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ORIGINAL ARTICLE

The questions we ask matter: insights from place-based research on nature's contributions to people

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Abstract

Inclusive management requires accounting for the diverse ways in which nature contributes to people's lives. To uncover the broad spectrum of Nature's Contributions to People (NCP) expressed by social actors, using plural methods has emerged as a useful approach in sustainability science. Yet, we lack research on how different interview questions influence participants' expressions of NCP. Given the paucity of methodological studies that explore this, we investigated the effect of four distinct framings in interview questions (Appreciation, Benefits, Well-being, and Importance) on the NCP diversity expressed by different social actors. To this end, we analyzed interviews with nature conservationists ($n = 28$), tour guides ($n = 20$), and tourists ($n = 38$) at Mount Kilimanjaro, Tanzania. We uncovered 27 NCP. Further, the framing of the questions worked differently for social actors to express NCP. Multiple question-framings were necessary for all social actors to express a diversity of NCP, i.e., conservationists expressed all 27 NCP, guides 25 NCP, and tourists 19 NCP, respectively. Moreover, ten NCP were sensitive to the question-framing, the social actor, or even both, suggesting that these factors conditioned the NCP diversity we uncovered. Arguing that methods used to uncover NCP serve as 'NCP-articulating institutions', we claim that researchers can reduce the risk of response omission by purposefully designing their research. Complementing previous calls for plural methods, our results showed that a 'within-method pluralizing' approach, i.e., using various question-framings as tools within one method, can also amplify social actors' NCP expression by drawing on the power of words.

Keywords Context-specific perspective · Interviews · Methodological tools · Nature's contributions to people (NCP) · Plural valuation · Value-articulating institutions

Introduction

'If we are the tools of our tools, as suggested by [Henry David] Thoreau, then it can also be said that language is not only a vehicle for communication, it is the driver as well.' (Saltelli et al. 2020, p. 78).

Inclusive management of nature[1] requires accounting for multiple and diverse ways in which people relate to nature. This requires us (researchers) to recognize the need to include diverse voices, worldviews, and knowledge systems (Coscieme et al. 2020; Díaz et al. 2015, 2018; IPBES 2002; Salomon et al. 2023). The framework of Nature's Contributions to People (NCP) proposed by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) (Díaz et al. 2015, 2018) represents a more holistic and inclusive way of understanding how nature supports human well-being by extending beyond traditional frameworks like 'ecosystem services' (Kadykalo et al. 2019). The context-specific perspective of the NCP framework 'recognizes that people have the right to interpret and make sense of their relationships with nature in their own ways' (Hill et al. 2021, p. 911). Recent research that has applied a place-based approach to uncover the diversity of NCP revealed more nuanced human–nature relationships than would otherwise have been described using the ecosystem services framework. For example, Topp et al. (2022) found that land managers expressed 13 context-specific NCP associated with the South African *renosterveld* and the wider farming

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[1] We acknowledge that people's understanding of and relationship with nature vary based on their worldview and knowledge system (Coscieme et al. 2020; Díaz et al. 2015). Here, we use the term 'nature' in its most inclusive sense to embrace diverse perspectives.

landscape. Nicolás-Ruiz et al. (2023) were able to detect 16 context-specific NCP provided by dry rivers of south-eastern Spain as articulated by ten social groups. Despite this incipient empirical evidence for place-based relationships between people and nature, we lack evidence on how the methodological approach can affect the diversity of NCP a study empirically uncovers.

Previous research in the field of sustainability science and nature valuation has demonstrated that methodological choices condition scientific results (Balaine et al. 2024; Saltelli et al. 2020; Vatn 2005, 2009; Vatn and Bromley 1994). Indeed, valuation methods have been referred to as 'value-articulating institutions' (Vatn 2005, 2009; Vatn and Bromley 1994) because they do not only capture values, but also frame the value space, i.e., the possible values the method can detect (Gross et al. 2023; Kaiser 2024). Following the recent IPBES Values Assessment, methods are 'based on rules [that define] which values can be expressed and in what form' (Anderson et al. 2022, p. 83). For instance, the valuation method of willingness-to-pay naturally yields monetary values (García-Llorente et al. 2011; Platania and Rizzo 2018). In contrast, using open-ended interviews as a valuation method allows to elicit intrinsic, instrumental, and relational values in mainly non-monetary, but also possibly also monetary metrics (e.g., Arias-Arévalo et al. 2017; Topp et al. 2022). Hence, the method pre-determines the metrics that will be used and thus, the values that can emerge (Jacobs et al. 2018). Invariably, value omission is highly likely if the rationale of a selected method is incapable of capturing additional values that might be held by research participant (see empirical studies showing how different methods capture different values, e.g., Allen and Colson 2019; Martín-López et al. 2007, 2014).

To uncover a broad spectrum of values and to avoid response omission, i.e., missing out on important elements of a response, which reduces the accuracy and completeness of the information provided by the research participant, empirical studies are advised to apply plural methods (e.g., Martín-López et al. 2014; Jacobs et al. 2016, 2018, 2020; Termansen et al. 2022). Plural methods evoke value expression in different ways through which the values are made available for the participant to articulate. For example, Hensler et al. (2021) found that drawings and their narrated interpretation by members of the Forest Stewards Network in Xalapa, Mexico, were complementary to elicit diverse values. Likewise, Yuliani et al. (2023) applied three methods to investigate the diversity of forest-related relational values held by local communities in Sulawesi, Indonesia. However, such studies do not usually report on methods–result linkages such as which elicitation method was most effective in uncovering specific values.

Drawing on Vatn and Bromley's (1994) and Vatn's (2005, 2009) proposal to view valuation methods as value-articulating institutions, we argue that methods that seek to uncover NCP do not simply capture the expressed NCP, but also frame the NCP space, i.e., the NCP the method can detect. In a similar vein, we propose that such methods are 'NCP-articulating institutions' because, through the methodological approach researchers select, they condition which framework is used to study human–nature relationships (the study topic of interest), whose perception is included (the research participants), and how data is consolidated, synthesized, and interpreted (data collection and analysis methods). Therefore, the methodological approach determines which NCP may be considered, but also omitted. Researchers who want to uncover diverse NCP need to purposefully design their studies and use diverse methods that can deliberately lower the risk of NCP omission. Totino et al. (2023), however, claim that most studies applied plural methods to reveal different insights on NCP. A single method was used to identify NCP, i.e., which NCP a research participant perceives as present in a place (the focus of this study), and then (an) additional method/s to assess these NCP, i.e., how a research participant evaluates and demands NCP. In fact, NCP have been rarely *identified* through plural methods, which increases the risk of yielding an incomplete NCP set (Totino et al. 2023). For instance, Maestre-Andrés et al. (2016) identified 18 NCP provided by the natural park of Sant Llorenç, Spain, through non-participant observation, but unraveled eight additional NCP by conducting interviews. The value of method plurality is exemplified by Totino et al. (2023) who found that it was only by applying five socio-cultural methods that they could uncover 53 NCP expressed by peasant communities in the Dry Chaco eco-region, Argentina. No single method was able to uncover the overall detected NCP diversity, implying that the chosen methods were complementary and ultimately reduced response omission.

Applying plural methods requires resources that studies may lack. It is worthwhile, therefore, to identify the extent to which some methods can—uncombined with other methods—capture diverse people–nature relationships including NCP and values. The IPBES Value Assessment (Termansen et al. 2022, p. 191) suggests that 'some single valuation methods can identify diverse values to some degree'. Moreover, if we understand methods to identify NCP diversity as NCP-articulating institutions, the risk of response omission could be lowered by developing strategies that maximize the NCP space of a single method approach. While a plural methods approach seeks to build upon different methods to broaden the NCP space and to make NCP for participants available to express, we propose that different tools might also be created without switching methods. For interviews, for example, framing open-ended questions differently might operationalize variation in such tools for two reasons (Briggs 1986). First, different questions are key to unlock the

interviewee's internal perspectives of diverse NCP. Second, the meaning of words can vary depending on the interpretation of the interviewee (Treece and Treece 1986; Cairns-Lee et al. 2022), whereby even synonyms may not be identically interpreted (Gadimova 2023). Factors such as the interviewee's cultural context, linguistic background, and cognitive framework contribute to the 'meaning making' of words, which also affects how people respond to questions (Briggs 1986; Kövecses 2010). We assume that different question-framings might evoke a wide range of meanings behind 'what [aspects of] nature contributes to people's good quality of life'. Different question-framings may constitute a strategy to facilitate multiple opportunities for interviewees to think about nature's benefits from multiple angles without switching methods. In fact, there is empirical evidence on the power of question-framings in fields such as health sciences (e.g., Ely et al. 1999; Price and Christenson 2013), psychology (e.g., Schwarz 1999), and consumer behavior (e.g., Magano et al. 2023) but, to our knowledge, not in the field of sustainability science, including NCP.

