local attitudes – positive and negative responses – towards natural resource management in protected areas	Cross-sectional	Rural households (310)	Questionnaire survey, (Chi square and logistic regression)	Forest reserve	Attitude and involvement in forest management	A forest reserve	1) Derived benefits from conservation such as employment and income 2) Involvement in management	Positive attitudes and increased participation in conservation were largely influenced by derived economic benefits and involvement in forest management.			**Medium quality (6)**
Baker et al. (2014)	Akpugoeze Enugu State, and Lagwa Imo State, Nigeria	Explored the relationships among informal institutions, religion, and human attitudes	Cross-sectional	Rural communities (410)	Questionnaire survey, (Binary logistic-regression models)	Community forestry	Behaviour towards conservation of monkey	Sclater's monkeys	1) Traditional belief, 2) perception of wildlife as a threat to farms	Traditional belief associated with monkey influenced their protection		Monkeys crop and garden raiding activities encourage	**Medium quality (6)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
		toward sacred populations of a threatened, endemic species										d the killing of monkeys	
Hartter et al. (2014)	Kibale National Park, Uganda	Explore public perceptions of benefits accrued from conservation	Cross-sectional	Forest households (381)	Questionnaire survey, (Generalised linear model)	National park	Attitude towards protected area	A national park	Perceived regulatory ecosystem services such as climate regulation, rain formation	Perceived regulatory ecosystem services from national park influenced positive attitudes towards protected area			**Medium quality (5)**
Nielsen & Meilby (2013)	Udzungwa Mts, Tanzania	Evaluated the effect of JFM on the number of bushmeat hunters in a forest reserve and test whether their response to regulations was best characterized by instrumental or normative explanations	Cohort study	Hunters and non-hunters (197)	Questionnaire survey, (Multinomial logistic regression)	Forest reserve	Illegal hunting	Joint forest management program	Perceived benefit from a conservation program			Perceived low benefit from conservation motivated continued illegal hunting	**High quality (9)**
Ramcilovic-Suominen et al. (2013)	Dormaa, Begoro, and Juaso in the High Forest zone, Ghana	Assess the importance of farmers' forest values and the potential associations between farmers' forest values and their compliance with the tree-felling rule	Cross-sectional	Farmers (226)	Questionnaire survey, (Multivariate binary logistic regression analysis)	Forest reserve	Compliance to tree felling rule	A forest reserve	1) Extraction of timber, cash crops, earnings from selling forest products, food crops, vegetables, meat, fruits, shelter, household items, firewood, 2) Clean and healthy air, water, soil, rainfall, shade, animal habitat, 3)	Farmers who ascribe high importance to economic forest values and religious forest values are more likely to comply with the tree-felling rule	The study found no association between compliance and subsistence forest values, environmental forest		**Medium quality (5)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
									Preservation of forest by future generations, 4) Perception of the forest as a place of worship		values, and bequest forest values		
Sharaunga et al. (2013)	KwaZulu-Natal, South Africa	Identify the values rural households in KwaZulu-Natal hold towards forests, and to investigate whether the values influence households' decisions to participate in self-initiated CBFM programs	Cross-sectional	Rural households (153)	Questionnaire survey, (Principal Component Analysis, Multinomial Logit Model)	Community forestry	Participation in community forestry	Community-based forest management project	1) Extraction of firewood, medicinal uses, 2) Preservation of forest by future generations, 3) Sense of wellbeing from forest existence, 4) Recreational uses, 5) Forest uses as a place of worship and communication with God, burial sites and ancestor abode	People who hold bequest forest value, existence forest value, recreational forest value, religious/spiritual forest values, and traditional forest value are likely to participate in managing the community forest		People who hold subsistence forest values and medicinal forest values are less likely to participate in managing the community forest	**Medium quality (6)**
Ezebilo (2012)	Cross River National Park, Nigeria	Examine local people's perceptions of a community forestry project and the factors that influence their perceptions increase local acceptance	Cross-sectional	Forest households (150)	Questionnaire survey, (Ordered logit and binary logit models)	Community forest conservation project	Satisfaction with community forest project	A community forest conservation project	Contribution of forest project to income from cash crops	Respondents who feel that the forest project contributes to their income are satisfied with the forest project			**Medium quality (5)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
Tesfaye et al. (2012)	Dodola woreda district, Ethiopia	Study the attitude and intention of households towards participating in collective forest management (tree planting) activity	Cross-sectional	Rural households (352)	Questionnaire survey, (Multiple regression analysis)	Community forestry	Intention and attitude towards participation in tree planting	Participatory forest management	1) Forest dependence 2) Subjective norm i.e. perceived behavioural control		Subjective norm had no significant effect on intention and attitude towards participation in forest management	The study shows that one of the factors that negatively influenced intention and attitude to participate in forest management is forest dependence.	**Medium quality (6)**
Ansong & Røskaft (2011)	Subri Forest Reserve, Ghana	Examine attitudes of primary stakeholders towards forest conservation management	Cross-sectional	Local community households (300)	Questionnaire survey, (Multiple regression analysis)	Forest reserve	Attitude towards forest reserve	A forest reserve	1) Dependence on the forest for livelihood, 2) Preservation of forest for a future generation, 3) Respect, concern, and admiration for forest	Respondents who are concerned about the forest or for a future generation had higher attitude score		Respondents who depend on the forest reserve for livelihood had lower attitude score than those who not derive benefit	**Medium quality (6)**
Kiyingi & Bukenya (2010)	Mabira Central Forest Reserve, Uganda	Understand community and ecotourist perception of conservation benefits and factors that	Cross-sectional	Local community and international ecotourists (78)	Questionnaire survey, (Chi- square, regression analysis)	Forest reserve	Willingness to pay for forest conservation	A forest reserve	1) Use of firewood, poles, craft, 2) Water catchment, rain formation carbon sink, 3) Preserving the forest for the future generation, 4)	Benefits people derive from the forest (i.e. direct and indirect forest uses) improved their willingness to pay for conservation and	The non-use values had no significant effect on willingness to pay for		**Low quality (4)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitude and behaviours	Subject/ Object of value	Motivational concerns/goals	Significant positive outcome	No significant effect (neutral)	Significant negative outcome	Quality score
		influence respondents' valuation of forest conservation							Perceiving forest as God's creation, and preserving the forest for traditional functions.	positively influence the value they place on forest conservation.	conservation		
Vodouhe et al. (2010)	Pendjari Biosphere Reserve, Benin	Assess community perception of biodiversity conservation within protected areas	Cross-sectional	Rural households (164)	Questionnaire survey, (Stepwise Discriminant Analysis)	National park	Acceptance of conservation	A national park	1) Perception of management strategy	Acceptance of conservation was highly correlated with the current management strategy that involved more effectively local communities			**Low quality (4)**
Morgan-Brown et al. (2009)	Msasa and Kwezitu in the East Usambara Mountains, Tanzania	Assess whether butterfly farmers perceive the link between farming and conservation and whether benefits derived from it are strong enough to change people's behaviours in ways that will benefit conservation	Cross-sectional	Butterfly farmers and local community (320)	Questionnaire survey, (Logistic regression, general linear model, propensity scores as regression weights)	Integrated conservation and development project	Participation in a conservation project	An integrated Conservation and Development	1) Contribution of the forest to the success of butterfly farming.	Farmers believed butterfly farming would be impossible if local forests were cleared, and butterfly farmers reported significantly more participation in forest conservation behaviours			**High quality (8)**

Table B.4: Summary of data extracted from qualitative studies included in the review

