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Plural valuation in southwestern Ethiopia: Disaggregating values associated with ecosystems in a smallholder landscape

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Abstract

1. Recognizing the diversity of preferences for, and values ascribed to, ecosystems in decision-making can help to realize more sustainable and equitable policies for transformative change.
2. The goal of this paper was to assess how rankings of ecosystem products (i.e. their relative importance in people's lives) relate to people's individual characteristics, their social–ecological context and the values they ascribe to each ecosystem product.
3. In our case study in southwestern Ethiopia, we considered 11 ecosystem products and four value types (direct use, exchange, relational, intrinsic). We used descriptive statistics, hierarchical clustering and chi-square tests of independence to analyse the data.
4. On average, maize and teff were ranked as most important, and direct use and relational value were the most important value types. Beneficiaries often ascribed multiple values to each ecosystem product, and direct use and relational values better explained overall importance rankings than exchange or intrinsic values.
5. Five groups of beneficiaries, who each prioritized a different set of ecosystem products, differed in their occupation, and in their social–ecological context, in terms of the villages they lived in and the ecosystem products they produced. Beneficiaries in each of the five groups ascribed different value types to their prioritized ecosystem products, and these did not always align with the value types that were generally judged most important by the group.
6. We recommend that sustainable landscape management should reflect the diversity of people's value ascription, including non-exchange values.

KEYWORDS
disaggregation, ecosystem services, Ethiopia, plural valuation, smallholder landscape, sociocultural values

1 | INTRODUCTION

Recognizing the multiple values associated with human–nature interactions can help generate more equitable and sustainable actions for transformative change (Beery et al., 2021; Zafra-Calvo et al., 2020). There are multiple conceptual frameworks for describing, categorizing and valuing those human–nature interactions, for example, ecosystem services (ES, Millennium Ecosystem Assessment, 2005), or nature's contributions to people (NCP, Díaz et al., 2018), each with their own strengths and weaknesses. For conceptual clarity, we choose to frame such human–nature interactions in terms of ES (defined here as the benefits obtained by humans from their interactions with ecological structures and functions, Millennium Ecosystem Assessment, 2005) as a widely used and understood approach in both science and practice.

During assessments of ES, relevant insights are often lost when aggregating data across groups of people (Arias-Arévalo et al., 2018; Spangenberg & Settele, 2010). Among others, the relative importance of ES can differ between women and men (Coelho-Junior et al., 2021; Lau et al., 2019), wealth groups (Lau et al., 2018; Tadesse et al., 2014), urban and rural populations (Arias-Arévalo et al., 2017; Lapointe et al., 2020) and between different types of occupation (Brooks et al., 2014; Horcea-Milcu et al., 2016). The relative importance of ES to people's livelihoods can also be shaped by their social–ecological context, for example, by people's main livelihood or productive activities, or their local surroundings (Reyes-Arroyo et al., 2021; Tauro et al., 2018). For equity concerns, it is therefore important that ES assessments are disaggregated by beneficiary groups (Brück et al., 2022).

Similarly, ES valuations that aggregate across value types, focus solely on monetary or exchange values or subsume plural values into one commensurable metric are problematic for understanding the complex way values are ascribed to ES (Arias-Arévalo et al., 2018; Spangenberg & Settele, 2010). For example, monetary values often do not reflect well the actual relative importance of ES in people's lives (Brooks et al., 2014; Tadesse et al., 2014). Instead, people hold a plurality of values, and instrumental values are sometimes considered less important than other value types (Arias-Arévalo et al., 2017; Topp et al., 2021), such as relational values (the preferences, principles and virtues associated with relationships, both interpersonal and as articulated by policies and social norms; Chan et al., 2016, 2018).

Here, we assume that each ES may provide multiple benefits and be valued for a range of different reasons (Chan et al., 2012; also termed 'bundled' values or benefits; Hoehn et al., 2003; Klain et al., 2014). For example, an ethnographic study in Ethiopia showed that coffee has numerous sociocultural benefits in addition to being an important exchange commodity, such as being a medium for conflict resolutions and a local traditional medicine (Bulitta & Duguma, 2021). Thus, people may ascribe a range of values, including instrumental, relational and intrinsic values, to coffee. Even in monetary valuation approaches, such as discrete choice experiments, that acknowledge the bundled values associated with ES, the use of a single commensurable metric (exchange value) for ES valuation is problematic, because it is based on the implicit assumption that the different sorts of values ascribed to ES are substitutable (Arias-Arévalo et al., 2018; Spangenberg & Settele, 2010). Here, we assume that those multiple ascribed values are non-substitutable and need to be valued individually, assessing not just the 'strength' of those values but also how they relate to each other and to overall value ascription (Chan et al., 2016; Pascual et al., 2017). Therefore, valuation approaches that acknowledge and elicit plural value ascription (disaggregation by value type) are also crucially important (Brück et al., 2022). In the absence of such pluralistic, disaggregated assessments it is possible ecosystems will be optimized for a single type of value (such as exchange value) at the 'system' level. This could happen at the expense of other important values associated with those ecosystems, and the equitable distribution of the benefits ascribed to those ES.

Different research approaches that capture this plurality facilitate the assessment of relative importance of ES and the values ascribed to nature from a disaggregated perspective, including comparisons between different beneficiary groups and value types (Arias-Arévalo et al., 2018; Zafra-Calvo et al., 2020). The relative importance of ES can be assessed, for example, through ranking exercises, Likert scale ratings, Q sorts or the distribution of counters (Hartel et al., 2014; Hicks et al., 2015; Maniatakou et al., 2020; Tauro et al., 2018). Values ascribed to nature can be elicited and disaggregated through qualitative (e.g. narrative approaches, interviews, participant observation; Arias-Arévalo et al., 2017; Coelho-Junior et al., 2021; Topp et al., 2021) or quantitative approaches (e.g. rating value statements, Q methodology; Gale & Ednie, 2020; Inglis et al., 2021; Klain et al., 2017; Riechers, Balázsi, et al., 2021). A range of case studies have already qualitatively investigated why (for which reasons or values) ES or nature matter to people (Arias-Arévalo et al., 2017; Lau et al., 2019; Maniatakou et al., 2020; Tauro et al., 2018), but quantitative investigations remain scarce. With regard to quantitative approaches, disentangling the relationship between the relative importance of ES and the specific values ascribed to those services can deliver additional important information on the reasons why people prioritize certain ES (Schutter et al., 2021).