In addition to the methodological tools, research has shown that social actors affect the empirical evidence on NCP uncovered through interviews. For example, in an agricultural landscape in the Colombian Andes, Kockelkoren et al. (2023) identified 32 NCP that six different social actors recognized. Each group expressed a different number of NCP, which together added to the overall diversity of NCP. Likewise, Nicolás-Ruiz et al. (2023) detected differences in expressed NCP associated with dry rivers in Spain between ten social actors. Both studies demonstrate that including different social actors enriches the NCP diversity uncovered. Moreover, former studies explained that the expression of particular NCP was associated with social actors' interaction with nature (Felipe-Lucia et al. 2015; Ramos et al. 2018), suggesting that diversifying social actors based on this feature can reduce the risk of intentional NCP omission. However, the choice of which social actors participate in the study is not random; it is decided by the researchers. Drawing on the rationale of NCP-articulating institutions, we claim that researchers can—intentionally—affect whose NCP perception is worthy of consideration or not.

In this methodological study, we investigated how different framings of interview questions affected the NCP diversity expressed by social actors. To this end, we drew on a qualitative place-based study conducted in the Kilimanjaro social–ecological system (hereafter referred to as Kilimanjaro), Tanzania. Specifically, we aimed to assess how (1) four differently framed open-ended questions affected the expression of diverse NCP (2) by different social actors.

Case study

Kilimanjaro encompasses the biophysical landscape of Mount Kilimanjaro, roughly covering the districts Hai, Moshi Rural, Moshi Municipality, Rombo, and Siha, and its associated social actors such as nature conservationists, tour guides, and tourists. The mountain is situated in Tanzania (Fig. 1) within a biodiversity hotspot (Hrdina and Romportl 2017). As the highest free-standing peak in the world (5895 meters above sea level (masl)), it hosts seven vegetation zones, with the lower two zones (800–2000

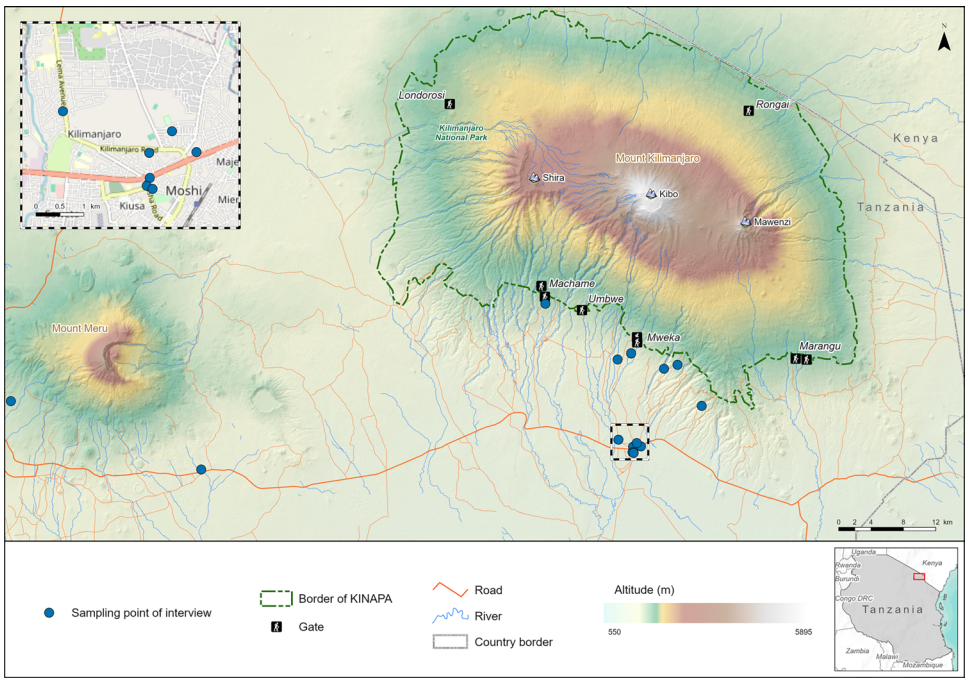

Fig. 1 Sampling points of interviews conducted in Kilimanjaro (Environmental Systems Research Institute (ESRI) 2020). *KINAPA* Kilimanjaro National Park

masl) heavily modified by human (Ensslin et al. 2015; Rutten et al. 2015). Kilimanjaro National Park (KINAPA) spans elevations from approximately 1600–2350 masl up to the summit (Hemp et al. 2017).

Kilimanjaro supplies diverse NCP that meets the needs of different social actors. For example, Kilimanjaro's forests located mainly inside the Park are pivotal in regulating water flow and purifying water, i.e., a regulating NCP, benefiting millions of people in and beyond the region (Said et al. 2019; Wamucii et al. 2021). Agricultural fields and forests on the slopes provide material NCP. The southern and eastern slopes are densely populated and have been transformed into large-scale monocultures and biodiverse home gardens, supplying energy, food, and feed (Fernandes et al. 1985; Misana et al. 2003; Soini 2005). In fact, agriculture is the major economic activity in the Kilimanjaro region (United Republic of Tanzania 2018). Additionally, non-material NCP, e.g., cultural heritage and identity, and recreation, are supplied along the entire altitudinal gradient (Frömming 2009; Sébastien 2010). Cultural heritage and identity are, for instance, supplied by home gardens (< ca. 1700 masl) and ritual sites such as Kifunika Hill (2900 masl) (Frömming 2009). Recreational hiking is one of Kilimanjaro's major tourist attractions (Holroyd 2016; Tanzania National Parks 2023). KINAPA's tourism is crucial for the national and local economy. After Serengeti National Park, its revenue is the second largest contribution to Tanzania's economy by national parks (Christie et al. 2014; Tanzania National Parks 2023). On a local scale, an estimated US$50 million in income contributed to the livelihoods of 400 guides, 10,000 porters, and 500 cooks in 2013 (Christie et al. 2014; Kitole and Sesabo 2024).

This methodological study drew on three groups of social actors at the nexus of nature conservation and nature-based tourism: nature conservationists, tour guides, and tourists. Nature conservationists and tour guides either lived and worked in Kilimanjaro or only worked there. All tourists visited Kilimanjaro. This nexus serves as an ideal platform to investigate NCP expression for three reasons. First, the groups differ in their duration of lifetime spent in the study area and hence, their scope of experience and place attachment with nature varies. Locals, foreign residents, and visitors are likely to perceive and express different aspects of NCP (Masao et al. 2022; Pearson et al. 2024). Second, even among locals and residents, nature offers some of these social actors different livelihood opportunities i.e., nature as an 'employer', 'office', and 'service provider', whereas for tourists, Kilimanjaro offers opportunities to experience various nature-based leisure time activities (Felipe-Lucia et al. 2015; Ramos et al. 2018). Third, along its entire altitudinal gradient, NCP supply varies. Hence, Kilimanjaro offers multiple experiences and activities for the social actors, maximizing the diversity of potential NCP that one might experience.

With the foundation of the Park in 1973, the ground was laid for the pursuit of the joint objectives of nature conservation and nature-based tourism in the region. Kilimanjaro National Park Authority (KINAPA Authority) under the mandate of Tanzania National Parks (TANAPA) started to 'sustainably conserve [the Park] (…) and optimiz[e] tourism development for human benefits' (Tanzania National Parks 2022). In 1977, the Park opened its gates to tourists (Durrant 2004), and ever since, has successfully attracted mainly international tourists (Tanzania National Parks 2023). In the season 07/2022 to 06/2023, for example, more than 43,000 international tourists visited KINAPA, the fourth highest international visitor rate across the 22 Tanzanian Parks (average international visitor rate: 31,700 visitors) (United Republic of Tanzania 2022). In contrast, the number of domestic visitors (ca. 6700 domestic tourists) is comparatively low compared with the international rate and other national parks (average domestic visitor rate: 15,800 visitors).