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
Rafidison et al. (2020)	Eastern side of the Malagasy Highlands, Madagascar	Investigate why communities protect isolated individuals and clusters of Ficus species in their rural landscapes.	Cross-sectional	Farmers (154)	Open ended interviews (Narrative analysis)	Community forestry	Compliance to forest rule	Ficus plant species	1) Because of the usefulness to livelihood, 2) Watershed protection, soil conservation, 3) Spiritual and cultural identity, 4) Protection of forest wildlife habitat	The protection of the nine Ficus species is driven by their multiple uses and varies depending on their distribution in social–ecological facets. Ficus tree that grows from self-sown seedlings near social–ecological facets such as tombs, steles, abandoned ancient villages or elements of landscapes such as large rocks, are systematically protected.	**High quality (14)**
Sinthumule & Mashau (2020)	Thathe Vondo sacred forest, South Africa	Identify and describe the key indigenous practices used by local communities to manage sacred forest, and examine the attitudes held by rural households regarding the value of TEK in forest management.	Cross-sectional	Forest households and community heads (6)	Key informant interviews (Thematic content analysis)	Community forestry	Compliance to forest rule	The Thathe Vondo sacred 'holy' forest	Traditional Ecological knowledge (TEK)- Belief (Religious/Spiritual), customs, rituals, myths (Traditional roles)	The key TEK that is used to conserve sacred forest in the study area includes rituals and customs for the protection of ancient burial grounds. The positive attitudes equated to compliance as local communities were found not to harvest fuelwood or hunt in the sacred forest because of TEK	**High quality (16)**
Mavhura & Mushure (2019)	Nharira communal lands of Chikomba district, Zimbabwe	Documents how the Nharira community of Chikomba district, Zimbabwe is using indigenous knowledge to conserve forest and wildlife resources.	Cross-sectional	Smallholder farmers (107)	Key informant interviews and focus group discussions (Thematic content analysis)	Community forestry	Promote natural resource conservation	Plant and animal species in forest hill landscape	Indigenous knowledg e - customary rules and regulations, rituals, taboos, totems, metaphors, and proverbs	Indigenous knowledge constitutes the social and religious values of the Nharira community that are used in conserving the human-environment system. However, shifting values resulting from change of faith from traditional belief to Christianity are eroding indigenous practices used for forest and wildlife conservation.	**High quality (17)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
Mmahi & Usman (2019)	Kainji Lake National Park, Kaiama; Nigeria	Examine wildlife poaching from the poachers' perspective; investigate the strategies adopted by the poachers to evade arrest and examine the factors contributing to the persistence of poaching	Cross-sectional	Wildlife poachers (37)	In-depth interviews (Thematic analysis)	Forest reserve	Compliance to forest rule	Wildlife species	Perception of forest landscape as community heritage for livelihood support	Findings from the study showed that community rationalization and justification of hunting as their heritage, and perception of the establishment of KNP as an incursion on their heritage was a major force propelling illegal hunting.	**Medium quality (13)**
Kent & Orlowska (2018)	Church forests around Lake Tana, Ethiopia	Understand the norms, beliefs, and practices of this sacred church forest, and how they have sustained conservation	Cross-sectional	Clergy and laypeople (31)	Semi-structured interviews (Narrative analysis)	Community forestry	Protection of sacred church forest	Church forest	Belief and religious norm	In actuality, the religiosity surrounding church forests maintains the purity of the most holy space in the center of the shrine.	**Low quality (7)**
Ruelle et al. (2017)	Debark District, Ethiopia	Investigate why and how the local clergy and laypeople protect and promote woody plants within their sacred spaces	Cross-sectional	Clergy and laypeople (22)	Semi-structured interviews (Thematic Content analysis)	Community forestry	Conservation of indigenous forest tree species	Indigenous forest tree species	Knowledge about customs and traditional ethos of tree planting	Ethiopia's church forests nurture the knowledge necessary to promote plant diversity in the rest of the landscape and serve as archetypes for community-driven conservation.	**High quality (15)**
Costa et al. (2017)	Tombali region, Cantanhez Forest National Park, Guinea Bissau	Understand whether women were willing to participate in the conservation strategies that were designed for CFNP	Cross-sectional	Rural women (47)	Focus group discussion (Thematic analysis)	National Park	Attitude towards conservation	Chimpanzee population	Perception of conservation as a threat to people's welfare	Women felt the park was responsible for malnutrition in the communities due to damage of crops by wildlife.	**High quality (19)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
Asante et al. (2017)	Ashanti region, Ghana	Identify the cultural practices that have been used to conserve forests by four Ashanti communities in Ghana	Cross-sectional	Traditional authorities, men & women, chain saw operators, foresters, and farmers (92)	Semi-structured interviews (Thematic content analysis)	Community forestry	Protection of indigenous forests	Indigenous forests	Traditional practices and religious belief	Beliefs, taboos, myths, proverbs, and songs were vital traditional systems used by the Ashantis to effectively conserve their forests. Cultural practices and traditional beliefs were found to be more useful in conserving forests more than the government-controlled forests	**High quality (16)**
Klepeis et al. (2016)	South Gondar Administrative Zone of the Amhara Regional State, Ethiopia	Understand reasons why communities value the forests	Cross-sectional	Clergy, laypeople, and local authorities (157)	Semi-structured interviews (Thematic content analysis)	Community forestry	Protection of sacred church forest	Church forest	Belief and traditional roles such as burial sites	Church forests represent an unusual form of community-based protection that integrates locally controlled common property with external institutional arrangements: this hybrid system is highly effective at protecting the forest while maintaining cultural practices	**Medium quality (13)**
Fritz-Vietta (2016)	Mananara-Nord, and the Sahamalaza Iles-Radama Biosphere Reserves, Madagascar	Investigated local peoples' conceptions of forest values	Cross-sectional	Forest communities (45)	Semi-structured interviews; participatory rural appraisal, (Thematic content analysis)	Integrated conservation and development project	Achievement of wellbeing	A biosphere reserve	1) Use of forest woods, medicinal plants, food, 2) Protection against erosion, 3) Forest aesthetics	Local population's views on valuable natural elements serve to indicate what they consider important for the achievement of well-being	**High quality (16)**
Fraser et al. (2016)	Gbarpolu, Bong, Lofa, and Nimba in Northwestern, Liberia	Examine cultural valuation in relation to biodiversity conservation	Cross-sectional	Forest communities (116)	Participant observation, oral histories, Semi-structured interviews (Narrative	Agroforestry	Attitude towards agroforestry	Sacred agroforest	Ancestor worship and ritual	Sacred agroforests are shaped and conserved by local cultural institutions revolving around ancestor worship, ritual, and the metaphysical conceptual category. However, the practice of sacred agroforestry is under threat from a generational shift in cultural valuation as youths have begun to challenge cultural	**High quality (15)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
					analysis)					worldviews such as sacredness of forest	
Irakiza et al. (2016)	Buhanga sacred forest in Musanze District, Rwanda	Assess the traditional ecological knowledge and belief in the utilization of some important plant species for the conservation of Buhanga sacred forest	Cross-sectional	Traditional healers and community elders (53)	Interviews and focus group discussion (Narrative analysis)	Community forestry	Protection of sacred forest	Sacred forest	1) Traditional norms, 2) Use of medicinal plants	Cultural norms and values associated with the sacred forest has led to non-exploitation	**Medium quality (13)**
Ouma et al. (2016)	Kakamega Forest, Kenya	Assess the use of indigenous knowledge in forest management and conservation	Cross-sectional	Forest communities (44)	Focus group discussions and in-depth interviews (Framework analysis)	Community forestry	Sustainable forest use	Community forest	Beliefs, practices, and norms	Local community applied various beliefs, practices, and norms to regulate the use of Kakamega Forest	**High quality (14)**
Mariki (2013)	Kiliimanjaro National Park, West Kilimanjaro Forest Plantation, Tanzania	Compare participatory approaches used by a national park and a state forest plantation	Cross-sectional	Rural communities (64)	Semi-structured interviews (Content analysis)	National park	Attitude towards conservation	A national park and forest plantation	Benefits from conservation (income, employment, infrastructure), involvement in park management	The extent of participation and amount of benefits accrued are found to have a paramount role in determining local people's attitude to conservation	**High quality (14)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
Baker (2013)	Akpugoeze, Enugu State and Lagwa Imo State, Nigeria	Understand the links between local folklore and the conservation of Sclater's monkey	Cohort	Rural people, traditional rulers, shrine priests, and village chiefs (19)	Semi-structured interviews (Narrative analysis)	Community forest	Support for the conservation of Sclater's monkeys	Sclater's monkeys	Belief, taboos, folklores	Folklore contributed to the continual observance of the taboos against harming monkeys. However, support for the taboos is weakened by the monkeys' crop- and garden-raiding activities and, due to widespread adoption of Christianity by residents	**High quality (16)**
Cocks et al. (2012)	Grahamstown, Alice and Peddie districts Eastern Cape Province, South Africa	Explore the cultural, spiritual, and emotional relationships people have with nature, as well as the activities that mediate this relationship	Cross-sectional	Rural households (36)	Interviews and participatory mapping (Narrative analysis)	Community forest	Wellbeing of local people	Xhosa forest	Perception of the forest as a spiritual protective covering	Maintenance of biodiversity and natural vegetation is as much in the interest of the local community's well-being as it is in the interest of conservation planners. This is because of the local peoples' perception of the forest as a spiritual protective covering, a place that bestows spiritual health and well-being	**Medium quality (13)**
Scales (2011)	Central Menabe, Madagascar	Understand the environmental perceptions and values of conservation organizations and rural households	Cross-sectional	Rural households and conservation experts (44)	Semi-structured key informant interviews; rapid rural appraisal methods, focus group discussions (Discourse analysis)	Community forestry	Sustainable forest use	Rural forest	1) Perception of forest as inexhaustible material and beneficial for agriculture, 2) Perception of forest as abode of spirits and ancestors	There is a misunderstanding of the values and beliefs of rural households. The forest is not seen as something to be protected but to be respected and used responsibly according to fady and the ancestors.	**High quality (16)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
Fournier (2011)	Bondoukuy region, Burkina Faso	Assess the consequences of wooded shrine rituals on vegetation conservation	Cross-sectional	Village elders (50)	Unstructured interview (Narrative analysis)	Community forestry	Protection of forest vegetation	Wooded sacred site	Beliefs and ritual practices	Ritual practices are much more diverse and fluid than might have been supposed. Protection 'by tradition' is thus rather different from what we call conservation. While vegetation does matter, its presence on sacred sites is not essential. It shows the inadequacy of sacred forests as a category of forest conservation	**Medium quality (12)**
Msuya & Kideghesho (2009)	West Usamabara Mountains, Tanzania	Assess the role of traditional management practices in enhancing sustainable use and conservation of medicinal plants	Cross-sectional	Rural households (30)	Focus group discussions, participant observation (Content analysis)	Community forestry	Protection bio-cultural forest species and sustainable forest use	Sacred plants	Belief and traditional practices	Discussions with key informants and focus groups revealed that sacred plants were important for: ritual purposes including worshipping; ceremonies such as marriage, childbirth, sacrifice, and circumcision; and meeting places	**Low quality (8)**
Tabuti et al. (2009)	Nawaikoke Sub-county, Uganda	Assess community attitudes and preferences towards woody species	Cross-sectional	Community heads, traditional medicine men, carpenters, craftsmen, farmers (42)	Focus group discussions, key informant interviews, semi-structured interviews (content analysis)	Community forestry	Willingness to conserve forest woody species	Woody species	Economic uses of forest woody species	The study shows that community members are interested in conserving prioritised trees with utility values and ignore others	**Medium quality (13)**
Jones et al. (2008)	Fianarantsoa province, Madagascar	Examine whether informal norms which relate to the use of natural resources in the eastern rainforests of Madagascar play an	Cross-sectional	Rural households (75)	Semi-structured interviews (Narrative analysis)	Community forestry	Protection of endemic forest species	Forest animal and plant species	Taboos, norms	Taboos reduced pressure on some economically important endemic species by preventing their sale or limiting the harvest season	**High quality (16)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
		important conservation role									
Tengö et al. (2006)	Southern Androy, Madagascar	Illustrates how the conservation values in some landscapes are directly dependent on locally self-organized institutions, taboos, which regulate human behaviour and ensure the continued existence of the forest patches	Cross-sectional	Local communities (58)	Semi-structured interviews and key informant interviews (Narrative analysis)	Community forestry	Protection of endemic forest species and conservation of forest landscape	Sacred forest	Taboos, sanctions	Over 90% of the total remaining forest cover is protected through taboos, these informal institutions represent an important, and presently the only, mechanism for conservation of the highly endemic forest species.	**Medium quality (12)**
Ormsby & Kaplin (2005)	Masoala National Park in north-eastern, Madagascar	Understand community perception of national park	Cross-sectional	Rural households (22)	Individual and group interviews (Thematic content analysis)	Integrated conservation and development project	Perception of a national park	National park	Derived or perceived benefits from the park	One of the factors found to influence the perceptions of the Park is actual or potential benefits received from the Park	**High quality (16)**
Marcus (2001)	Masoala, Ranomafana, and Andohahela National Parks, Madagascar	Explores local perceptions of ICDP in Madagascar and the success of these projects at influencing perceptions	Cross-sectional	Village heads and villagers (24)	Local leader interviews, focus groups, surveys, and follow-up interviews (Narrative	Integrated conservation and development project	Support for a conservation project	A conservation and development project	Perception of benefit and cost of conservation e.g. impact on the livelihood	Focus group responses, however, indicate that while some people may feel they are benefiting from land-use change initiatives, they do not associate these with the park	**Medium quality (12)**