In this paper, we focus on the relative importance of, and the multiple types of values people ascribe to, specific products (such as coffee) appropriated from ecosystems rather than on specific types of ES those products provide (e.g. cultural, provisioning etc.). We do this because many of those ecosystem products provide multiple types of ES, and people in our study area typically ascribe values to the products themselves rather than the ES associated with them. Therefore, to provide conceptual clarity, where appropriate, we refer to 'ecosystem products' rather than ES. We seek to assess not only the relative importance of a range of ecosystem products, or the different value types ascribed to nature in general, but we quantitively explore the relationship between rankings of ecosystem products and individual value ascription. Assessing the diversity of values ascribed to ecosystem products supports a more holistic understanding of their importance, by understanding the reasons for which ecosystem products are valued, and also how well values ascribed to ecosystem products are reflected in rankings of general importance.

The goal of this paper is to assess how rankings of ecosystem products (according to their general importance in people's lives) relate to people's individual characteristics, their social–ecological context and the types of values they ascribe to each ecosystem product. Through a case study in southwestern Ethiopia, we address the following aims:

1. To assess, in general, the relative importance that people ascribe to different ecosystem products and to different value types;
2. To assess, more specifically, the value types people ascribe to each ecosystem product, and how they relate to the relative importance of ecosystem products;
3. To assess the influence of individual characteristics and contexts on the relative importance of ecosystem products, by identifying main groups of beneficiaries based on their ecosystem product rankings, and by assessing differences in their individual characteristics and social–ecological context.

2 | METHODS

2.1 | Study area

The study area consisted of three woredas (districts), in Jimma Zone, Oromia Region, Ethiopia, namely Gera, Gumay and Setema woreda (Figure 1). The landscape is characterized by a mosaic of farmland and moist evergreen Afromontane forest (Hylander et al., 2013) and is a recognized biodiversity hotspot (Mittermeier et al., 2011). Local smallholders are especially dependent on nature, for subsistence and income generation (Schultner et al., 2021; Shumi et al., 2019), but local ecosystems also provide benefits of global importance (de Beenhouwer et al., 2016). The landscape is undergoing rapid social–ecological change due to different drivers, such as population growth, land use change and climate change (Jiren et al., 2020). In this context, it is important to understand which ecosystem products are important to local people and why, in order to inform decision-making for sustainable land management.

2.2 | Data collection

The study was approved by the Leuphana ethics review committee (EB-Antrag_202111-15-Abson_ ESValues). In November and December 2021, we collected data on the relative importance of ecosystem products and the values ascribed to them through a questionnaire. To investigate the role of social–ecological context, the 78 kebeles (smallest administrative units in Ethiopia) in our study area were clustered into four social–ecological groups, based on a range of ecological and social variables, including land use and land cover data, altitude, remoteness and wealth. The pasture–cropland, the khat–cropland, the woody vegetation and the accessible–wealthy group were characterized, respectively, by high availability of pasture and arable land, by high availability of khat (a popular plant stimulant) and arable land, by high extent of woody vegetation cover and by being relatively accessible and wealthy (Duguma et al., 2022). We then selected eight kebeles—two from each social–ecological group (Figure 1, Table S1). We additionally selected one town, which belongs to the accessible–wealthy group, to reflect non-farmers in the sample.

We applied stratified sampling to achieve equally sized groups of women and men, and convenience sampling within each stratum, where respondents were approached randomly. We obtained verbal informed consent from each participant (to overcome barriers related to illiteracy and anonymity). A final sample of 316 participants answered questions regarding the relative importance of ecosystem products, whereas only a subsample of 164 participants answered additional questions regarding values due to time restrictions. The full sample of 316 participants remained below the threshold of 385 required participants for a representative sample (study area population of roughly 270,000 people, 95% confidence level, 5% margin of error), due to resource constraints and security issues. However, the final sample represented the study area's population relatively well in terms of gender and occupation. Approximately 89% of the population in Jimma Zone are smallholder farmers (Jiren et al., 2020), compared to 89.5% in our sample. Approximately half of the total population in Jimma Zone are women (Central Statistical Agency, 2007), compared to 46% in our sample.

We selected 11 ecosystem products that we knew were important to the local people from previous research in the study area, namely beef, biodiversity, cattle, coffee, eucalyptus, firewood, honey, khat, maize, sorghum and teff, to be included in our questionnaire. We distinguished between two inherently different types of livestock, namely between cattle kept as draft animals or as a capital asset versus cattle used specifically for beef fattening (i.e. for meat production). We also included ecosystem products stemming from the use of woody plants, namely eucalyptus (*Eucalyptus* spp.), firewood and honey (Shumi et al., 2019). Coffee (*Coffea arabica*) and khat (*Catha edulis*) are the main cash crops in the study area, whereas maize (*Zea mays*), sorghum (*Sorghum bicolor*) and teff (*Eragrostis tef*) are the main food crops in the study area (Manlosa et al., 2019). Biodiversity delivers important local and global benefits (de Beenhouwer et al., 2016).

A multitude of frameworks exists for the categorization of values, for example, the Total Economic Value (TEV) or The Economics of Ecosystems and Biodiversity (TEEB) framework (Jacobs et al., 2018; TEEB, 2010; Turner et al., 2003). In this paper, we followed the IPBES framework (Pascual et al., 2017), and considered instrumental, relational and intrinsic values (Chan et al., 2016; Himes & Muraca, 2018). Within the instrumental value category, we differentiated between direct use value (which people obtain from directly consuming an ecosystem product) and exchange value (which people obtain from selling or trading