While one- and multiple-day hikes inside KINAPA are the most popular tourism activities, nature-based activities such as visiting waterfalls and participating in bio-cultural experiences with local Chagga people are also offered outside the Park in non-protected areas (Tanzania National Parks 2023; interview with tour guides). Likewise, conservation efforts are also undertaken outside protected areas (personal communication with the natural resource officer at the Moshi district office and interviews with nature conservationists). Governmental officers, e.g., natural resource officers, as well as local and international community-based and non-governmental conservation organizations implement projects on the foothills to conserve nature by planting seedlings and protecting old trees (Hemp et al. 2018). For example, beehives are hung on and the oyster nut vine (*Telfairia pedata*) is grown on trees in home gardens to protect against logging; the owners can consume or sell the honey and seeds. Additionally, some projects are coupled with nature-based tourism, i.e., tourists participate in activities, or touristic revenue is generated from selling products to tourists derived from conservation activities. For instance, the Beehive Fence Project uses bees that deter elephants from destroying crops to reduce human–wildlife conflict, while generating income from selling honey. Such projects demonstrate a vibrant nature-based tourism sector dependent on nature outside the Park.

Methods

Interview guide

We developed an English-language interview guide to guide face-to-face semi-structured conversation between the

interviewee and a researcher (interview guides in Supporting Material S1). Two non-Tanzanian co-authors and a Tanzanian research assistant were trained to conduct the interview. We pre-tested the interview questions in iterative rounds with former tourists. The interview guide comprised open-ended questions about the interviewees' experience with Mount Kilimanjaro and people–nature relationships and closed-ended questions on socio-demographics. Open-ended questions allow interviewees to report their perceptions in their own words (Bryman 2016), required to acknowledge the context specificity of the NCP framework.

The main component of our interview consisted of four NCP-targeting open-ended questions (Table 1) that used different framings to (seemingly) ask interviewees the same thing, i.e., the many ways of what they perceive nature contributes to their and other people's quality of life. In version 1 of the question-framing (hereafter referred to as Appreciation), we used the framing 'appreciate', in version 2 'benefits' (Benefits), in version 3 'contributing to well-being/quality of life' (Well-being), and in version 4 'importance of nature' (Importance). All interviewees were asked all four question-framings followed in the same sequence with one exception: for the interview with tourists, the sequence of questions was adjusted such that questions related to Well-being were posed second, followed by those about Benefits. After pre-testing the guide, it was deemed that this order permitted better flow of the conversation.

We opted for these four framings based on two assumptions. First, we assumed semantic differences between the four framings distinct enough to capture the multi-faceted NCP framework. Despite such a clear semantic understanding on our end, this might not necessarily correspond with that of the interviewees. The same question-framing can evoke various meaning-makings and hence, different NCP perceptions for different interviewees (Louise Barriball and While 1994; Treece and Treece 1986). How an interviewee interpreted and hence, made meaning of the question-framings was a confounding factor we could not control for, but ultimately influenced how they expressed NCP and hence, the NCP diversity uncovered (Cairns-Lee et al. 2022). Therefore, using slightly different question-framings to (seemingly) ask interviewees the same 'thing' might overcome language barriers, particularly if they were non-native English speaking interviewees as in our study, and increase the chance that an interviewee reported the information we were interested to uncover. Moreover, the questions addressed both the interviewees themselves and other people who reside on, work at, and come as tourists to Kilimanjaro (Table 1). We assumed that this might expand the scope of interviewee's perceptions beyond their own and thus, uncover to a broader diversity of NCP. We did not use question-framings that could target specific NCP, e.g., beautiful aspects of nature, which could bias a response toward that NCP, e.g., aesthetic enjoyment.

Qualitative data gathering

Between May 2021 and February 2022, we conducted 86 interviews with nature conservationists ($n = 28$ interviewees), tour guides ($n = 20$), and tourists ($n = 38$) (Table 2). Importantly, interviewees might have multiple identities in their lives, thus belonging to various social actors. For example, a Tanzanian person who we approached as a tour guide according to our definition might also engage in conservation or farm in the area (Kitole and Sesabo 2024). In this study, we considered the social actor affiliation of interviewees as the identity they expressed at the time we encountered them. By selecting interviewees based on their social actor affiliation, we sought to guarantee that the interviewees cover a broad range of people–nature relationships. We acknowledge that other social actors we did not interview for this study such as farmers are also present in Kilimanjaro and capable of expressing NCP.

We interviewed all tourists and five tour guides online (home countries of the online interviewees in Table S2.1 in Supporting Material S2), while interviews with the other tour guides and all nature conservationists took place in several locations in Kilimanjaro (Fig. 1). Interviews lasted between 20 min and three hours, as they also

Table 1 Summary of the question-framings used to investigate their effect on the diversity of Nature's Contributions to People (NCP) uncovered (full interview guides in Supporting Material S1)

Question-framing	Interview questions
Appreciation	What do you appreciate about nature at Mount Kilimanjaro? And other people?
Benefits	Do you think that nature at Mount Kilimanjaro provides benefits to humans? If yes, what are the benefits of nature at Kilimanjaro? Are there any other contributions and/or benefits of nature at Mount Kilimanjaro to you and other people that you can think of, for example, in environmental, economic, social, or cultural terms?
Well-being	What does nature at Mount Kilimanjaro contribute to your well-being? And other people's well-being?
Importance	Do you think nature at Mount Kilimanjaro is important and why? For you personally? And for other people?

Table 2 Overview of the sampling characteristics of the social actors

	Nature conservationists ($n=28$)	Tour guides ($n=20$)	Tourists ($n=38$)
Definition of social actors	Conservation-related officers at governmental (working for KINAPA Authority), regional, and district level, and national and international members of environmental NGOs, CBOs, and advisory boards with conservation activities in Kilimanjaro	Local and international tour guides and tour operators	Tanzanian and international tourists who attempted or succeeded to summit Mount Kilimanjaro
Social actor-specific sampling strategies in addition to snowball sampling	Contacting governmental, regional, and district officers, and searching the web for nature conservationists working for NGOs, CBOs, and advisory boards	Searching the web for tour guides and tour operators	Identifying former tourists through various websites and social media platforms

n sample size, *CBOs* community-based organizations, *KINAPA Authority* Kilimanjaro National Park Authority, *NGOs* non-governmental organizations

included questions relevant to other researchers of the Kili-SES research project (https://kili-ses.senckenberg.de/).

Ethics

The Ethics Committee at the university of the first author (EB-Antrag_202104-07-Martin-Lopez_KiliSES; EB-Antrag_202109-12-Martin-Lopez_KiliSES-02) granted ethics clearance based on an ethics application prior to data gathering. Additionally, the Tanzania Commission for Science and Technology (COSTECH; 2021-225-NA-2021-09), the Tanzanian Wildlife Research Institute (TAWIRI), and TANAPA issued research permits to conduct research in Kilimanjaro. As is the required protocol for undertaking research in Tanzania, executive commissioners at regional and district level provided additional permissions in writing and in some cases orally.

Before the interview commenced, we informed prospective interviewees about the research goals and participant explanation and declaration of consent form (Supporting Material S3) and/or orally. Only interviewees at least 18 years of age were allowed to participate. We granted interviewees the right to withdraw their data entry before data analysis and hence, collected our data pseudo-anonymously. With participant consent, we recorded interviews to transcribe them. All but one interviewee gave consent to be recorded and therefore, notes were taken in that one case. To account for potential language barriers, local understanding, and cultural values, the Tanzanian research assistant mainly interviewed Tanzanian interviewees and the non-Tanzanian co-authors international interviewees. When one of the two co-authors interviewed a Tanzanian interviewee, the research assistant usually accompanied them.

As part of the consent process, interviewees could indicate their interest in receiving a summary of the published results (Supporting Material S3). Preliminary findings were shared during a knowledge exchange tour in Kilimanjaro (Box 1).