Study (Year of publication)	Study location	Objective of study	Study design	Study population (Sample size)	Data collection (Analysis)	Forest conservation strategy	Conservation attitudes and behaviours	Subject/ Object of Value	Motivational concerns/goals	General result	Quality Score
					analysis)						
Lykke (2000)	Fathala Forest, Senegal	Understand local perceptions of vegetation change and priorities for conservation of woody-savanna vegetation	Cross-sectional	Elderly villages (27)	Semi-structured interviews (Narrative analysis)	Community forestry	Attitude towards conservation	Woody vegetation	1) Material benefits derived from woody forests such as timber, medicinal forest uses, 2) Belief that the forest brings rain.	The study shows that local people expressed concern about the status of the woody vegetation and a wish for its conservation. However, their positive attitude towards conservation is motivated by the material benefits they derive from the woody forests	**High quality (15)**

B.1.8 Quality assessment

We used two approaches to assess the quality of the reviewed studies. For quantitative studies, we used the Environmental-Risk of Bias tool and the Environmental-Grade tool for assessing the internal and external validity of environmental studies (Bilotta et al., 2014) (Table B.5 and B.6). Qualitative studies were assessed using the 10-item Critical Appraisal Skill Programme (CASP, 2018) tool (Table B.7). The outcome of the quantitative study assessment is presented in Tables B.8 and B.9, while the outcome of qualitative study assessment is presented in Table B.10.

Table B.5: Criteria for judging the risk of bias for quantitative studies using environmental-risk of bias tool

Bias domains	Grade level
1. Selection bias due to inadequate randomization	High risk; unclear risk; Low risk
2. Selection bias due to inadequate allocation of concealment	High risk; unclear risk; Low risk
3. Performance bias	High risk; unclear risk; Low risk
4. Detection bias	High risk; unclear risk; Low risk
5. Attrition bias due to incomplete outcome data	High risk; unclear risk; Low risk
6. Reporting bias due to selective reporting	High risk; unclear risk; Low risk
7. Other bias	High risk; unclear risk; Low risk

Risk of bias summary assessment for each study was judged as Low risk (when all sources of bias are assessed as low risk), High risk (when one or more sources of bias are assessed as high risk), and Unclear risk (when one or more sources of bias are assessed as low risk and unclear risk) (Bilotta et al., 2014).

Table B.6: Criteria for grading the quality of quantitative studies using the environmental-grade tool

Criteria	Criteria Score
1. Study design	Cross-sectional study=1; cohort study=2
2. Environmental-risk of bias assessment	High risk= 0; unclear risk= 1; low risk=2
3. Directness of the study	Measured variables not relevant to our review= 0; measured variables relevant to our review =1
4. Precision of effect estimates	No statistical testing (confidence intervals; p-value) for estimates of treatment effects= 0; provides statistical testing (confidence intervals; p-value) for estimates of treatment effects = 1
5. Effect size	Incomplete information=0, complete information (standardized mean difference, odd ratio, correlation coefficient) = 1
6. Plausible confounding factors	No confounding factors considered=0, confounding factors considered but some key confounders omitted=1, careful consideration of confounders=2
7. Evidence of dose-response gradient	Not applicable (NA) for cross-sectional studies; No for cohort studies=0; yes for cohort studies= 1

The highest total possible grade for cross-sectional and cohort studies is 9 and 10 respectively. We created three quality categories for final grade assessment: High quality (score: 7-9/10), medium quality (score: 4-6), and low quality (score: 1-3).

Table B.7: Criteria for quality assessment of qualitative studies

1. Was there a clear statement of the aims of the research?
2. Is a qualitative methodology appropriate?
3. Was the research design appropriate to address the aims of the research?
4. Was the recruitment strategy appropriate to the aims of the research?
5. Was the data collection in a way that addressed the research issue?
6. Has the relationship between the researcher and participants been adequately considered?
7. Have ethical issues been taken into consideration?
8. Was the data analysis sufficiently rigorous?
9. Is there a clear statement of findings?
10. How valuable is the research?

Source: Critical Appraisal Skills Programme (CASP, 2018)

To obtain a quality score for each study, we rated each item using a numeric score gradient: 0 for 'No', 1 for 'Unclear', and 2 for 'Yes'. The highest total possible score for a study was 20. We then classified the studies into three quality categories: High quality (score:14-20), medium quality (score:8-14), and low quality (score: 1-7).