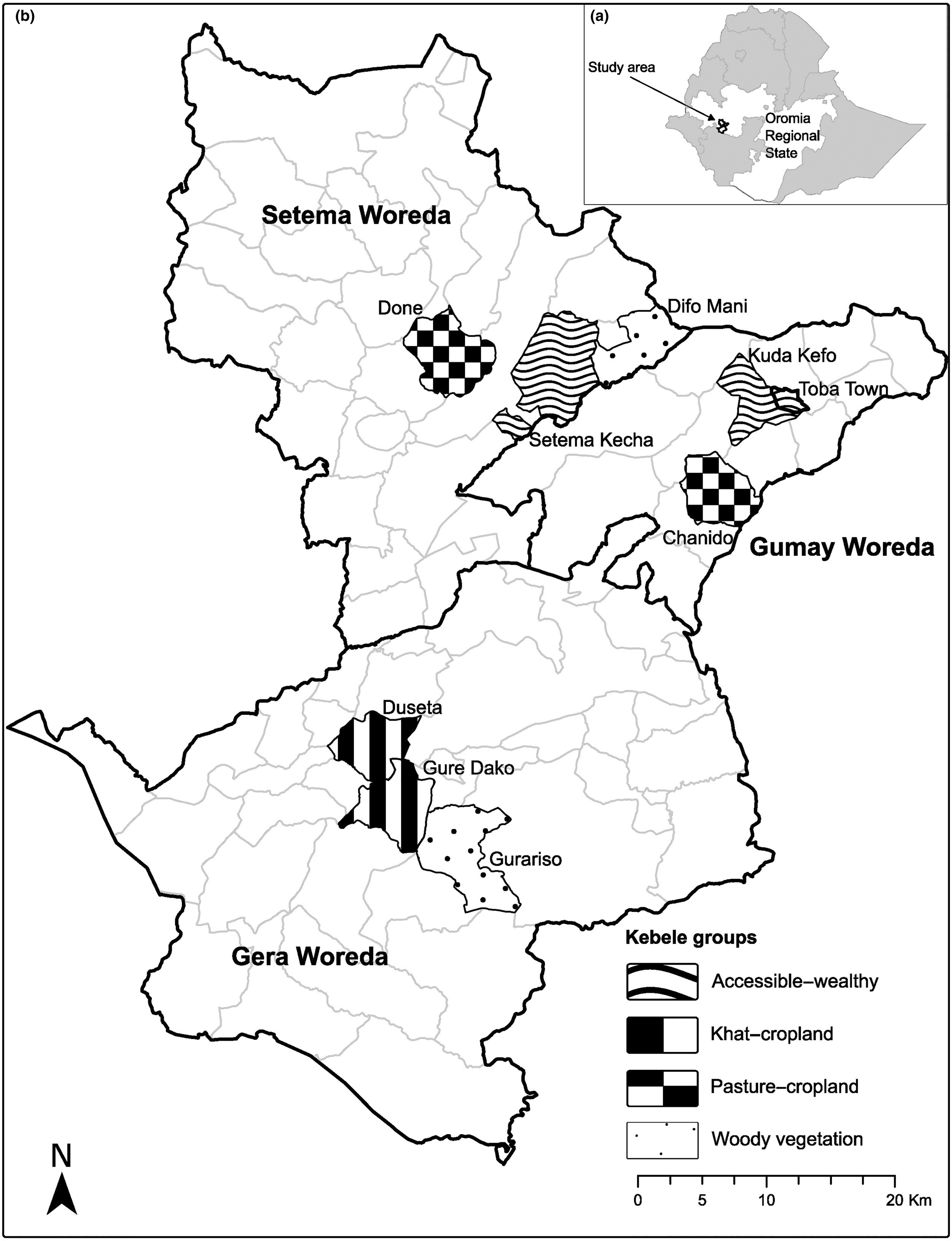

FIGURE 1 Map of the study area, which is situated in Oromia regional state in Ethiopia (a). Data were collected in eight kebeles (smallest administrative units in Ethiopia) and one town in three different woredas (districts) (b). Each kebele belongs to one of four social-ecological kebele groups (see Section 2.2).

ecosystem products). Relational values encompass both human–nature relationships and human–human relationships that are mediated by nature (Chan et al., 2016, 2018; Himes & Muraca, 2018). Among the many different types of relational values, we chose to focus on the social aspect of the production or consumption of ecosystem products which brings people together ('social cohesion'). We understood intrinsic value as the value that nature has in and of itself (inherent value), independent of human benefit (Chan et al., 2016). We thus included four value types: exchange, direct use, relational and intrinsic value (Table 1).

The questionnaire was translated into the local language Afaan Oromoo and consisted of three parts (see full questionnaire in Supporting Information). In the first part, participants were asked about their kebele, their gender, wealth (number of cattle, land size and type of housing as potential proxies) and occupation as well as the ecosystem products they produced and consumed. The second part was a picture-based ranking exercise to assess the general importance of the 11 ecosystem products to participants' livelihoods (Figure 2). Here, participants were asked to rank pictures of the ecosystem products based on their general importance to them. Such a picture-based ES ranking, also called ES card game, is a sociocultural preference assessment method (Jacobs et al., 2018), which has already been applied in other studies (Martín-López et al., 2012; Tauro et al., 2018), and is an efficient and quick way to gather information. The third part of the questionnaire consisted of distributing tokens, to assess the value types ascribed to each ecosystem product (Figure 2). Prompted by one specific question for each value type (e.g. 'How important is each natural product or benefit to you because you directly use or consume it?' for direct use value), participants were asked to distribute 30 tokens between the 11 ecosystem products for each of the four value types. Participants were allowed to leave some or all tokens undistributed (if the value type was relatively unimportant to them). This thus resulted in a weighted ranking of the 11 ecosystem products for each of the four value types.

2.3 | Data analysis

Data were analysed using R version 4.1.3 (R Core Team, 2022; main R packages used are indicated in the text, information on additional packages can be found in Supporting Information). We checked the data for missing values and inconsistencies. If a participant had indicated that an ecosystem product was unimportant (and therefore was not included in the picture ranking), we replaced the missing rank

TABLE 1 Definition of value types as used in this paper, based on Chan et al. (2016) and Pascual et al. (2017).

Value type	Definition
Direct use	Instrumental value obtained from directly using or consuming an ecosystem product
Exchange	Instrumental value obtained from selling or trading an ecosystem product
Relational	Value of the social aspect of ecosystem product production or consumption, that is 'social cohesion'; the human–human relationship mediated by an ecosystem product
Intrinsic	Value that an ecosystem product has in and of itself (inherent value), independent of human benefit

FIGURE 2 Stylized version of the data sheet used in the questionnaire (for more details, see Supporting Information). In the first column, the participant ranked pictures of the 11 ecosystem products by their general importance to their livelihood. Each of the following columns represents one value type (direct use, exchange, relational, intrinsic). For each value type, participants distributed 30 tokens (coffee beans) between the 11 ES, to indicate a weighted ranking of the ecosystem products in each value type.

by 11 (the lowest possible rank), and assumed that the number of tokens ascribed to the ecosystem product was 0 for all value types. If a participant had indicated for one or more ecosystem products that they did not want to answer questions related to that ES, we kept the missing values due to lack of information. To ensure consistency of the data, we made some adjustments to the number of tokens where necessary (see data processing in Supporting Information).