Box 1: Report of knowledge exchange tour

Our study was part of subproject 3 within the Kili-SES research project. In 2023, the core team of this subproject, comprising three co-authors and a fourth researcher, embarked on a 'knowledge exchange tour' in Kilimanjaro to present the initial findings of this subproject. Results were shared with research participants and others who were involved in or interested in our work through posters with quotes, visual illustrations, photos, and language tailored for lay audiences (Meyer et al. 2023). Over 160 guests were welcomed across seven locations (Fig. 2). Participants were encouraged to ask questions and engage in reflections and discussions with us. The posters were emailed to research participants who expressed interest in the results.

Another ethical issue, in the context of any scientific work, concerns the researchers' positionality (first author's positionality statement in Supporting Material S4).

Qualitative content analysis

We analyzed the transcribed responses and the notes of one interview in MAXQDA 2022 (VERBI software 2021). We applied a qualitative content analysis to code context-specific NCP. We developed a coding scheme in an inductive–deductive process. We were cognitively guided by the NCP proposed as the generalizing perspective of the NCP framework (Díaz et al. 2018) (deductive process) and simultaneously focused on the contextual nuances of what nature contributed to people's quality of life to account for the

Fig. 2 Visual impressions from the knowledge exchange tour. **a** Public poster presentation at a guesthouse. **b** Public project and poster presentation at Mweke College for African Wildlife Management. **c** Public poster presentation in collaboration with the Kilimanjaro Hiking Club. **d** Photo exhibition in Maharo village. Photo credit and gratitude to **a** John Sanya; **b**, **d** Milena Gross; **c** Berta Martín-López

context-specific perspective of the NCP framework (inductive process).

Coding was a joint effort among five co-authors. To create an initial coding scheme, we identified context-specific NCP using a subset of three interviews. We extended the coding scheme from the remaining interviews using an iterative process that led to the final set of coded NCP when information was saturated and we could not identify additional NCP. While developing the coding scheme, we noticed that interviewees tended to refer to the final benefits rather than the underlying regulating NCP. For example, references were made to the provision of 'fresh air' or 'clean water' instead of the purification processes of air and water, i.e., regulating NCP. Considering that most interviewees were neither native English speakers nor natural science experts, we coded these expressions using regulating NCP terminology. Our coding process was accompanied by a living intercoder agreement that documented our coding rules and the reasons for the decisions we took. Table S2.2 in Supporting Material S2 displays how we translated the interviewee's words into the scientific framework of context-specific and generalizing NCP by providing one example for each NCP expressed by each social actor. Upon completion, the first author double-checked all coded transcripts for consistency. Additionally, both Tanzanian co-authors were consulted to minimize potential contextual misunderstandings.

We analyzed the data in two steps. First, we coded context-specific NCP in all transcripts and the notes. We adapted the NCP descriptions by Díaz et al. (2018) and Pearson et al. (2024) and combined them with the specific words used by the interviewees (Table 3). We aimed to retain the contextual meaning behind NCP by honoring the terminology used by interviewees to express them. For example, regulation of climate refers to nature's regulation of atmospheric conditions, including effects on greenhouse gases and temperature, carbon sequestration and storage, and pleasant weather conditions. Where possible, we also applied an interwoven approach (Hill et al. 2021) to associate the context-specific NCP we had identified with the generalizing NCP sensu Díaz et al. (2018).

Table 3 Description of context-specific Nature's Contributions to People (NCP) expressed by nature conservationists ($n=28$), tour guides ($n=20$), and tourists ($n=38$) in Kilimanjaro, Tanzania

Regulating NCP	
	**Habitat creation and maintenance** refer to nature's processes and conditions to form a place for people and non-human organisms to live and thrive and to continue providing such.
	**Pollination** refers to animals' contribution of distributing pollen among flowers.
	**Dispersal of seeds** refers to animals' contribution to moving seeds.
	**Regulation of air quality** refers to nature's processes of purifying air to improve its quality for people.
	**Regulation of climate** refers to nature's regulation of atmospheric conditions, including effects on greenhouse gases and temperature, carbon sequestration and storage, and pleasant weather conditions.
	**Regulation of freshwater quantity** refers to nature's hydrological processes to regulate the water flow and function as a source of water for various people-related purposes, such as irrigation and water for domestic use.
	**Regulation of freshwater quality** refers to nature's processes of purifying water to improve its quality for people.
	**Regulation of soil fertility and protection of soils** refers to nature's processes to create and maintain soils and soil fertility, and to prevent soil erosion.
	**Regulation of hazards and extreme events** refers to nature's processes to prevent people and their infrastructure from damage caused by, for example, strong winds, and storms.
	**Regulation of detrimental species** refers to the controlling effects derived from organisms and abiotic conditions on organisms that are pests or transmit diseases, e.g., the temperature limits the spatial coverage of anopheles mosquitos that can transmit the Malaria disease.
Material NCP	
	**Energy** refers to the production of timber-based fuels such as firewood and hydropower.
	**Food** refers to the production of food and beverages derived from wild, managed, or domesticated organisms such as maize, banana, coffee, milk, and meat.
	**Feed** refers to the production of forage and fodder for domesticated animals such as grasses.
	**Building materials** refer to producing materials derived from nature to construct buildings such as timber.
	**Medicine** refers to the collection and production of materials derived from non-human organisms used for medicinal purposes such as insects and herbs.
Non-material NCP	
	**Learning** refers to the different levels of learning that can be experienced by and through nature, from education on different species to gaining new profound insights, which can influence one's outlook on life.
	**Aesthetic enjoyment** refers to the pure enjoyment of the aesthetic appearance and beauty of nature.
	**Recreation** refers to the provision of opportunities for physical, including recreational and touristic, activities in nature.
	**Challenging experiences** refer to the provision by nature of opportunities for people to seek challenges, which test their mental and physical capabilities, often resulting in a sense of achievement.
	**Therapeutic and restorative benefits** refer to nature's opportunities for therapeutic and restorative benefits such as healing, stress-relief and relaxation.
	**New and unique experiences** refer to the provision by nature of new and unique opportunities for the human experience.
	**Connectedness with nature** refers to the opportunities for people to develop or deepen a feeling of being part of and immersed in nature.
	**Cultural heritage and identity** refer to the opportunities in which nature and cultural rootedness, traditions, historical incidences and people's identification blend, e.g., a whole country identifies with a natural entity.
	**Sense of place** refers to the opportunities for people to develop a sense of belonging or feeling at 'home' in nature.
	**Social cohesion and bonding** refer to the basis of nature for people to develop new connections or nurture their existing relationships with other people.
	**Spiritual experiences** refer to the basis of nature for nurturing one's religion or inner spirit by connecting to self or a higher entity.
Intergenerational benefits	
	**Intergenerational benefits** refer to maintaining the existence of nature for future generations to experience.

Table 3 (continued)

The descriptions were adapted from Díaz et al. (2018), and Pearson et al. (2024). NCP group: regulating; material; non-material; intergenerational benefits. Icon design credit: Jelke Meyer

Second, we identified whether the four question-framings (Table 1) affected the expression of NCP by the three social actors. Then, we categorized our findings into four groups: Group 1 comprised NCP expressed in response to all four question-framings and by all three social actors—neither the question-framing nor the social actor matters. Group 2 contained NCP expressed in response to not all four question-framings, i.e., a maximum of three question-framings, but by all three social actors—the question-framing matters. Group 3 covered NCP expressed in response to all four question-framings, but not by all three social actors, i.e., a maximum of two social actors—the social actor matters. Group 4 contained NCP in response to not all four question-framings expressed by not all three social actors—the question-framing and social actor matter.

Results

Interviewee profile

Our interview sample comprised 86 interviewees ranging from 22 to 81 years of age ($\bar{x} = 46$ years; SD 13.8) (full summary of interviewees' socio-demographic attributes in Table S5.1 in Supporting Material S5). More than half (63% of the interviewees) of the interviewees were male. Most conservationists (82%) and tour guides (67%) were raised in Tanzania, while most tourists grew up in: countries in the Global North (70%). The majority of conservationists (undergraduate degree: 32%; postgraduate degree or Ph.D.: 43%) and tourists (47%; 26%) achieved university degrees. Tour guides' levels of formal education ranged from primary and secondary school (25%) to college diplomas (25%) and university degrees (undergraduate degree: 25%; postgraduate degree or Ph.D.: 15%). All tourists who entered the Park intended to summit Mount Kilimanjaro and almost every tourist (92%) entered for the first time.