Table B.8: Outcome of environmental-risk of bias assessment for quantitative studies

Study	Selection bias (randomization)	Selection bias (Concealment)	Performance bias	Detection bias	Attrition bias	Reporting Bias	Other bias	Environmental risk of bias assessment
Kibru et al. (2020)	Low risk	Low risk	Unclear risk	Unclear risk	Low risk	Unclear risk	Unclear risk	**Unclear risk**
Araia & Chirwa (2019)	Low risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Low risk	**Unclear risk**
Gebregziabher & Soltani (2019)	Low risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Low risk	Low risk	**Unclear risk**
Abukari & Mwalyosi (2018)	Low risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Low risk	Low risk	**Unclear risk**
Nsonsi et al. (2017)	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Low risk	**Unclear risk**
Ofoegbu & Speranza (2017)	Low risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Low risk	**Unclear risk**
Rickenbach et al. (2016)	Low risk	Low risk	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	**Unclear risk**
Garekae et al. (2016)	Low risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Low risk	**Unclear risk**
Meijer et al. (2016)	Low risk	Unclear risk	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	**Unclear risk**
Dewu & Røskaft (2016)	Low risk	Low risk	Unclear risk	Unclear risk	Unclear risk	Low risk	Unclear risk	**Unclear risk**
Amin et al. (2015)	Low risk	Low risk	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	**Unclear risk**
Cobbinah (2015)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Baker et al. (2014)	Low risk	Low risk	Unclear risk	Unclear risk	Low risk	Low risk	Unclear risk	**Unclear risk**
Hartter et al. (2014)	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	**Unclear risk**
Nielsen & Meilby (2013)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**
Ramcilovic-Suominen et al. (2013)	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	**Unclear risk**
Sharaunga et al. (2013)	Low risk	Low risk	Unclear risk	Unclear risk	High risk	Unclear risk	Unclear risk	**High risk**
Ezebilo (2012)	Unclear risk	Unclear risk	Unclear risk	Unclear risk	High risk	Unclear risk	Unclear risk	**High risk**
Tesfaye et al. (2012)	Low risk	Unclear risk	Unclear risk	Unclear risk	High risk	Unclear risk	Unclear risk	**High risk**
Ansong & Røskaft (2011)	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Low risk	**Unclear risk**

Study	Selection bias (randomization)	Selection bias (Concealment)	Performance bias	Detection bias	Attrition bias	Reporting Bias	Other bias	Environmental risk of bias assessment
Kiyingi & Bukenya (2010)	Low risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	**Unclear risk**
Vodouhe et al. (2010)	High risk	High risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	Unclear risk	**High risk**
Morgan-Brown et al. (2009)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	**Low risk**

Table B.9: Outcome of quality assessment of quantitative studies using environmental-grade assessment tool

Study	Study design[1]	Environmental-risk of bias assessment[2]	Directness of the study[3]	Precision of effect estimates[4]	Effect size[5]	Plausible cofounding factors[6]	Evidence of Dose-response gradient[7]	Quality grade category (Final environmental grade assessment score)
Kibru et al. (2020)	1	1	1	0	0	0	NA	**Low quality (3)**
Araia & Chirwa (2019)	1	1	1	1	1	0	NA	**Medium quality (5)**
Gebregziabher & Soltani (2019)	1	1	1	1	1	0	NA	**Medium quality (5)**
Abukari & Mwalyosi (2018)	1	1	1	1	1	0	NA	**Medium quality (5)**
Nsonsi et al. (2017)	1	1	1	1	1	1	NA	**Medium quality (6)**
Ofoegbu & Speranza (2017)	1	1	1	1	1	0	NA	**Medium quality (5)**
Rickenbach et al. (2016)	1	1	1	0	0	0	NA	**Low quality (3)**
Garekae et al. (2016)	1	1	1	1	1	0	NA	**Medium quality (5)**
Meijer et al. (2016)	1	1	1	1	0	2	NA	**Medium quality (6)**
Dewu & Røskaft (2016)	1	1	1	1	1	0	NA	**Medium quality (5)**
Amin et al. (2015)	1	1	1	0	0	0	NA	**Low quality (3)**
Cobbinah (2015)	1	2	1	1	1	0	NA	**Medium quality (6)**

Study	Study design[1]	Environmental-risk of bias assessment[2]	Directness of the study[3]	Precision of effect estimates[4]	Effect size[5]	Plausible cofounding factors[6]	Evidence of Dose-response gradient[7]	Quality grade category (Final environmental grade assessment score)
Baker et al. (2014)	1	1	1	1	1	1	NA	**Medium quality (6)**
Hartter et al. (2014)	1	1	1	1	1	0	NA	**Medium quality (5)**
Nielsen & Meilby (2013)	2	2	1	1	1	2	0	**High quality (9)**
Ramcilovic-Suominen et al. (2013)	1	0	1	1	1	1	NA	**Medium quality (5)**
Sharaunga et al. (2013)	1	0	1	1	1	2	NA	**Medium quality (6)**
Ezebilo (2012)	1	0	1	1	1	1	NA	**Medium quality (5)**
Tesfaye et al. (2012)	1	1	1	1	1	1	NA	**Medium quality (6)**
Ansong & Røskaft (2011)	1	1	1	1	1	1	NA	**Medium quality (6)**
Kiyingi & Bukenya (2010)	1	1	1	0	0	0	NA	**Low quality (3)**
Vodouhe et al. (2010)	1	0	1	0	0	1	NA	**Low quality (3)**
Morgan-Brown et al. (2009)	1	2	1	1	1	2	NA	**High quality (8)**

[1]cross-sectional study=1, cohort study=2

[2] High risk= 0; unclear risk= 1; low risk= 2

[3] Measured variables not relevant to our review= 0; measured variables relevant to our review =1

[4] No statistical testing (confidence intervals; p-value) for estimates of treatment effects= 0; provides statistical testing (confidence intervals; p-value) for estimates of treatment effects = 1

[5] Incomplete information=0, complete information (standardized mean difference, odd ratio, correlation coefficient) = 1

[6] No confounding factors considered=0, confounding factors considered but some key confounders omitted=1, careful consideration of confounders=2

[7] Not applicable (NA) for cross-sectional studies; No for cohort studies=0; Yes for cohort studies= 1

Table B.10: Outcome of quality assessment of qualitative studies using the Critical Appraisal Skills Programme (CASP) tool

Study	Research statement	Qualitative methodology	Research design	Recruitment strategy	Data collection	Researcher - participant relationship	Ethical issues	Data analysis	Statement of finding	Valuable research	Quality category (Quality score)
Rafidison et al. (2020)	2	2	2	1	2	0	0	1	2	2	**High quality (14)**
Sinthumule & Mashau (2020)	2	2	2	2	2	2	0	0	2	2	**High quality (16)**
Mavhura & Mushure (2019)	2	2	2	2	1	0	2	2	2	2	**High quality (17)**
Mmahi & Usman (2019)	2	2	2	2	1	0	0	0	2	2	**Medium quality (13)**
Kent & Orlowska (2018)	2	2	2	0	0	0	0	0	1	1	**Low quality (7)**
Ruelle et al. (2017)	2	2	2	1	1	0	1	1	2	2	**High quality (15)**
Costa et al. (2017)	2	2	2	1	2	2	2	2	2	2	**High quality (19)**
Asante et al. (2017)	2	2	2	2	2	0	0	2	2	2	**High quality (16)**
Klepeis et al. (2016)	2	2	2	0	2	0	0	1	2	2	**Medium quality (13)**
Fritz-Vietta (2016)	2	2	2	2	2	0	0	0	2	2	**High quality (16)**
Fraser et al. (2016)	2	2	2	1	2	0	0	0	2	2	**High quality (15)**
Irakiza et al. (2016)	2	2	2	1	1	2	0	0	2	2	**Medium quality (13)**
Ouma et al. (2016)	2	2	2	1	1	0	0	2	2	2	**High quality (14)**
Mariki (2013)	2	2	2	2	1	0	0	1	2	2	**High quality (14)**
Baker (2013)	2	2	2	2	2	0	1	1	2	2	**High quality (16)**
Cocks et al. (2012)	2	2	2	1	2	0	0	0	2	2	**Medium quality (13)**
Scales (2011)	2	2	2	2	2	2	0	0	2	2	**High quality (16)**
Fournier (2011)	2	2	2	0	2	0	0	0	2	2	**Medium quality (12)**
Msuya & Kideghesho (2009)	1	0	0	0	1	0	0	1	2	2	**Low quality (7)**

Study	Research statement	Qualitative methodology	Research design	Recruitment strategy	Data collection	Researcher - participant relationship	Ethical issues	Data analysis	Statement of finding	Valuable research	Quality category (Quality score)
Tabuti et al. (2009)	2	2	1	2	2	0	0	0	2	2	**Medium quality (13)**
Jones et al. (2008)	2	2	2	2	1	2	0	1	2	2	**High quality (16)**
Tengö et al. (2006)	2	1	1	0	2	0	1	1	2	2	**Medium quality (12)**
Ormsby& Kaplin (2005)	2	2	2	2	2	0	0	2	2	2	**High quality (16)**
Marcus (2001)	2	2	2	2	1	0	0	1	1	1	**Medium quality (12)**
Lykke (2000)	2	2	2	1	2	0	0	2	2	2	**High quality (15)**

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Appendix C: Supplementary material Chapter 3

Title: Understanding the diversity of values underpinning forest conservation

Table C.1: Value statements for Q-sorts using value orientation framework. The statements were identified from Nigeria's forest conservation policy and program documents, online media, and literature review