In order to assess the relative importance of ES, we calculated the median rank and interquartile range (IQR) for each ecosystem product based on the picture-based ranking. Based on the subsample of 164 participants, we assessed the relative importance of value types by calculating the mean number of distributed tokens for each of the four value types (more distributed tokens = more importance). To assess the values participants ascribed to individual ecosystem products, we calculated the mean number of tokens attributed to each ecosystem product in each value type.

To reduce the dimensionality of our disaggregated data, we clustered participants based on their picture-based ranking of ecosystem products into beneficiary groups. We applied hierarchical clustering with Kendall distance to account for the ordinal data structure, and Ward clustering method (Dist in R package amap; Lucas, 2019). Here, we excluded 19 observations due to missing information about the rank of one or more ES. We chose five beneficiary groups based on group interpretability and multiple statistical tests, including the Calinski-Harabasz criterion and the Dunn index, which helped to determine the optimal number of clusters and to assess the strength of the clustering structure (Figure S1). For each of the five beneficiary groups, we calculated the deviation from the overall median rank for each ecosystem product. We also calculated the relative importance of each value type and the values participants ascribed to individual ecosystem products as well as the respective deviations from the overall sample means.

We evaluated whether there was a significant association between the beneficiary groups and the participants' individual characteristics or their social–ecological context (gender, wealth, occupation, social–ecological kebele group) by applying a chi-square test of independence. Where the expected frequency in any cell was smaller than 5, we computed p-values by Monte Carlo simulation with 2000 replicates. In addition, we calculated Pearson residuals (absolute standardized residuals) for each cell to assess their contribution to the overall chi-square score. Cells with the highest Pearson residuals contribute the most to the total chi-square score, where positive/negative values specify an attraction/repulsion (positive/negative association) between the corresponding row and column variables. We decided to use number of cattle as a measure of wealth, and split the variable at its median to create two groups (see data processing in Supporting Information). For each beneficiary group, we also calculated the average number of ecosystem products produced or consumed per participant as well as the share of beneficiaries in each group that produced and consumed each ES.

3 | RESULTS

3.1 | Ecosystem product and value type rankings (overall sample means)

The picture-based rankings showed clear differences in relative importance between the individual ecosystem products (Figure 3). For example, maize and teff were ranked as the most important

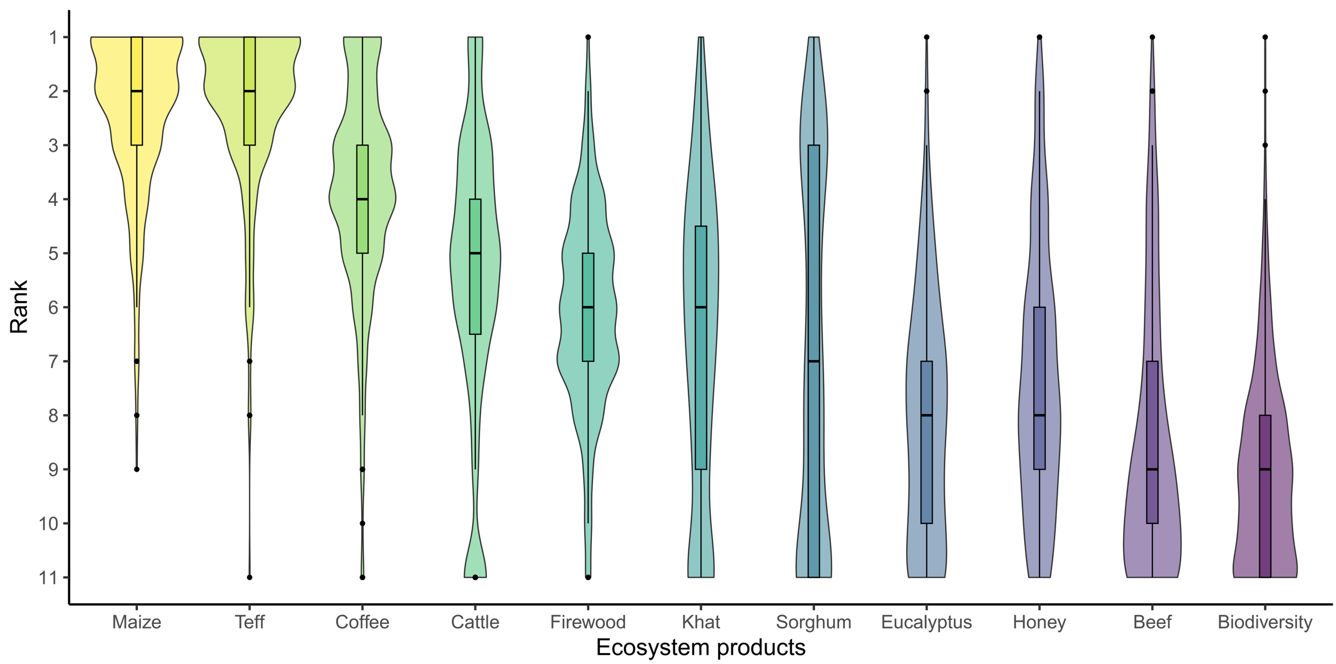

FIGURE 3 Box and violin plots of ecosystem product rankings based on the picture-based ranking, where participants were asked to rank pictures of 11 ecosystem products based on their general importance ($n = 316$).

ecosystem products (median = 2, IQR = 3–1), whereas biodiversity was ranked lowest (median = 9, IQR = 11–8). The distributions of the rankings for each ecosystem product were also different from each other (Figure 3). For example, firewood had a median rank of 6 (IQR = 7–5), and most people gave it a relatively moderate ranking. Sorghum had a median rank of 7 (IQR = 11–3), whereas the individual rankings tended to be either high or low.

Participants (in the subsample, $n = 164$) ascribed most importance to direct use value (mean of 29.85 distributed tokens), followed by relational value (27.33 tokens). Exchange value was much less important to participants (17.75 tokens), with least importance ascribed to intrinsic value (11.46 tokens).

Participants valued the 11 ecosystem products for different reasons (Figure 4). For five of 11 ecosystem products (teff, maize, firewood, sorghum, honey), participants on average ascribed most importance to their direct use value, followed by relational, exchange and intrinsic value. For coffee, most importance was ascribed to its exchange value, followed by relational, direct use and intrinsic value, whereas for khat, relational value was most important, followed by exchange, direct use and intrinsic value. For cattle, eucalyptus and beef, direct use, exchange and relational value were ascribed relatively equal importance (less than 0.5 tokens difference), but with intrinsic value still being least important. Only for biodiversity, participants ascribed most importance to its intrinsic value, followed by direct use, relational and exchange value.