Context-specific NCP expressed by social actors

A total of 27 context-specific NCP were expressed across all interviewees of which ten were classified as regulating, five as material, and eleven as non-material NCP (Table 3). Furthermore, we identified intergenerational benefits which are understood as maintaining the existence of nature for future generations to experience (Table 3). Because this NCP cuts across all three NCP groups, we treated it as a separate NCP group (Díaz et al. 2018). All but one context-specific NCP new and unique experiences corresponded with one of the generalizing NCP perspective.

The effect of different question-framings on NCP expressed by social actors

We found that nature conservationists expressed all 27 NCP, tour guides 25 NCP, and tourists 19 NCP (Table 4). Across all social actors, no question-framing elicited all NCP. In fact, question-framings were complementary and necessary to enrich NCP expression. Moreover, each question-framing revealed different and new NCP in each social actor (Table 4; Fig. 3). For example, all social actors expressed one NCP in response to the second question-framing that they did not mention in response to the first one (Nature conservationists: cultural heritage and identity; tour guides: regulation of soil fertility and protection of soils; tourists: regulation of freshwater quantity). While tour guides expressed the highest number of NCP ($n = 23$ NCP) in response to the first question-framing of Appreciation, nature conservationists and tourists expressed the highest number of NCP to the third question-framing of Well-being ($n = 24$) and the final question-framing of Importance ($n = 16$), respectively (Table 4). For tour guides, the question-framings of Benefits and Importance revealed one additional NCP each. In contrast, the other two social actors expressed five additional NCP, when asked all additional question-framings. Thus, asking sequential question-framings was pivotal to uncovering the 'complete' NCP diversity for all social actors, but particularly nature conservationists and tourists.

Our analysis revealed that the identification of specific NCP ($n = 10$ NCP) was sensitive to the question-framing, the social actor, and the interaction of these two factors (Fig. 3). The question-framing was key to identifying cultural heritage and identity, connectedness with nature, and intergenerational benefits (Group 2; ♠ in Fig. 3). Cultural heritage and identity, and connectedness with nature were expressed

Table 4 Overview of the total number of Nature's Contributions to People (NCP) expressed by the social actors in response to the four question-framings (Table 1) and the number of additional NCP uncovered in the subsequent question-framing

Social actor|question-framing	Nature conservationists	Tour guides	Tourists
Appreciate	22	**23**	14
Benefits	18	19	13
Additional NCP uncovered	1	1	2
Well-being	**24**	15	12
Additional NCP uncovered	3	0	1
Importance	19	15	**16**
Additional NCP uncovered	1	1	2
Total number of NCP and of additional NCP uncovered in the subsequent question-framing (in parentheses) expressed per social actor	27 (+5)	25 (+2)	19 (+5)

The question-framing of Well-being was posed second, followed by question-framing of Benefits in tourist interviews

by all social actors, but not in response to the final question-framing of Importance. In contrast, social actors expressed intergenerational benefits only in response to this particular question-framing. Moreover, only nature conservationists and tour guides, but not tourists expressed feed and building materials, indicating that the expression of these two NCP was sensitive to the social actor (Group 3; ♣ in Fig. 3). Finally, particular question-framings and social actors were simultaneously crucial in uncovering five NCP (pollination, dispersal of seeds, regulation of hazards and extreme events, regulation of detrimental species, and medicine) (Group 4; ♦ in Fig. 3). For instance, nature conservationists and tour guides but not tourists expressed dispersal of seeds and regulation of detrimental species in response to all question-framings except for Benefits. Another example concerned regulation of hazards and extreme events. Nature conservationists were the only social actor group to express this NCP in response to the question-framings of Appreciation and Well-being. These results demonstrate that the expression of particular NCP was sensitive to the question-framing, social actor, and both.

Discussion

Varying question-framings provided social actors multiple opportunities to articulate which NCP they perceive that ultimately enriched the NCP diversity we uncovered. Here, we discuss how pluralizing across social actors broadens the diversity of NCP expressed and the workings of the interview method as NCP-articulating institutions. Building on calls for a plural method approach, we propose an approach that draws on the power of words as tools to amplify social actors' NCP expression: 'within-method pluralizing'. Finally, we suggest four endeavors to empirically advance this novel approach.

Diversity of social actors broadens the NCP diversity

Our study demonstrates that incorporating perspectives from a diverse set of social actors, whose knowledge about and experiences with nature differ, is necessary for broadening the diversity of NCP, as pointed out by previous studies (Felipe-Lucia et al. 2015; Ramos et al. 2018). Kockelkoren et al. (2023) stressed how knowledgeable local social actors were about the NCP present in their natural surroundings. Our study also corroborates the importance of including local actors in NCP studies, as international tourists expressed the lowest number of NCP compared with nature conservationists and tour guides, comprising mainly Tanzanian interviewees (82% of the nature conservationists were raised in Tanzania; 58% of the tour guides). Moreover, nature conservationists expressed the highest number of NCP across the investigated social actors, a result similar to other studies (Cáceres et al. 2015; Kockelkoren et al. 2023; Masao et al. 2022). This suggests that nature conservationists are a key social actor to consider for identifying NCP diversity. Nevertheless, we favor a multi-actor approach in studies that aim to capture NCP diversity for two reasons. First, no researcher can foresee whether a social actor will be able to express the 'complete' NCP diversity that can be uncovered by the study. Second, Kockelkoren et al. (2023) and Masao et al. (2022) found that environment-related actors expressed a broad, but not the complete NCP diversity uncovered. Hence, including a single social actor or a narrow set of social actors can result in omitting certain NCP. Furthermore, such a multi-actor approach can contribute to conducting socially inclusive research that accounts for the multiple and diverse ways in which people relate to nature, an essential pathway to provide meaningful insights for inclusive sustainable management (Jacobs et al. 2020; Zafra-Calvo et al. 2020).

Context-specific NCP		I. Appreciation			II. Benefits			III. Well-being			IV. Importance		
Regulating NCP													
Habitat creation and maintenance		•	•	•	•	•		•			•	•	
Pollination	♦	•			•						•		
Dispersal of seeds	♦		•					•			•		
Regulation of air quality		•	•	•	•	•		•	•	•	•	•	•
Regulation of climate		•	•		•	•		•	•		•	•	•
Regulation of freshwater quantity		•	•		•	•	•	•	•	•	•	•	•
Regulation of freshwater quality		•	•		•	•		•	•		•	•	•
Regulation of soil fertility and protection of soils		•	•		•	•	•	•	•		•		•
Regulation of hazards and extreme events	♦	•						•					
Regulation of detrimental species	♦	•	•					•					
Material NCP													
Energy		•	•	•	•	•		•		•	•	•	
Food		•	•	•	•	•	•	•	•		•	•	•
Feed	♣	•	•		•	•		•	•		•	•	
Building materials	♣	•	•		•	•		•			•		
Medicine	♦	•	•		•			•					
Non-material NCP													
Learning		•	•	•	•	•	•	•	•	•	•	•	•
Aesthetic enjoyment		•	•	•	•	•	•	•	•	•	•	•	•
Recreation		•	•	•	•	•	•	•	•	•	•	•	•
Challenging experiences		•	•	•			•	•		•			•
Therapeutic and restorative benefits		•	•	•	•	•	•	•	•	•	•	•	•
New and unique experiences		•	•	•		•	•	•	•	•	•	•	•
Connectedness with nature	♠	•	•	•			•	•	•	•			
Cultural heritage and identity	♠		•	•	•	•	•						•
Sense of place		•	•		•	•	•	•	•			•	•
Social cohesion and bonding				•		•	•	•	•	•		•	
Spiritual experiences			•	•		•	•	•		•			•
Intergenerational benefits													
Intergenerational benefits	♠										•	•	•

Fig. 3 Overview of context-specific Nature's Contributions to People (NCP) expressed by nature conservationists ($n=28$), tour guides ($n=20$), and tourists ($n=38$) in response to the question-framings (Table 1). • NCP expressed; ♦ question-framing and social actor matter; ♣ social actor matters; ♠ question-framing matters; nature conservationist; tour guide; tourist. Icon design credit: Jelke Meyer

Methods as NCP-articulating institutions

We uncovered a total of 27 context-specific NCP, of which one does not fit within the established generalizing perspective of the NCP framework (Nicolás-Ruiz et al. 2023). New and unique experiences were expressed by all three social actors and has not been reported by any other study, in Kilimanjaro (except for Pearson et al. (2024) who used the same tourist interview data) or elsewhere. Our findings demonstrate the value of open-ended questions for enabling social actors to express a wide set of NCP (Nicolás-Ruiz et al. 2023). This underscores the importance of applying narrated responses with a context-specific NCP lens to fully capture the diverse ways that nature contributes to people's lives as expressed by social actors (Díaz et al. 2018; Hill et al. 2021).