Value orientation	Value type	Statement as used	Original statement(s)	Source(s)
Anthropocentric value orientations	Economic values	Forest management or conservation may restrict access to the forest to harvest wild foods for human food security.	We found that PA regulations have the potential to restrict traditional food access because these regulations ban shifting agriculture and heavily restrict hunting.	Sylvester et al. (2016). The Protection of Forest Biodiversity can Conflict with Food Access for Indigenous People. *Conservation and Society,* 14(3):279. DOI: 10.4103/0972-4923.191157.
	Economic values	Forest management or conservation may restrict the harvesting of forage to feed domestic animals.	PA regulations have the potential to restrict people's ability to enjoy wild meat and plants and forage for animals.	Sylvester et al. (2016). The Protection of Forest Biodiversity can Conflict with Food Access for Indigenous People. *Conservation and Society,* 14(3):279. DOI: 10.4103/0972-4923.191157.
	Economic values	Forest management or conservation will enhance wood and timber production.	Ensure that forests provide timber and other arrays of goods and services on sustainable basis in order to improve human livelihoods.	National forest policy (2020). Federal Republic of Nigeria, *Offline.*
	Economic values	Forest management or conservation may restrict the use of non-wood raw materials like bamboo,	PAs have restricted Indigenous peoples' ability to access forest resources like non-wood raw materials.	Sylvester et al. (2016). The Protection of Forest Biodiversity can Conflict with Food Access for Indigenous

	fibres, and raffia.		People. *Conservation and Society,* 14(3):279. DOI: 10.4103/0972-4923.191157.
Economic values	Forest management or conservation may reduce fuelwood production.	The federal government has initiated moves to reduce the excessive dependence on firewood for daily cooking in the country.	Leadership online media. Nigeria: FG to Reduce Firewood Consumption. https://allafrica.com/stories/200711060213.html.
Economic values	Forest management or conservation will enhance the provision of biochemical and genetic materials for production.	A number of NGOs are now involved into ex situ and in situ conservation of the forest genetic resources.	Oni P.I. 2001. S (2021). State of Forest Genetic Resources in the dry north of Nigeria. https://www.fao.org/3/ab392e/ab392e.pdf.
Economic values	Forest management or conservation will enhance forest contributions to government revenue.	The Policy provided opportunities for broadening the revenue base for government.	Global forest goals_Nigeria (2019) https://www.un.org/esa/forests/wp-content/uploads/2019/12/Nigeria.pdf.
Economic values	Forest management or conservation will support income generation for forest dependent	Provide opportunities for broadening income generation for forest dependent communities.	Global forest goals_Nigeria (2019) https://www.un.org/esa/forests/wp-

	communities.		content/uploads/2019/12/Nigeria.pdf.
Economic values	Forest management or conservation will enhance job creation and employment in the forest sector.	The forestry sector aims at providing optimum employment opportunities in environmentally safe and secured working conditions.	National forest policy (2020). Federal Republic of Nigeria *Offline.*
Economic values	Forest management or conservation preserve medicinal plants.	Provide materials that Public Health and traditional medicine.	Fifth National biodiversity report (2015). https://www.cbd.int/doc/world/ng/ng-nr-05-en.pdf.
Environmental values	Forests should be managed to serve as carbon stocks/ carbon sinks for climate change mitigation.	Sustainable management of forests and enhancement of forest carbon stocks (REDD+).	National Forest Reference Emission Level (FREL) for the Federal Republic of Nigeria (2019). https://redd.unfccc.int/files/2019_submission_frel_nigeria.pdf.
Environmental values	Forest management or conservation will support desertification control.	The forest policies and programmes at federal level aim to address desertification.	Nigeria REDD+ Readiness Programme (2015). https://info.undp.org/docs/pdc/Documents/NGA/Nigeria%20REDD+%20Readiness_Prodoc.pdf.
Environmental values	Forest management or conservation will support erosion control.	Forest protective influence on the environment includes protection from flood, control of erosion, storage of water and shelter of agricultural lands against the desiccative effect of winds and the sun.	Adeniyi, P (2016). Ensuring Environmental Sustainability Through Forestry in Nigeria. https://www.ijser.org/researchpaper/ENSURING-ENVIRONMENTAL-SUSTAINABILITY-THROUGH-FORESTRY-IN-NIGERIA.pdf.

	Environmental values	Forest management or conservation will improve protection against storms.	Forests are critical habitats for biodiversity and they are also essential for the provision of a wide range of ecosystem services such as resistance to wind storms.	Brockerhoff, *et al.* (2017). Forest biodiversity, ecosystem functioning and the provision of ecosystem services. https://doi.org/10.1007/s10531-017-1453-2.
	Environmental values	Forest management or conservation will reduce deforestation occurring from land use change.	The forest policy aims to address the drivers of deforestation and forestland degradation.	National forest policy (2020). Federal Republic of Nigeria (Offline).
	Environmental values	Forest management or conservation will support climate regulation such as cool temperature.	The basis of environmental policy in Nigeria is contained in the 1999 Constitution of the Federal Republic of Nigeria….to support climate regulation.	National Policy on the Environment (1999). https://www.academia.edu/7175000/NATIONAL_POLICY_ON_THE_ENVIRONMENT_19_99.
	Environmental values	Forest management or conservation will support agriculture through pollination and insect control.	Constitute the foundation upon which our agriculture is based. Forests are also habitats for pollinators.	National biodiversity strategy and action plan (2015). https://www.cbd.int/doc/world/ng/ng-nbsap-v2-en.pdf. Premium times (2021) https://www.premiumtimesng.com/agriculture.
	Environmental values	Forest management or conservation will support rain formation.	Forests recycle moisture in the atmosphere through the process of transpiration to increase rainfall.	Importance of forest and trees in sustaining water supply and rainfall (2016).

			https://www.researchgate.net/publication/310458060.
Environmental values	Forest management or conservation will support ecosystem functions such as species diversity.	Sustaining ecosystem functioning and ecological services.	Fifth National biodiversity report (2015). https://www.cbd.int/doc/world/ng/ng-nr-05-en.pdf.
Environmental values	Forest management or conservation will improve air quality.	Support a Nigeria with healthy living environment such as air quality.	National biodiversity strategy and action plan 2016- 2020. (2015). https://www.cbd.int/doc/world/ng/ng-nbsap-v2-en.pdf.
Recreational values	Forests should be managed to provide a natural environment to go for a leisure nature walk.	On a guided walk, participants take a leisurely stroll on wooded paths under a forest canopy, mindfully observing the sights, sounds and smells of nature.	Minnpost (2019). https://www.minnpost.com/mental-health-addiction.
Recreational values	Forests should be managed to support ecotourism development.	For development of tourism.	Fifth National biodiversity report (2015). https://www.cbd.int/doc/world/ng/ng-nr-05-en.pdf.
Recreational values	Forests should be managed to provide a natural environment for hunting for enjoyment.	Hunting opportunities on the forest are varied, ranging from big game animals… to small game.	United States Department of Agriculture. https://www.fs.usda.gov/activity/superior/recreation/hunting.
Health values	Forests should be managed to support mental health and wellbeing.	To ensure environmental protection for for good health and well being	National policy on the environment (1999) www.academia.edu/7175000/National_policy.
		Spending time in nature can improve your mood and overall mental health.	Daily life (2020). https://dailylife.com/article/mental-benefits-of-spending-time-in-nature.

	Health values	Forests should be managed to help relieve stress and anxiety.	Being close to vegetation, such as trees, shrubs, and grasses improve our mental health by reducing stress, anxiety, and depression.	Assessing Nature's Contributions to People https://kids.frontiersin.org/articles/10.3389/frym.2020.00098#ref1.
	Health values	Forests should be managed to provide natural space for rest and relaxation.	The negative ion-rich oxygen found in nature also has a relaxing effect on the body.	Mental floss. https://www.mentalfloss.com/article/60632/11-scientific.
	Educational values	Forests should be managed to provide a natural environment for conducting research.	Provides an outdoor laboratory for researchers.	Fifth National biodiversity report (2015). https://www.cbd.int/doc/world/ng/ng-nr-05-en.pdf.
	Educational values	Forests should be managed to provide a natural environment for outdoor teaching/learning and hands-on experience.	Classroom in the forest provides students with a unique outdoor learning experience.	Troy messenger news (2018) https://m.troymessenger.com/2018/03/20/class-in-the-forest.
	Creative values	Forests should be managed to provide a natural environment for artistic and technological inspiration.	Provides opportunity for artistic inspiration.	Assessing nature's contributions to people. https://science.sciencemag.org/content/359/6373/270.full.
			Nature is a great place to look for ideas. Nature-inspired innovation is science of using designs in nature to create a new product or solution.	The Washington post (2011). https://www.washingtonpost.com/lifestyle.