The four value types ascribed to the ecosystem products reflected their relative importance to varying degrees. In Figure 4, ecosystem products were ordered by their median rank based on the picture-based ranking. Hence, if a value type reflected the overall ranking well, we should see a gradient from light to dark. Direct use and relational value were better predictors of overall ranking than exchange and intrinsic value.

3.2 | Ecosystem product and value type rankings for five beneficiary groups

The five beneficiary groups were named according to their prioritization of certain ecosystem products: the cereal croppers, the cash croppers, the livestock owners, the forest users and the diverse users (Figure 5, Table 2).

The *cereal croppers* and the *cash croppers* group both accounted for 34% of the participants, and ranked sorghum and maize, or khat, coffee and cattle higher than the overall median rank. The *livestock owners* group consisted of 12% of the participants who ranked cattle and beef higher than the overall median rank. Ten per cent of the participants were included in the *forest users* group, and ranked honey and coffee much higher than the overall median rank. The *diverse users* group with 9% of the participants was characterized by higher ranks for a broad range of different types of ecosystem products (beef, firewood, honey, teff and coffee).

The five beneficiary groups differed in their individual characteristics, their social–ecological context (in terms of the kebeles participants lived in, and the ecosystem products they produced

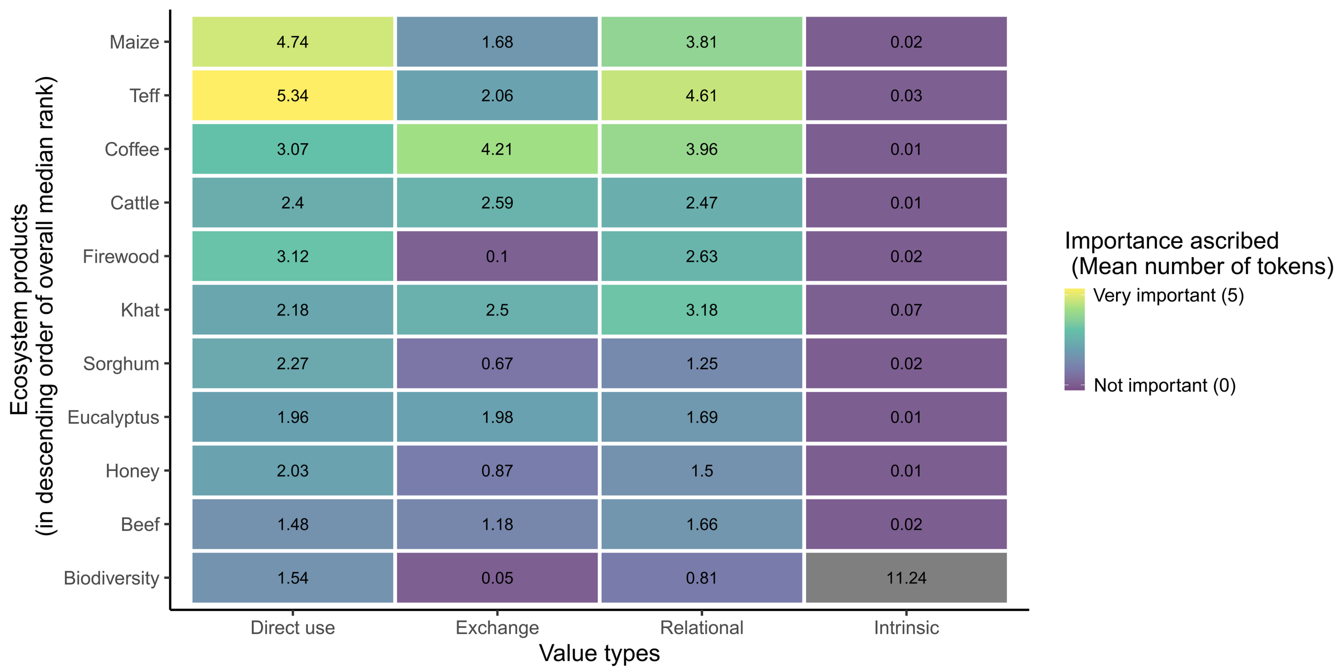

FIGURE 4 Importance ascribed to each ecosystem product within four value types, based on mean number of tokens attributed ($n = 164$). Participants were asked to indicate a weighted ranking of 11 ecosystem products for each value type by distributing 30 tokens within each value type. The lighter the colour, the more important the ecosystem product. ES products are sorted by their overall median rank based on the picture-based ranking. The intrinsic value of biodiversity is indicated in grey due to design considerations, as the inclusion of its very high relative value in the colour scale would have rendered other values indistinguishable.