Different question-framings presented interviewees with multiple opportunities to think about nature and its contributions to themselves and other people. Our study provides evidence that varying question-framings was necessary to uncover all 27 NCP (Table 4; Fig. 3), stressing the value of reframing questions and their workings as tools to amplify NCP expression. For example, without including the question framed to evoke perceptions of the importance of nature (question-framing Importance), participants would have omitted intergenerational benefits from the NCP expressed. In fact, we found NCP are sensitive to the question-framing (Fig. 3), i.e., certain framings evoked the expression of specific NCP. We cannot prove whether these differences are a result of the NCP perceptions inherent to the different social actor groups or how the interviewees made meaning of the question-framing in the interview setting (Briggs 1986; Kövecses 2010). Yet, experimental research on question-framing indicates that even slight changes in phrasing can significantly influence the responses given (Schuman and Presser 1981). Falling short on question-framings can omit context-specific NCP. Also, the influence of variation in question-framing varies across contexts (Bryman 2016). Particularly, the language used to conduct the interview, whether it is interviewees', interviewers' or researchers', can influence NCP expression and identification. Thus, we cannot advise other studies on using these particular question-framing/s or a specific number of question-framings. Rather, we suggest using multiple question-framings to reduce the risk of NCP omission and encourage other researchers to build upon our work to explore other potential framings.

The design of research methods is a vector of inclusion and omission of scientific knowledge (Balaine et al. 2024; Saltelli et al. 2020; West and Schill 2022). Methods used to identify NCP diversity do not simply capture NCP, but also frame the space in which NCP are expressed. Hence, we propose them as NCP-articulating institutions. It is the responsibility of us (researchers) to frame different questions in a way that different social actors can comprehend them, ultimately maximizing NCP identification. In fact, the rules we (researchers) follow to identify NCP diversity can be a conscious and a 'political' choice to conduct research in an inclusive manner (Jacobs et al. 2023; West and Schill 2022). Further, establishing trustful relationships between interviewees and interviewers through, e.g., multiple interactions, participant observation, and disseminating initial findings (Box 1), though time-intensive and requiring significant engagement, can provide deeper insights into people's perceptions of nature's benefits (Beaty et al. 2024; Care et al. 2024; Yuliani et al. 2023). This is crucial when research aims to inform inclusive sustainable management. Our findings indicate that relying on a limited set of question-framings increases the risk of developing and carrying out management actions based on an incomplete NCP understanding. Further, if conservation managers aim to gather information directly, this study can help them evaluate their data gathering approaches by examining how the phrasing of questions may influence the responses they receive. To account for the diversity of NCP, we encourage NCP researchers similarly to researchers in nature valuation (Jacobs et al. 2020) to engage with the place and people involved in the research and purposefully design their research and, particularly in the case of conservation managers, elicitation tools to amplify social actors' expression of diverse NCP.

Pluralizing within methods enriches the NCP diversity

Previous literature has advocated for employing a plural method approach to uncover the diverse ways in which people relate to nature (e.g., Jacobs et al. 2018, 2020; Termansen et al. 2022; Totino et al. 2023). We show that the question-framing served as a 'tweak' within the method of semi-structured interviews that provided multiple opportunities for the social actors to think about NCP from various angles without switching methods. Hence, we claim that pluralizing question-framing can function as tools within the same method to amplify NCP expression, an approach we term as a within-method pluralizing approach. Drawing on recent findings from the field of nature valuation, we borrowed the terminology and rationale of the within-method pluralizing approach from the plural method approach used to capture a rich spectrum of values that different social actors express (Jacobs et al. 2018, 2020; Termansen et al. 2022). This study contributes to the field of nature valuation by demonstrating the relevance of pluralizing within the same method by implementing variation in question-framings across the different social actors interviewed. Hence, we claim that within-method pluralizing is one potential complementary approach to operationalize plural valuation.

Recommendations for empirically advancing 'within-method pluralizing'

To our knowledge, this is the first study to investigate how question-framings can affect social actors' expression of NCP. To advance empirical evidence on within-method pluralizing, we propose four endeavors for future studies.

(1) Investigate other wordings.

We encourage future research to investigate the effect of question-framings, including other wordings than the four question-framings we posed, on NCP diversity expressed by social actors. For example, wordings such as 'What do you and other people use from nature?' (Nicolás-Ruiz et al. 2023) and 'What aspects of nature are worth conserving, for you, and other people?' can constitute relevant question-framings.

(2) Compare within-method pluralizing across methods.

We suggest researching the effect of within-method pluralizing for and across different methods, including interviews (Cáceres et al. 2015; Totino et al. 2023), questionnaires with open-ended questions (e.g., Masao et al. 2022), focus group discussions (e.g., Ebner et al. 2022; Lau et al. 2018), and arts-based methods (e.g., Pearson et al. 2024; Totino et al. 2023). Such comparative analysis provides insights into whether within-method pluralizing and plural method approaches are complementary or redundant in uncovering NCP.

(3) Consider variation within social actors.

Empirical evidence suggests within- and across-variation of social actors concerning, for example, NCP preferences (Tauro et al. 2018) and attitudes toward species (Arbieu et al. 2023), hinting at the risk of stereotyping and over-simplifying social actors. We hypothesize that NCP diversity can be a result of including different social actors but also that of the internal heterogeneity that exists within each group and hence, is worthwhile investigating.

(4) Reflect on the role of the methods and its application to articulate scientific knowledge.

In addition to data gathering methods, we argue that data analysis also, i.e., the translation of the interviewee's words into the scientific language of the NCP framework, is determined by frameworks used, e.g., NCP, and rules, e.g., followed by researchers in the context of an inter-coder agreement. We propose that future research investigates how the selected framework of interest and the rules set by the researchers in the data analysis process articulate scientific knowledge.

Conclusion

Uncovering the diversity of human–nature relationships is a pivotal endeavor of sustainability scientists to inform inclusive sustainable management. To this end, scholars have argued for applying plural methods to evoke the expression of diverse NCP by social actors. Building on their argument, our methodological study revealed that pluralizing question-framings in an interview setting also amplifies social actors' NCP expression. This suggests that by implementing a so-called within-method pluralizing approach, a single method can capture a broad NCP spectrum. Although our study indicates the potential of within-method pluralizing in uncovering rich NCP diversity, whether this approach can grow into its fuller potential requires researchers to reflect on the use of the methods—as NCP-articulating institutions in the case of our study—and accordingly develop them further for the sake of inclusive research. Ultimately, it is our endeavor—and even responsibility—as researchers, to continue developing our methods for the greater good.

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Author contribution MG and BML conceived the idea and designed the methodology; MG, JP, and one field assistant conducted the interviews; JH transcribed the interviews; MG, JP, DS, and FV developed the coding scheme and analyzed the data; FC created the map; MG supervised by BML led the writing of the first draft of the manuscript. THM, UA, and JKS contributed to the discussion section. All authors commented on previous versions of the manuscript and gave final approval for publication.

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Data availability Due to the sensitive nature of the knowledge shared with us, the risk of being able to identify interviewees based on information they shared, and according to the ethics approval granted by the university of the first author, we will not make interview transcripts publicly available.

Declarations

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 article.