	Creative values	Forests should be managed to provide a natural environment that stimulates thinking and mental development.	Spending time in nature is essential for cognitive development. Nature p lay stimulates creativity and problem solving skills integral to executive function development.	Informal Science (2017). https://www.informalscience.org/news-views/nature-play-important-cognitive-development-early-learners.
Relational value orientations	Cultural values	Forests should be managed to preserve cultural identity.	Forest area designated or managed to preserve cultural linkage and identity.	Global Forest Resources Assessment Nigeria Country Report (2015). http://www.fao.org/tempref/docrep/fao/010/ai919E/ai919E00.pdf.
	Cultural values	Forests should be managed to preserve heritage values.	The forests are our common heritage. There would have been no forests to destroy today if the past generations had not spared them. Sacred Forest of Osun… contributes to preserving Nigeria's Cultural Heritage.	Guardian newspaper (2019). https://guardian.ng/opinion/save-our-forests-conserve-wildlife/. Daily Trust Newspaper (2016). https://dailytrust.com/preserving-nigerias-cultural-heritage.
	Cultural values	Forests should be managed to support spiritual experiences.	Provides opportunity spiritual experiences.	Assessing nature's contributions to people. https://science.sciencemag.org/content/359/6373/270.full.
	Cultural values	Forests should be managed to maintain a natural environment for traditional practices.	Beliefs, taboos, myths, proverbs, and songs were vital traditional systems associated with the forests.	Ihemezie et. al. (2021) https://doi.org/10.1016/j.jenvman.2021.112857.
	Social values	Forests should be managed to provide natural environments	Forests… providing opportunities for… social cohesion.	Assessing nature's contributions to people. https://science.sciencemag.

	where people can bond and connect (social cohesion).		org/content/359/6373/270.full.
Social values	Forests should be managed to provide natural environments for communal interaction.	Forest areas will always encourage positive social and communal interaction.	Brain forest (2018). https://www.brainforestcenters.com/resources/health-benefits-of-positive-social-interactions.
Social values	Forests should be managed in order to align, comply, or contribute to international regulations and obligations on conservation.	Meet international commitments on sustainable management and utilization of forests and forest resources	National forest policy (2019) (Offline).
		The Federal Republic of Nigeria welcomes the invitation to submit a Forest Reference Emission Levels under the United Nations Framework Convention on Climate Change (UNFCCC).	National Forest Reference Emission Level (FREL) for the Federal Republic of Nigeria (2019). https://redd.unfccc.int/files/2019_submission_frel_nigeria.pdf.
Management values	Forest management or conservation will promote equitable sharing of benefits of forest resources.	Ensure fair and equitable sharing of the benefits from biodiversity and ecosystem services to all.	National biodiversity strategy and action plan 2016- 2020. (2015). https://www.cbd.int/doc/world/ng/ng-nbsap-v2-en.pdf.
Management values	Forests should be managed to promote private sector involvement in its management.	Promote partnerships with the private sector and Civil Society Organisation.	National forest policy (2019) (Offline).
Management values	Forests should be managed to promote community participation in its management.	Mobilize the community and civil society organization in forestry development.	National forest policy (2019). Federal Republic of Nigeria (Offline).

Biocentric value orientations	Existence values	Forest management or conservation will ensure the continuous existence of wildlife even though I will never use or see them.	Areas set aside by the government to protect wildlife and halt their extinction.	National biodiversity strategy and action plan (2006) Offline.
			Intensify campaign on combatting illegal wildlife trade.	Punch newspaper (2021) https://punchng.com/1169-forest-reserves-in-nigeria-neglected-ncf/.
	Existence values	Forest management or conservation will protect the existence of native and endangered species.	Provide habitat for native species and endangered biota.	Forest biodiversity, ecosystem functioning and the provision of ecosystem services https://doi.org/10.1007/s10531-017-1453-2.
	Bequest values	Forest management or conservation will ensure that the forests are preserved for future generations.	Sustainable management of biodiversity resources for future generations.	Sixth National biodiversity report (2018). https://chm.cbd.int/pdf/documents/nationalReport6/241291/1.
	Aesthetic values	Forests should be managed to preserve an attractive natural environment.	Forest dotting the scenery of Ise-Ikere Road, Ekiti State, should allure travelling businessman.	Punch newspaper (2021) https://punchng.com/criminals-invasion-of-nigerias-forest-reserves.
	Aesthetic values	Forests should be managed to enjoy their beautiful scenery.	This implores us to get outdoors and into nature, to appreciate its beauty and its importance.	Punch newspaper (2017). https://punchng.com/wed-2017-connecting-the-people-with-nature/.

C.1 Socio-economic characteristics of Q-participants

i. Gender:

[0] Male [1] Female

ii. Age (years): [ ] 18-25 [ ] 25-60 [ ] 60+

iii. Marital status:

[1] Unmarried [2] Married [3] Widowed [4] Divorced [5] Separated

iv. Educational level

[1] No formal education [2] Secondary education

[3] Primary education [4] Tertiary education

v. Household size, i.e., those eating from the same pot (Number):

vi. Source of your household cooking energy? (Tick all that apply)

[1] Gas [2] Kerosene [3] Fuelwood

Others please specify (_____)

vii. What is your current household monthly net income (in naira)? [ ]

viii. Religion:

[1] None [2] Muslim [3] Christian [4] Traditionalist

Others specify (_____)

ix. Main occupation:

[1] Farming [3] Civil service [5] Artisan

[2] Trading [4] Teaching/Research [6] Policy-making/Government official

Others specify (_____)

C.2. Post sorting interview question guide

i. What do you understand by forest conservation?
ii. Why do you think forests should be conserved?
iii. Why do you think forests should not be conserved? (If any)
iv. At a personal level, have you been involved in forest conservation before? If yes, what motivations or concerns drove you to engage in that?
v. At the community level, what issues do you think forest conservation should address?
vi. At the nation level, what do you think should be the main focus of forest conservation policies and programmes?
vii. What do you think are the benefits of conserving forests?
viii. What do you think are the challenges of forest conservation in Nigeria?
ix. How do you think the challenges of forest conservation you mention above can be addressed?

Figure C.1: Q-Sort Distribution Grid

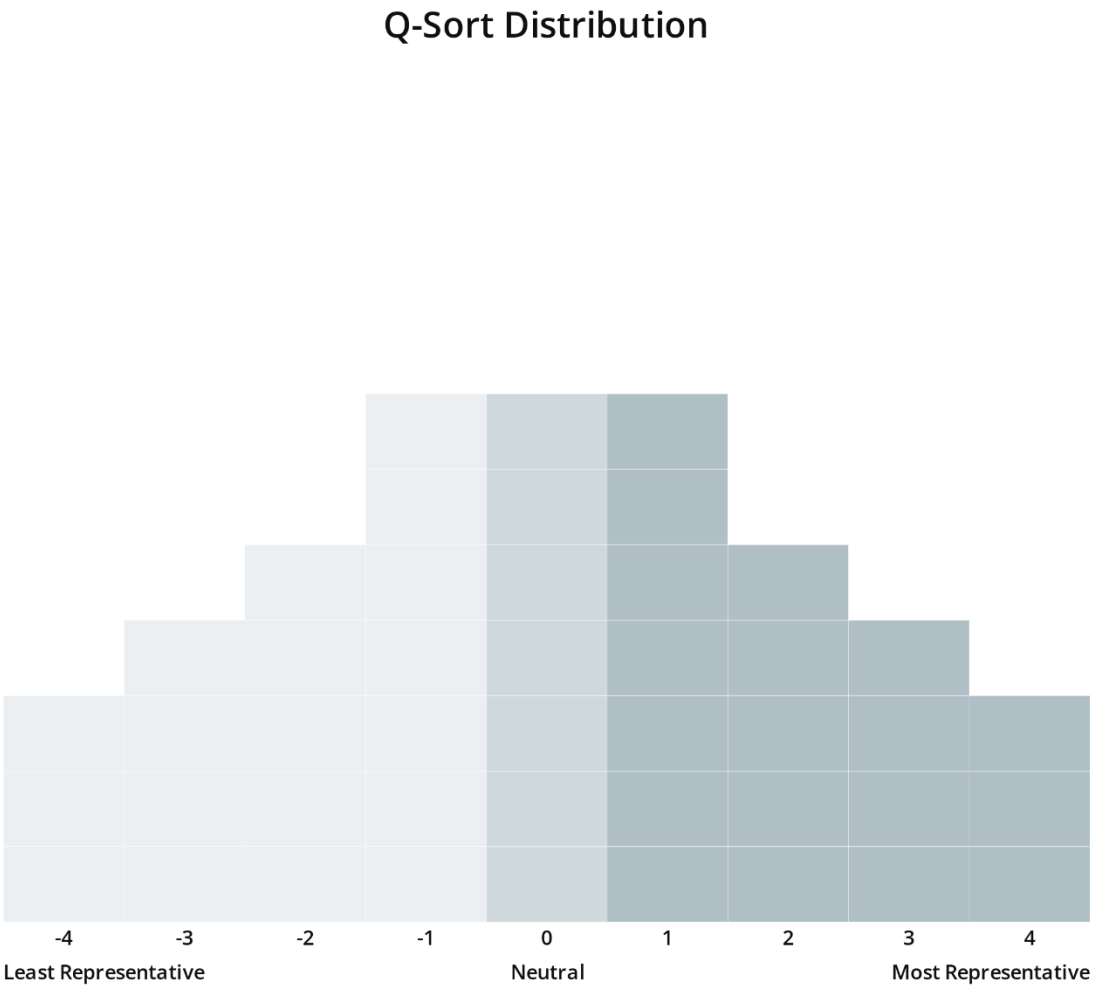

Table C.2: Consensus Statements -- Those That Do Not Distinguish Between ANY Pair of Factors.