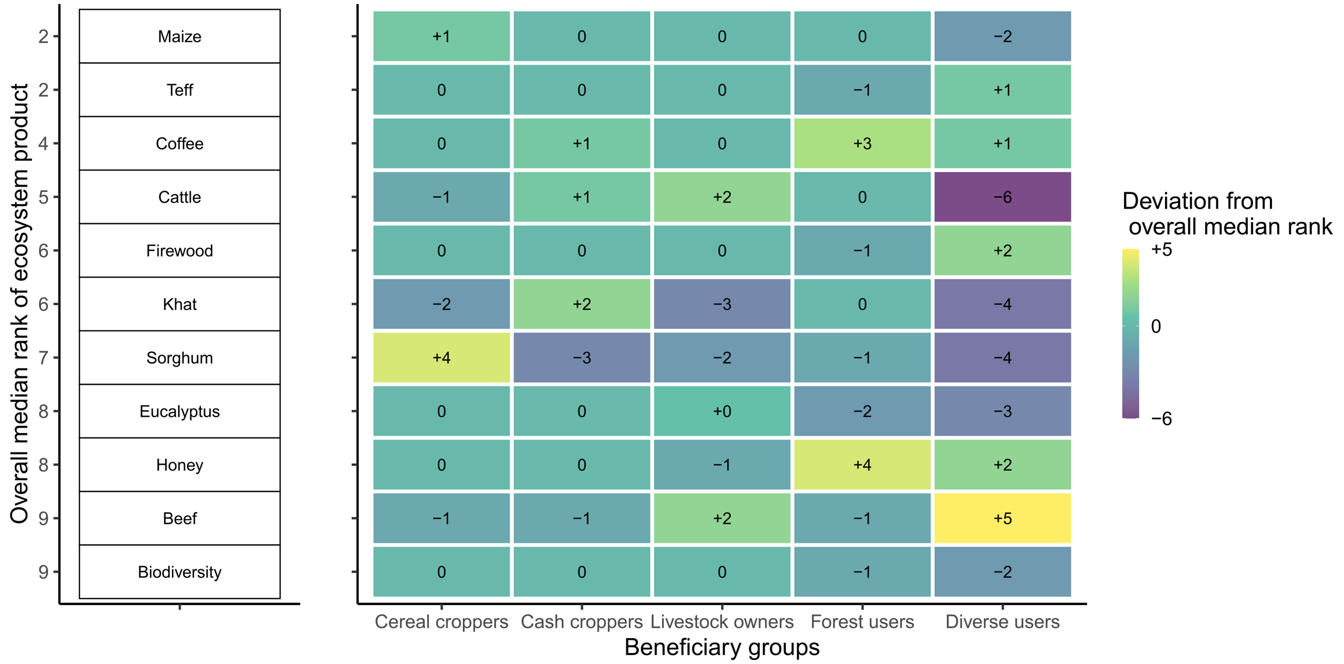

FIGURE 5 Ecosystem products sorted by their overall median rank based on the picture-based ranking, and deviations from these overall median ranks for each of five beneficiary groups ($n = 297$). Participants were clustered into five groups based on their picture-based ranking of ecosystem products. The lighter the colour, the more positive the deviation.

and consumed), and in how they ascribed value types to ecosystem products (Table 2). The beneficiary groups were associated with occupation (being a farmer or not; χ-squared = 100.4, df = NA, p-value <0.01—with simulated p-value), with a strong positive association between *diverse users* and non-farmers (Figure S2). However, they were not associated with any other individual characteristic (Table 2). There was no significant association between the beneficiary groups and gender (χ-squared = 3.0593, df = 4, p-value = 0.55) or wealth (χ-squared = 5.9546, df = NA, p-value = 0.19—with simulated p-value).

Regarding the social–ecological context, the beneficiary groups were associated with the social–ecological groups of kebeles that participants lived in (χ-squared = 115.85, df = 12, p-value <0.01). Besides some weaker associations (0 < Pearson residual <1), we found strong positive associations (Pearson residual >1) between the *cereal croppers* and the *forest users* and the *woody vegetation* kebele group, the *cash croppers* and the *khat-cropland* group, the *livestock users* and the *pasture-cropland* group, and between the *diverse users* and the *accessible–wealthy* group (Table 2, Figure S3).

Most participants consumed and produced almost all 11 ecosystem products (Table S2). The *forest users* had the highest average production and consumption richness (8.45 ecosystem products produced and 10.71 consumed), whereas the *diverse users* had the lowest respective values (2.81 and 8.04; Table 2). The relative importance of ecosystem products in each beneficiary group was more reflected by ecosystem product production rather than their consumption, except for the *diverse users* (Table 2, Table S2).

Whereas the overall order of relative importance of the four value types remained the same in each group (direct use value > relational value > exchange value > intrinsic value), they still differed in the exact importance they ascribed to each value type (Figure 6b, Table 2). The beneficiary groups showed no differences for direct use value. Relational value was comparatively more important to *cash croppers* and *forest users*, and less important to *diverse users*. Exchange value was comparatively more important to *cereal croppers* and *forest users*, and again less important to the *diverse users*. Intrinsic value was comparatively important to *cereal croppers*, less important to *forest users* and again least important to *diverse users*.

Participants in each of the five beneficiary groups ascribed different types of values to their prioritized ecosystem products (Table 2, Figures S4–S8). For example, the *cereal croppers* ranked sorghum comparatively high, and they ascribed more importance to its direct use and its relational value than participants in the other groups. The *cash croppers* ranked khat relatively high, and ascribed more importance to its exchange value. The *forest users* ranked honey and coffee comparatively high, and the exchange value of coffee and honey and the relational value of honey were more important to them than to participants in the other groups. The *diverse users* ranked inter alia beef, teff and coffee comparatively high, and they ascribed more importance to the direct use value of these ecosystem products, and to the relational value of coffee.

4 | DISCUSSION

We investigated the relative importance and the plural values that beneficiaries in rural southwestern Ethiopia ascribed to ecosystem products, and the influence of individual and social–ecological contexts on the relative importance of ecosystem products. We discuss

TABLE 2 Ecosystem product rankings, individual characteristics, social–ecological context and values ascribed to ecosystem products for five beneficiary groups ($n=297$).

Beneficiary group	Cereal croppers	Cash croppers	Livestock owners	Forest users	Diverse users
Number of beneficiaries	102	101	36	31	27
Picture-based ecosystem product ranking					
Ecosystem products ranked comparatively high	Sorghum, maize	Khat, coffee, cattle	Cattle, beef	Honey, coffee	Beef, firewood, honey, teff, coffee
Ecosystem products ranked comparatively low	Beef, cattle, khat	Beef, sorghum	Honey, sorghum, khat	Teff, firewood, sorghum, beef, biodiversity, eucalyptus	Maize, biodiversity, eucalyptus, khat, sorghum, cattle
Individual characteristics					
Occupation					
Farmer %	94[a]	96[a]	100[a]	97[a]	37
Non-farmer %	6	4	0	3	63[b]
Gender					
Women %	50	41	53	42	52
Men %	50	59	47	58	48
Wealth					
Wealthy %	51	65	67	68	50
Poor %	49	35	33	32	50
Social–ecological context					
Social–ecological kebele group					
Pasture–cropland %	24[a]	26[a]	36[b]	3	15
Khat–cropland %	11	46[b]	28[a]	16	0
Woody vegetation %	35[b]	6	11	65[b]	7
Accessible–wealthy %	30[a]	23	25	16	78[b]
Ecosystem product production richness	7.29	7.87	7.92	8.45	2.81
Ecosystem product consumption richness	10.17	10.34	9.89	10.71	8.04
Main producers of	Sorghum	Khat, maize, teff	Beef, cattle, eucalyptus	Biodiversity, coffee, firewood, honey, maize	-
Values based on token distribution ($n=164$; deviations by more than one token from overall mean number)					
Relative importance of VTs	+EX +INT	+REL	—	+REL +EX −INT	−REL −EX −INT
Importance ascribed to each ecosystem product within VT	+DU sorghum +REL sorghum +INT biodiversity	+EX khat	—	+EX coffee/honey +REL honey -INT biodiversity	+DU beef/coffee/teff −DU cattle/sorghum −EX cattle/coffee/khat +REL coffee −REL cattle/eucalyptus/firewood/maize/sorghum/teff −INT biodiversity

Note: Clustering was based on participants' picture-based ecosystem product rankings.Abbreviations: DU, direct use value; EX, exchange value; INT, intrinsic value; REL, relational value; VT, value type(s).