References

Allen KE, Colson G (2019) Understanding PES from the ground up: a combined choice experiment and interview approach to understanding PES in Costa Rica. Sustain Sci 14:391–404. https://doi.org/10.1007/s11625-018-00653-w

Anderson CB, Athayde S, Arias-Arévalo P et al (2022) Chapter 2: conceptualizing the diverse values of nature and their contributions to people. In: Balvanera P, Pascual U, Christie M et al (eds) Methodological assessment report on the diverse values and valuation of nature of the intergovernmental science-policy platform on biodiversity and ecosystem services. IPBES secretariat, Bonn

Arbieu U, Albrecht J, Böhning-Gaese K et al (2023) The attitudinal space framework: embracing the multidimensionality of attitudinal diversity. iScience 26:107340. https://doi.org/10.1016/j.isci.2023.107340

Arias-Arévalo P, Martín-López B, Gómez-Baggethun E (2017) Exploring intrinsic, instrumental, and relational values for sustainable management of social–ecological systems. E&S 22:43. https://doi.org/10.5751/ES-09812-220443

Balaine L, Buckley C, Baillet V et al (2024) Influence of methodological choices in farm sustainability assessments: a word of caution from a case study analysis of European dairy farms. Environ Sci Policy 156:103745. https://doi.org/10.1016/j.envsci.2024.103745

Beaty F, Domínguez-Sánchez PS, Nalven KB et al (2024) Centering relationships to place for more meaningful research and engagement. Proc Natl Acad Sci USA 121:e2306991121. https://doi.org/10.1073/pnas.2306991121

Briggs CL (1986) Learning how to ask: a sociolinguistic appraisal of the role of the interview in social science research, 1st edn. Cambridge University Press, Cambridge

Bryman A (2016) Social research methods, 5th edn. Oxford University Press, Oxford

Cáceres DM, Tapella E, Quétier F, Díaz S (2015) The social value of biodiversity and ecosystem services from the perspectives of different social actors. E&S 20:62. https://doi.org/10.5751/ES-07297-200162

Cairns-Lee H, Lawley J, Tosey P (2022) Enhancing researcher reflexivity about the influence of leading questions in interviews. J Appl Behav Sci 58:164–188. https://doi.org/10.1177/00218863211037446

Care O, Zaehringer JG, Bernstein MJ et al (2024) Reaping what we sow: centering values in food systems transformations research. Ambio. https://doi.org/10.1007/s13280-024-02086-5

Christie I, Fernandes E, Messerli H, Twining-Ward L (2014) Tourism in Africa: harnessing tourism for growth and improved livelihoods. The World Bank, Washington

Coscieme L, da Silva HH, Fernández-Llamazares Á et al (2020) Multiple conceptualizations of nature are key to inclusivity and legitimacy in global environmental governance. Environ Sci Policy 104:36–42. https://doi.org/10.1016/j.envsci.2019.10.018

Díaz S, Demissew S, Carabias J et al (2015) The IPBES conceptual framework—connecting nature and people. Curr Opin Environ Sustain 14:1–16. https://doi.org/10.1016/j.cosust.2014.11.002

Díaz S, Pascual U, Stenseke M et al (2018) Assessing nature's contributions to people. Science 359:270–272. https://doi.org/10.1126/science.aap8826

Ebner M, Fontana V, Schirpke U, Tappeiner U (2022) Stakeholder perspectives on ecosystem services of mountain lakes in the European Alps. Ecosyst Serv 53:101386. https://doi.org/10.1016/j.ecoser.2021.101386

Ely JW, Osheroff JA, Ebell MH et al (1999) Analysis of questions asked by family doctors regarding patient care. BMJ 319:358–361. https://doi.org/10.1136/bmj.319.7206.358

Ensslin A, Rutten G, Pommer U et al (2015) Effects of elevation and land use on the biomass of trees, shrubs and herbs at Mount Kilimanjaro. Ecosphere 6:1–15. https://doi.org/10.1890/ES14-00492.1

Environmental Systems Research Institute (ESRI) (2020) ArcGIS Pro

Felipe-Lucia MR, Martín-López B, Lavorel S et al (2015) Ecosystem services flows: why stakeholders' power relationships matter. PLoS One 10:e0132232. https://doi.org/10.1371/journal.pone.0132232

Fernandes ECM, Oktingati A, Maghembe J (1985) The Chagga Home gardens: a multi-storeyed agro-forestry cropping system on Mt. Kilimanjaro, Northern Tanzania. Food Nutr Bull 7:1–8. https://doi.org/10.1177/156482658500700311

Frömming UU (2009) Kilimanjaro's melting glaciers: on the colonial and postcolonial perception and appropriation of African nature1. Etnografica 13:395–416. https://doi.org/10.4000/etnografica.1158

Gadimova LS (2023) Synonyms as the semantic component of conversion. IJSSHR. https://doi.org/10.47191/ijsshr/v6-i3-03

García-Llorente M, Martín-López B, Díaz S, Montes C (2011) Can ecosystem properties be fully translated into service values? An economic valuation of aquatic plant services. Ecol Appl 21:3083–3103. https://doi.org/10.1890/10-1744.1

Gross M, Pearson J, Arbieu U et al (2023) Tourists' valuation of nature in protected areas: a systematic review. Ambio 52:1065–1084. https://doi.org/10.1007/s13280-023-01845-0

Hemp A, Buchroithner MF, Oleson E (2017) Kilimanjaro, Editorial deadline: November 2017. Institut für Kartographie TU Dresden, Dresden

Hemp C, Böhning-Gaese K, Fischer M, Hemp A (2018) The KiLi Project: Kilimanjaro ecosystems under global change: linking biodiversity, biotic interactions and biogeochemical ecosystem processes, 1. Auflage. Senckenberg Gesellschaft für Naturforschung, Frankfurt/Main

Hensler L, Merçon J, Vilsmaier U (2021) Diverse values and a common Utopia. Case Stud Environ 5:1234747. https://doi.org/10.1525/cse.2021.1234747

Hill R, Díaz S, Pascual U et al (2021) Nature's contributions to people: weaving plural perspectives. One Earth 4:910–915. https://doi.org/10.1016/j.oneear.2021.06.009

Holroyd M (2016) The political ecology of tourism development on Mount Kilimanjaro. In: Mostafanezhad M, Norum R, Shelton EJ, Thompson-Carr A (eds) Political ecology of tourism: community, power and the environment. Routledge is an imprint of the Taylor & Francis Group, an Informa Business, Abingdon, pp 251–269

Hrdina A, Romportl D (2017) Evaluating global biodiversity hotspots—very rich and even more endangered. J Landsc Ecol 10:108–115. https://doi.org/10.1515/jlecol-2017-0013

Jacobs S, Dendoncker N, Martín-López B et al (2016) A new valuation school: integrating diverse values of nature in resource and land use decisions. Ecosyst Serv 22:213–220. https://doi.org/10.1016/j.ecoser.2016.11.007

Jacobs S, Martín-López B, Barton DN et al (2018) The means determine the end—pursuing integrated valuation in practice. Ecosyst Serv 29:515–528. https://doi.org/10.1016/j.ecoser.2017.07.011

Jacobs S, Zafra-Calvo N, Gonzalez-Jimenez D et al (2020) Use your power for good: plural valuation of nature—the Oaxaca statement. Glob Sustain 3:e8. https://doi.org/10.1017/sus.2020.2

Jacobs S, Kelemen E, O'Farrell P et al (2023) The pitfalls of plural valuation. Curr Opin Environ Sustain 64:101345. https://doi.org/10.1016/j.cosust.2023.101345

Kadykalo AN, López-Rodriguez MD, Ainscough J et al (2019) Disentangling 'ecosystem services' and 'nature's contributions to people.' Ecosyst People 15:269–287. https://doi.org/10.1080/26395916.2019.1669713

Kaiser M (2024) The multi-dimensionality of value landscapes. Futures 158:103345. https://doi.org/10.1016/j.futures.2024.103345

Kitole FA, Sesabo JK (2024) Tourism-driven livelihood dynamics: a comprehensive empirical study of Mount Kilimanjaro National Park communities in Tanzania. Int J Geoheritage Parks 12:416–433. https://doi.org/10.1016/j.ijgeop.2024.07.001

Kockelkoren R, Bermudez-Urdaneta M, Restrepo Calle S (2023) Participatory mapping of local stakeholders' perceptions of nature's contributions to people in an intensified agricultural area in the Colombian Andes. Ecosyst People 19:2279584. https://doi.org/10.1080/26395916.2023.2279584