All Listed Statements are Non-Significant at P>.01, and Those Flagged With an * are also Non-Significant at P>.05.

No	Statement	No	Factors 1 RNK SCORE	2 RNK SCORE	3 RNK SCORE
1*	Forest management or conservation may restrict access to the forest to harvest wild foods for human food security.	1	2 0.77	3 1.18	3 1.19
9*	Forest management or conservation will enhance job creation and employment in the forest sector.	9	3 1.11	4 1.33	4 1.72
11*	Forests should be managed to support mental health and well-being.	11	-3 -1.24	-3 -1.16	-3 -1.11
13*	Forests should be managed to provide natural space for rest and relaxation.	13	-2 -1.02	-1 -0.65	-2 -0.82
16*	Forests should be managed to provide a natural environment for artistic and technological inspiration.	16	-3 -1.05	-2 -0.96	-1 -0.66
17*	Forests should be managed to provide a natural environment that stimulates thinking and mental development.	17	-2 -0.88	-2 -1.09	-1 -0.54
18*	Forests should be managed to provide a natural environment to go for a leisure nature walk.	18	-1 -0.54	-2 -1.01	-2 -1.07
19*	Forests should be managed to support ecotourism development.	19	2 0.84	2 1.14	1 0.75
43	Forest management or conservation will protect the existence of native and endangered species.	43	0 0.35	-1 -0.31	1 0.21

Table C.3: Participants' demographic information and stakeholder category

Participant Number	Participant identity	Gender	Age	Education	Cooking Energy Source	Net Income per annum (naira)	Stakeholder Category
P1	M42TGEK	Male	42	Tertiary	Gas	1,920,000	Knowledge
P2	M55TGfEK	Male	55	Tertiary	Gas & fuelwood	1,800,000	Knowledge
P3	M31TGfEU	Male	31	Tertiary	Gas & fuelwood	960,000	User
P4	M59TGEK	Male	59	Tertiary	Gas	1,680,000	Knowledge
P5	F47TFEK	Female	47	Tertiary	Fuelwood	1,200,000	Knowledge
P6	M40TGDH	Male	40	Tertiary	Gas	9,000,000	Hierarchical
P7	M53TGDH	Male	53	Tertiary	Gas	8,400,000	Hierarchical
P8	M59TGEU	Male	59	Tertiary	Gas	840,000	User
P9	F55TGDH	Female	55	Tertiary	Gas	6,360,000	Hierarchical
P10	M60TFFF	Male	60	Tertiary	Fuelwood	660,000	User
P11	M44TGkDH	Male	44	Tertiary	Gas & Kerosene	7,680,000	Hierarchical
P12	F22SKfFU**	Female	22	Secondary	Kerosene & fuelwood	240,000	User
P13	M63TKfU*	Male	63	Tertiary	Kerosene & fuelwood	540,000	User
P14	F65PKfFU	Female	65	Primary	Kerosene & fuelwood	600,000	User
P15	F35TGEK**	Female	35	Tertiary	Gas	2,400,000	Knowledge
P16	M41TGEK	Male	41	Tertiary	Gas	3,000,000	Knowledge
P17	M52TGCH	Male	52	Tertiary	Gas	9,600,000	Hierarchical
P18	F29TGkFU**	Female	29	Tertiary	Gas & Kerosene	360,000	User
P19	M56TGkEK	Male	56	Tertiary	Gas & Kerosene	1,320,000	Knowledge

P20	F57TGDH*	Female	57	Tertiary	Gas	6,000,000	Hierarchical
P21	M64TGDH*	Male	64	Tertiary	Gas	5,400,000	Hierarchical
P22	F69NFFU*	Female	69	No formal education	Fuelwood	360,000	User
P23	F66PKfFU	Female	66	Primary	Kerosene & fuelwood	720,000	User
P24	F70NKfFU	Female	70	No formal education	Kerosene & fuelwood	660,000	User
P25	M73NKfFU	Male	73	No formal education	Kerosene & fuelwood	480,000	User
P26	F26SKfFU	Female	26	Secondary	Kerosene & fuelwood	300,000	User
P27	M42TGEF*	Male	42	Tertiary	Gas	2,160,000	Functional
P28	F30TGkEF	Female	30	Tertiary	Gas & kerosene	1,200,000	Functional
P29	M36TGkEF	Male	36	Tertiary	Gas & kerosene	1,980,000	Functional
P30	F47TGEF	Female	47	Tertiary	Gas	1,440,000	Functional
P31	F60TGEF	Female	60	Tertiary	Gas	1,350,000	Functional
P32	M29TGEF*	Male	29	Tertiary	Gas	1,560,000	Functional
P33	F43TGEF*	Female	43	Tertiary	Gas	2,520,000	Functional
P34	M58TGkEF*	Male	58	Tertiary	Gas	2,280,000	Functional
P35	M35TGEK**	Male	35	Tertiary	Gas	2,400,000	Functional

Participants' identity Coding

1. Gender: **M** or **F**
2. Age:
3. Education: **N**=No formal education; **P**= Primary education; **S**=Secondary education; **T**=Tertiary education
4. Cooking Energy source: **G**=Gas; **K**=Kerosene; **F**=Fuelwood; **Gk**=Gas and kerosene; **Kf**=Kerosene and fuelwood
5. Income (*using Nigeria living standard measurement*):
   - **A**= upper class income from $140,000 p.a. = >₦58.1M p.a
   - **B**= lower-upper class income from $90,000 to $139,999p.a. = ₦37.3m to 58.09m p.a.
   - **C**= upper-middle class income from $50,000 to $89,999p.a. = ₦20.7m to ₦37.29m p.a.
   - **D**= lower-middle class income from $14,000 to $49,999p.a. = ₦5.8m to ₦20.69m p.a
   - **E**= lower class income from $1,400 to $13,999 p.a = ₦580,000 to ₦5.79m p.a
   - **F**= Poor income < >$600 p.a = ₦250,000 p.a
6. Stakeholder category:

H= Hierarchical (Forest stakeholder with influence and authority)
K= Knowledge (Forest expert with knowledge and skills)
F= Functional (Worker or staff in the forest sector)
U= User (Forest user)**.**

Appendix D: Supplementary material Chapter 4

Title: Integrating sociocultural valuation in biocultural conservation: what values are important to the public?

D1: Description of socio-demographic variables

The following thirteen socio-demographic variables were used to describe the local people's profile and understand how they differ across the five identified clusters.

i. Gender (GEND): a binary variable that takes the value of 1 if the respondent is a female and 0 if male (%).
ii. Age (AGE): a continuous variable that expresses the respondent's age (years).
iii. Tertiary Education (TEREDU): a binary variable that takes the value of 1 if the respondent has studied or is currently studying at the tertiary level (university, polytechnic, monotechnic, and college) and 0 if otherwise (%).
iv. Household size (HHSIZE): a continuous variable that indicates the number of those eating from the same pot in a household (number of members).
v. Fuelwood (FUELWD): a binary variable that takes the value of 1 if the respondent uses fuelwood as a source of household cooking energy and 0 if they do not (%).
vi. Domestic animals (DOMANI): a binary variable that takes the value of 1 if the respondent keeps domestic animals and 0 if they do not (%).
vii. Home garden (HOMEGAD): a binary variable that takes the value of 1 if the respondent has a home garden and 0 if they do not (%).
viii. Household income (HHINCOM): a continuous variable corresponding to the respondent's monthly net household income in naira (₦/month).
ix. Traditional religion (TRADREL): a binary variable that takes the value of 1 if the respondent practices traditional religion and 0 if they do not (%).
x. Farming (FARM): a binary variable that takes the value of 1 if the respondent is involved in farming as an occupation and 0 if they do not (%).
xi. Distance (DIST): a continuous variable that indicates the distance in kilometer between the respondent's residence and the nearest sacred forest (kilometer).

xii. Visit (VISIT): a binary variable that takes the value of 1 if the respondent has visited the sacred forest in the past one year and 0 if they have not (%).

xiii. No of visit (NOVISIT): a continuous variable that indicates the number of times a respondent has visited the sacred forest in the last one year (Number).