[a]Positive association based on chi-square test (1 > Pearson residual >0).

[b]Strong positive association based on chi-square test (Pearson residual >1).

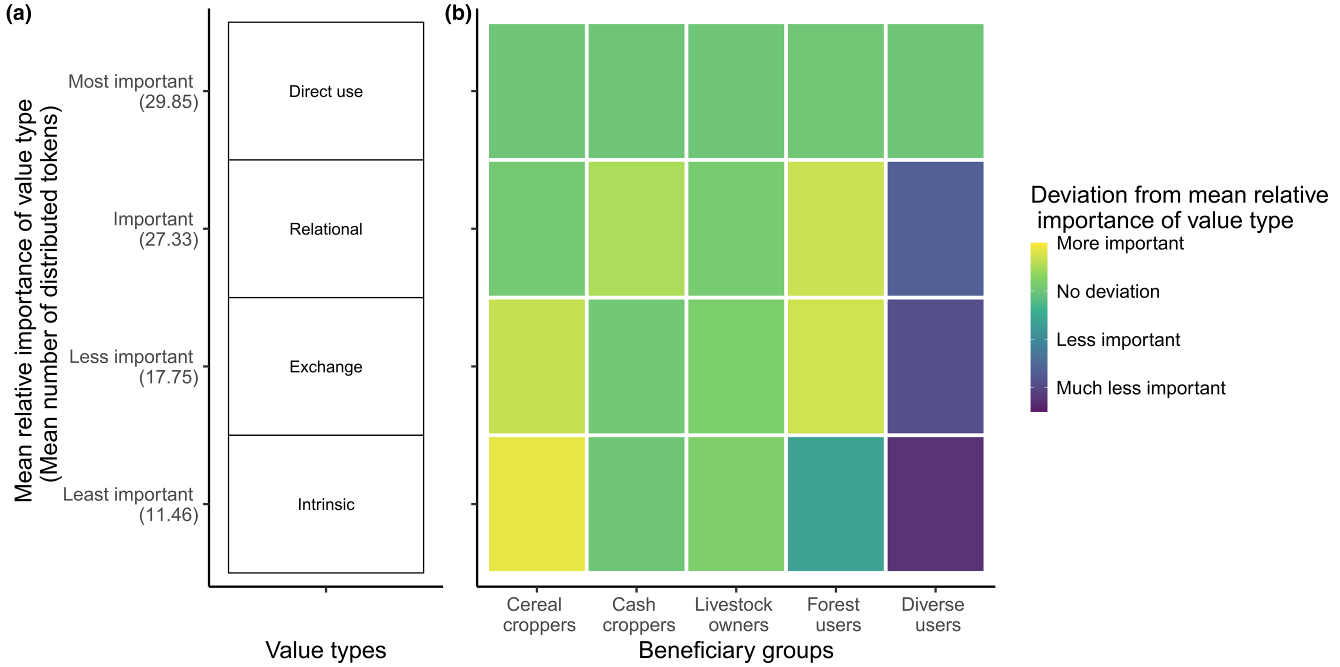

FIGURE 6 Relative importance ascribed to each of four value types (a; based on mean number of distributed tokens, $n = 164$), and deviations from these means in each of five beneficiary groups (b). Participants were asked to indicate a weighted ranking of 11 ecosystem products for each value type by distributing 30 tokens within each value type, with the option of not distributing tokens if the value type was relatively unimportant to them. Participants were clustered into five beneficiary groups based on their picture-based ecosystem product ranking (see Section 3.2). The lighter the colour, the more important the value type in the beneficiary group compared to the average.

the specific empirical and the general methodological insights as well as implications for decision-making in more detail below.

4.1 | Empirical insights

4.1.1 | Overall sample

Overall, maize and teff were ranked the most important ecosystem products, and other studies have also shown that ES that are directly related to people's livelihoods were ascribed most importance (Lau et al., 2019; Tauro et al., 2018). In contrast to our results, studies that considered a range of provisioning, regulating and cultural services found that biodiversity-related ES, such as habitat protection or satisfaction for conserving biodiversity, were considered more important than other services (Lau et al., 2018; Martín-López et al., 2012).

Recently, in the study area, direct ES flows have declined and access to emerging market-oriented services with indirect benefits has increased (Schultner et al., 2021). However, the study area is still a largely subsistence-based landscape and direct use value thus plays an important role (Manlosa et al., 2019). Nevertheless, relational values related to local traditions and experiences connected to multiple ecosystem products were more important to local people than exchange and intrinsic value (Figure 6a). Our findings suggest that many of the ecosystem products studied here support the generation and maintenance of social cohesion (Chan et al., 2016). For example, the production of honey (beehive making and hanging), khat chewing and coffee drinking and ceremonies increased social interactions and relationships (based on field notes during data collection).

Beneficiaries ascribed diverse and often multiple values to a given ecosystem product (Figure 4), and ostensibly material services can have crucial non-material dimensions. Such plural values seem to be common, as for example people in European farming landscapes understood local food production both as a provisioning and as a cultural ES (Plieninger et al., 2019), and while gleaning played a role for subsistence to women in Timor-Leste, socializing or spending time in nature were even more important (Grantham et al., 2020). The nature's contributions to people (NCP) framework acknowledges that material and non-material contributions can often be interlinked, with culture permeating through all groups of contributions, and that context-specific perspectives can include multiple ways of understanding and categorizing relationships between people and nature (Díaz et al., 2015, 2018). In line with these findings, our results raise questions regarding the utility of categorizing the benefits of nature to humans solely in terms of the types of services or contributions they provide. Rather, the focus should be on the types of values ascribed to specific ecosystem structures or functions (Kenter, 2018).

Regarding the relationship between the relative importance of ecosystem products and ascribed values, we found that direct use and relational value reflected the general importance of ecosystem products relatively well, whereas exchange and intrinsic value did not. This is in line with other research, which found, for example, that monetary values of wetlands in Asia correlated negatively with the nonmonetary values held by some of the most dependent groups, which were assessed by an importance score (Brooks et al., 2014), or that ES with low market or exchange values were still highly appreciated in some villages in Southwestern Ethiopia (Tadesse et al., 2014).