Kövecses Z (2010) Metaphor, language, and culture. DELTA 26:739–757. https://doi.org/10.1590/S0102-44502010000300017

Lau JD, Hicks CC, Gurney GG, Cinner JE (2018) Disaggregating ecosystem service values and priorities by wealth, age, and education. Ecosyst Serv 29:91–98. https://doi.org/10.1016/j.ecoser.2017.12.005

Louise Barriball K, While A (1994) Collecting data using a semi-structured interview: a discussion paper. J Adv Nurs 19:328–335. https://doi.org/10.1111/j.1365-2648.1994.tb01088.x

Maestre-Andrés S, Calvet-Mir L, van den Bergh JCJM (2016) Socio-cultural valuation of ecosystem services to improve protected area management: a multi-method approach applied to Catalonia, Spain. Reg Environ Change 16:717–731. https://doi.org/10.1007/s10113-015-0784-3

Magano NN, Tuorila H, De Kock HL (2023) Food choice drivers at varying income levels in an emerging economy. Appetite 189:107001. https://doi.org/10.1016/j.appet.2023.107001

Martín-López B, Montes C, Benayas J (2007) The non-economic motives behind the willingness to pay for biodiversity conservation. Biol Cons 139:67–82. https://doi.org/10.1016/j.biocon.2007.06.005

Martín-López B, Gómez-Baggethun E, García-Llorente M, Montes C (2014) Trade-offs across value-domains in ecosystem services assessment. Ecol Ind 37:220–228. https://doi.org/10.1016/j.ecolind.2013.03.003

Masao CA, Prescott GW, Snethlage MA et al (2022) Stakeholder perspectives on nature, people and sustainability at Mount Kilimanjaro. People Nat 4:711–729. https://doi.org/10.1002/pan3.10310

Meyer J, Gross M, Martín-López B et al (2023) Outreach Posters for the PreliminaryResults of the Project "Demand and Values of Nature's Contributions to People (NCP)"embedded within the DFG Research Unit "The role of nature for human well-being inthe Kilimanjaro Social-Ecological System (Kili-SES)". Leuphana Universität Lüneburg. https://doi.org/10.48548/pubdata-78

Misana SB, Majule AE, Lyaruu HV (2003) Linkages between changes in land use, biodiversity and land degradation on the slopes of Mount Kilimanjaro, Tanzania. International Livestock Research Institute, Nairobi, Kenya

Nicolás-Ruiz N, Quintas-Soriano C, Suárez ML, Rosario Vidal-Abarca M (2023) Co-production of nature's contributions to people in dry rivers: a case study in Murcia. Spain Ecosyst People 19:2288953. https://doi.org/10.1080/26395916.2023.2288953

Pearson J, Gross M, Hofmann J (2024) Non-material contributions of nature expressed by former tourists of Mount Kilimanjaro, Tanzania. People Nat. https://doi.org/10.1002/pan3.10575

Platania M, Rizzo M (2018) Willingness to pay for protected areas: a case of Etna Park. Ecol Ind 93:201–206. https://doi.org/10.1016/j.ecolind.2018.04.079

Price CP, Christenson RH (2013) Ask the right question: a critical step for practicing evidence-based laboratory medicine. Ann Clin Biochem 50:306–314. https://doi.org/10.1177/0004563213476486

Ramos A, Jujnovsky J, Almeida-Leñero L (2018) The relevance of stakeholders' perceptions of ecosystem services in a rural-urban watershed in Mexico City. Ecosyst Serv 34:85–95. https://doi.org/10.1016/j.ecoser.2018.10.003

Rutten G, Ensslin A, Hemp A, Fischer M (2015) Vertical and horizontal vegetation structure across natural and modified habitat types at Mount Kilimanjaro. PLoS One 10:e0138822. https://doi.org/10.1371/journal.pone.0138822

Said M, Komakech HC, Munishi LK, Muzuka ANN (2019) Evidence of climate change impacts on water, food and energy resources around Kilimanjaro, Tanzania. Reg Environ Change 19:2521–2534. https://doi.org/10.1007/s10113-019-01568-7

Salomon AK, Okamoto DK, Wilson Kii'iljuus Barbara J et al (2023) Disrupting and diversifying the values, voices and governance principles that shape biodiversity science and management. Philos Trans R Soc B 378:20220196. https://doi.org/10.1098/rstb.2022.0196

Saltelli A, Benini L, Funtowicz S et al (2020) The technique is never neutral. How methodological choices condition the generation of narratives for sustainability. Environ Sci Policy 106:87–98. https://doi.org/10.1016/j.envsci.2020.01.008

Schuman H, Presser S (1981) Questions and answers in attitude surveys: experiments on question form, wording, and context. Academic Press, New York

Schwarz N (1999) Self-reports: how the questions shape the answers. Am Psychol 54:93–105. https://doi.org/10.1037/0003-066X.54.2.93

Sébastien L (2010) The Chagga people and environmental changes on Mount Kilimanjaro: lessons to learn. Clim Dev 2:364–377. https://doi.org/10.3763/cdev.2010.0055

Soini E (2005) Changing livelihoods on the slopes of Mt. Kilimanjaro, Tanzania: challenges and opportunities in the Chagga homegarden system. Agrofor Syst 64:157–167. https://doi.org/10.1007/s10457-004-1023-y

Tanzania National Parks (TANAPA) (2022) Mission and vision. https://www.tanzaniaparks.go.tz/pages/mission-and-vision. Accessed 8 May 2023

Tanzania National Parks (2023) KILIMANJARO NATIONAL PARK Celebrating the Golden Anniversary in Biodiversity Conservation and Tourism

Tauro A, Gómez-Baggethun E, García-Frapolli E et al (2018) Unraveling heterogeneity in the importance of ecosystem services: individual views of smallholders. E&S 23:11. https://doi.org/10.5751/ES-10457-230411

Termansen M, Jacobs S, Mwampamba TH, et al (2022) Chapter 3. The potential of valuation. Zenodo. https://zenodo.org/record/6521298

Topp EN, Loos J, Martín-López B (2022) Decision-making for nature's contributions to people in the Cape Floristic Region: the role of

values, rules and knowledge. Sustain Sci 17:739–760. https://doi.org/10.1007/s11625-020-00896-6
Totino M, Urdampilleta CM, Ithuralde RE et al (2023) A methodological approach for the analysis of ecosystem services from the local communities' perspective. Ambio 52:786–801. https://doi.org/10.1007/s13280-022-01807-y
Treece EMW, Treece JW (1986) Elements of research in nursing, 4th edn. Mosby, St. Louis
United Republic of Tanzania (2018) Kilimanjaro Region Investment Guide
United Republic of Tanzania (2022) Ministry of Natural Resources and Tourism-Maliasili statistical bulletin
Vatn A (2005) Rationality, institutions and environmental policy. Ecol Econ 55:203–217. https://doi.org/10.1016/j.ecolecon.2004.12.001
Vatn A (2009) An institutional analysis of methods for environmental appraisal. Ecol Econ 68:2207–2215. https://doi.org/10.1016/j.ecolecon.2009.04.005
Vatn A, Bromley DW (1994) Choices without prices without apologies. J Environ Econ Manag 26:129–148. https://doi.org/10.1006/jeem.1994.1008
VERBI Software (2021) MAXQDA 2022
Wamucii CN, van Oel PR, Ligtenberg A et al (2021) Land use and climate change effects on water yield from East African forested water towers. Hydrol Earth Syst Sci 25:5641–5665. https://doi.org/10.5194/hess-25-5641-2021
West S, Schill C (2022) Negotiating the ethical-political dimensions of research methods: a key competency in mixed methods, inter- and transdisciplinary, and co-production research. Humanit Soc Sci Commun 9:294. https://doi.org/10.1057/s41599-022-01297-z
Yuliani EL, Moeliono M, Labarani A et al (2023) Relational values of forests: value-conflicts between local communities and external programmes in Sulawesi. People Nat 5:1822–1838. https://doi.org/10.1002/pan3.10389
Zafra-Calvo N, Balvanera P, Pascual U et al (2020) Plural valuation of nature for equity and sustainability: insights from the Global South. Glob Environ Change 63:102115. https://doi.org/10.1016/j.gloenvcha.2020.102115

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