Table D.1: Socio-demographic parameters of the total sample population and that of the identified five clusters.

Variable	Unit	C1: Pro-bequest value	C2: Pro-ecotourism value	C3: Pro-environmental value	C4: Pro-cultural value	C5: Pro-medicinal value	Total
GEND***	Female (%)	47.40	25.60	34.50	41.30	60.70	47.00
AGE***	Years (Median)	70.00	27.00	45.00	70.00	33.00	54.00
TEREDU**	yes (%)	15.80	71.80	69.00	12.70	19.60	29.00
HHSIZE ns	Number (Median)	10.00	5.00	4.00	13.00	6.00	7.00
FUELWD**	Yes (%)	86.00	33.30	27.60	42.90	83.90	63.70
DOMANI ns	Yes (%)	87.70	43.60	34.50	57.10	82.10	68.30
HOMEGAD ns	Yes (%)	86.00	51.30	65.50	81.00	81.30	76.70
HHINCOM**	₦/Month (Median)	125,000.00	30,000.00	220,000.00	40,000.00	30,000.00	50,000.00
TRADREL***	Yes (%)	22.80	0.00	0.00	58.70	53.60	36.70
FARM ns	Yes (%)	56.10	30.80	37.90	46.00	68.80	53.70
DIST**	Kilometer (Km)	1.00	6.00	2.00	1.00	2.00	1.45
VISIT***	Yes (%)	100.00	23.10	48.30	100.00	78.60	77.00
NOVISIT**	Number/year(Median)	50.00	0.00	1.00	100.00	10.00	20.00

, * Significant at 5% and 1 %, respectively; ns indicate non-significance.

D2: Household Questionnaire

Questionnaire No.:……. Date of Interview:/……/……. / ID of Interviewer:…….....

Time interview commenced: _____ Time interview concluded:

_____

LGA/State: _____ Town:

_____

Village: _____ Name of Respondent:

_____ Phone number of Respondent _____

Table D.2. General perception of the values of the sacred forest

To what extent do you agree with the following statements about the values of the sacred forest?
Tick (√) one box per row

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The sacred forest is a reservoir of medicinal plants					
The sacred forest is a source of food for my household					
The sacred forest is a source of feed for my domestic animals					
The sacred forest is a source of my household energy (e.g., firewood)					
The sacred forest is a source of wood and timber					
The sacred forest is a source of non-wood raw materials like bamboo, fibres, and raffia					
The sacred forest needs to be managed to attract eco-tourists to create jobs and provide income for members of the community.					
The sacred forest provides environmental services like rain formation, fresh air, erosion control					
The sacred forest is beneficial for my farming					
The sacred forest is important for recreational purposes, such as taking a walk					
The sacred forest is a shelter for deities					
The sacred forest is a symbol of our cultural heritage					

The sacred forest is a symbol of our communal identity					
The sacred forest is a holy place					
The sacred forest is an ‘evil’ place that evokes fear					
It is my responsibility to protect the sacred forest					
It is the responsibility of the community to protect the sacred forest					
It is the responsibility of the government to protect the sacred forest					
I will participate in the conservation of sacred forests if it is a law in this community					
I will participate in the conservation of sacred forests if my friends and family are also interested					
I appreciate the presence of sacred forest in this community					
The sacred forest is a reservoir of biodiversity					
I am familiar with the range of plant and animal species contained in the sacred forest					
I would like the sacred forest to be protected and preserved for future generations when I am no more					
I will like my children and grandchildren to enjoy the sacred forest as I am doing					
I admire the scenic beauty of an intact sacred forest					
It is a place of interaction with nature					
I derive a sense of well-being from the sacred forest					
I have respect for the sacred forest					
I am concerned about the existence of the sacred forest					

Table D.3: Contingent ranking of Value Preferences for Sacred Forest Conservation

I want to find out your preference on how you want the sacred forests to look in the future. Currently, the sacred forest is providing high cultural values 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. However, they do not have planned or formal conservation measures. They are still being protected solely by the cultural/religious beliefs and traditional customs attached to them, which are currently inadequate considering some of the ongoing degradations. As a result, some of the values derived from the sacred forests are being threatened. However, the application of formal

conservation measures can help to halt further degradation and improve the values. In trying to improve some other values of the sacred forest, the primary value, which is cultural functions, may also reduce. To effectively apply conservation management measures, it is important to first understand the values of the sacred forests that are most preferred by you.

Can you rank the following eight (8) cards as to which one will be your most or least preferred level of values provided by the sacred forest? This will help in designing conservation policy objectives for the sacred forests in order to target/focus on the values that are most important to the people. On the cards are shown different levels of values that can be provided by the sacred forest. **Please rank without ties from 1 (highest preference) to 8 (lowest preference).**

↑ = High provision for cultural values and improved provision for other values

↓ = Zero provision for ecotourism and decreasing provision for other values

Values	Card 1	Card 2	Card 3	Card 4	Card 5	Card 6	Card 7	Card 8
Preservation of cultural heritage	↓	↑	↓	↓	↑	↑	↑	↓
Enhancement of social cohesion	↑	↓	↓	↓	↓	↑	↑	↑
Provision of medicinal plants	↑	↓	↑	↓	↑	↓	↑	↓
Prevention of erosion	↓	↓	↑	↑	↓	↑	↑	↓
Promotion of ecotourism	↑	↓	↓	↑	↑	↑	↓	↓
Protection of rare and endangered species	↓	↓	↓	↑	↑	↓	↑	↑
Preservation of forest for the	↓	↓	↑	↓	↑	↑	↓	↑

future generation								
Ranking								

D3: Household socio-demographic characteristics

i. Gender of the respondent: [1] Female [0] Male

ii. Age of the respondent (years) [ ]

iii. Have you studied, or are you currently studying at the tertiary level of education?

Yes [1] No [0]

iv. Size of your household, i.e., those eating from the same pot (Number): [ ]

v. Do you use fuelwood as a source of household cooking energy? Yes [1] No [0]

vi. Do you keep domestic animals? Yes [1] No [0]

vii. Do you have a home garden? Yes [1] No [0]

viii. What is your current household monthly net income (in naira)? [ ]

ix. Do you practice Traditional religion? Yes [1] No [0]

x. Do you farm as an occupation? Yes [1] No [0]

xi. What is the distance from your house to the ……. sacred forest? (kilometre)

xii. Have you visited the sacred forest in the past one year? Yes [1] No [0]

xiii. If yes to C12, can you approximate the number of times you have visited the sacred forest in the last year? [ ] times.

D4: Participatory Workshop Question Guide

Workshop phase 1

i. I would like to learn what the sacred forest landscape means to you.
ii. What do you consider as the boundary of the …….sacred forest?
iii. What are the features of a good quality sacred forest, and what values can be derived from each of the features listed?
iv. Do you want the sacred forest to be conserved in the future, Yes or NO, and what are your reasons for each choice?
v. What do you want the sacred forest landscape to look like in the future for your grandchildren and great-grandchildren if:
   a) each feature and their corresponding values mentioned in question 3 is conserved (both alone or in combination with the other features and values);
   b) the status quo continues (assuming this also means those features and their values are lost)?
vi. What management strategies do you think should be put in place to deliver the different future conservation outcomes from question 5, and who should be responsible for and involved in each strategy?
vii. If households would be fully or partly responsible for and involved in sacred forest management strategies, how much money or labour (hours) per month do you think each household should contribute to delivering each of the future conservation outcomes developed in the first workshop? OR
viii. If households are not responsible for and involved in sacred forest management strategies, how should the resources needed to conserve the sacred forest be generated?

Workshop phase 2

i. How do you describe each of the values identified in the first workshop?
ii. Using the list of values identified in the first workshop, can you rank these values from the most to the least important to you? Why did you rank them as you did?

iii. Can you rank the current level of provision for each of the identified values in terms of whether they are increasing/high, decreasing/low, or have remained the same?

iv. How do you describe each of the management strategies identified in the first workshop?

Table D.4: Profile of participatory workshop participants

Group	**Number of participants**
Village heads/chiefs (Community leaders)	2
Traditional chief priests (Traditional religious leaders)	2
Herbalists (Traditional medicine practitioners)	2
Youths (18 -29 years of age)	2
Middle-aged adults (30 – 59 years of age)	2
Elderly (From 60 years of age and above)	2
Forest officials (Officials from Enugu State Forestry Commission)	2
Total	**14**