4.1.2 | Beneficiary groups

Different individual and social–ecological contexts influenced the assignment of importance to ecosystem products. The missing association between the beneficiary groups and gender or wealth (Table 2) is not in line with the literature, since we would have expected some differences in the relative importance of ecosystem products by gender and wealth that were found by other studies (Coelho-Junior et al., 2021; Lau et al., 2018). However, similar to our results, both occupation and the urban–rural gradient can explain differences in the relative importance of ES (Brooks et al., 2014; Lapointe et al., 2020).

Moreover, the relative importance of ecosystem products was clearly connected to the social–ecological context of beneficiaries, both to the types of kebeles they lived in and in terms of patterns of ecosystem product production and consumption (Table 2, Figure S3, Table S2; for a more detailed discussion see Supporting Information). The influence of the social–ecological context on assigned relative importance of ES has also been recognized elsewhere. For example, perceptions of the importance of mangrove ES differed between communities, likely due to differences in access to ES and in main economic activities (Reyes-Arroyo et al., 2021). The relative importance of ES as assessed by cattle ranchers in Mexico was associated with their livelihood, in terms of diversity of productive activities and also generational changes in livelihoods (Tauro et al., 2018).

The ranking of value types overall was consistent between the five beneficiary groups (Figure 6b), but they differed in the exact importance they ascribed to each value type. The likelihood to express certain value types may depend on people's motivations (e.g. egoistic vs. altruistic), their place of residence, their level of education, age or their cultural identity (Arias-Arévalo et al., 2017; Lau et al., 2019). In our study, diverse activities were connected to the production and consumption of ecosystem products that beneficiaries associated with relational value (see above). In contrast, the importance of exchange value is likely to depend on the contribution of market activities to people's livelihoods. However, understanding the exact reasons behind the importance ascribed to the different value types in the beneficiary groups requires further research.

Each of the five beneficiary groups ascribed different types of values to their prioritized ecosystem products (Figures S4–S8). These value ascriptions were not necessarily consistent with the relative importance of value types in the groups (e.g. *cash croppers* prioritized relational value in general, but prioritized khat in particular for its exchange value). These findings mirror other studies, for example, in coastal communities in Papua New Guinea, people ascribed most importance to provisioning ES, but mentioned different aspects of well-being when explaining why they mattered to them, often referring to bequest values (Lau et al., 2019). When analysing wetland ES in Greece, Maniatakou et al. (2020) found five perspectives of the relative importance of ES, and each reflected divergent understandings of relational and instrumental values.

4.2 | Methodological insights

Even though the need for plural valuation of nature is increasingly recognized (e.g. in initiatives such as IPBES, Hill et al., 2021; Pascual et al., 2023), ES valuation is still often based on a single commensurable metric (often in monetary terms, Arias-Arévalo et al., 2018), which in turn implies a single type of value ascription. In this study, we allowed the association of multiple value types with a given ecosystem product (in our case, up to four value types could be ascribed to each of 11 ecosystem products), and this proved useful in assessing and comparing the plural values. To elicit such diverse values ascribed to ecosystem products, we developed our own method using tokens, inspired by approaches in the literature (placing counters on ES to evaluate importance—see Hicks et al., 2015; Lau et al., 2018, 2019). From our experience, tokens as a vehicle to assess values were useful, because they were tangible. They also allowed for a flexible and differentiated picture of how beneficiaries ascribed different types of value to ecosystem products in the form of a consistent weighted ranking.

While it is relatively simple to define direct use and exchange value, relational and intrinsic values are more complex and multidimensional notions, and how they are defined and operationalized is likely to influence value ascription. For relational values, we chose to focus on social cohesion, using the formulation 'because it brings people together'. We found that beneficiaries responded well to this formulation, which we had tested in a pilot study, and attributed a lot of importance to this value type (Figure 6a). However, there are multiple other dimensions within relational values that could have been explored (see Chan et al., 2016; Riechers, Balázsi, et al., 2021 for a detailed discussion). Communicating intrinsic values appeared to be the most challenging. As could be expected, biodiversity was ascribed most intrinsic value compared to the other ecosystem products (Figure 4). However, certain observations made us less confident of our results related to both intrinsic value and biodiversity. The formulation we used to ask about intrinsic value ('because it simply exists without any benefit to you') might have prompted beneficiaries to think about intrinsic value rather as a 'disvalue' (Lliso et al., 2022), and, respectively, about biodiversity as a 'disservice' (Shackleton et al., 2016). Wild animals were often mentioned by beneficiaries when talking about biodiversity, which are a disservice to smallholders due to crop raiding (Dorresteijn et al., 2017). Through our formulation for intrinsic value, we might have pre-assigned lesser worth to this value type and/or the ecosystem products it is ascribed to, and biodiversity might have stood out in a peculiar way among a range of (what is typically categorized as) provisioning services.

Whereas disaggregated valuation is important, communicating the results of such multidimensional value elicitations is challenging (Brück et al., 2022; Daw et al., 2011). In this study, we provide an approach to partly re-aggregate the ecosystem product ranking data, in order to reduce dimensionality, while keeping important distinctions. Here, the use of statistical clustering of beneficiaries based on the ecosystem product ranking helped to organize and aggregate the data. This approach allowed a meaningful interpretation of the data and insights into the relationship between the relative importance of ecosystem products and beneficiaries' individual characteristics and social–ecological context.

4.3 | Insights for decision-making

In this section, we do not suggest concrete policies, but based on our empirical and methodological insights, discuss the relevance of our results for decision-making. First, landscape management in our study area should consider other types of values ascribed to ecosystem products beyond exchange value. The focus of current development plans in the study area is on specialization and market integration, and indeed production in our study area has shifted from subsistence to marketed crops over the past decades, reflecting a focus on commercialization and the exchange value of ecosystem products. However, we clearly show here that not only exchange value, but a range of different values can be ascribed to ecosystem products that are currently produced and consumed in the landscape. This seems even more urgent when considering that exchange value in our case was much less important to people than direct use and relational value, and that exchange value ascribed to ecosystem products did not reflect well the overall importance ascribed to ecosystem products for people's livelihoods. A shift towards more intensified and commercialized agriculture, without careful considerations of potential implications for people's livelihoods and connected values, might lead to unforeseen losses of certain value types other than exchange value, and particularly of relational values. Such developments have already been described elsewhere, for example, where relational values were negatively affected by adoption of large-scale irrigation or through landscape simplification (Albizua et al., 2019; Riechers, Martín-López, et al., 2021). In our study area, the relational value and the exchange value of coffee were ascribed similar importance, even though coffee is considered a key cash crop. The decision whether to prioritize export coffee production, or to establish a biosphere reserve that combines eco-coffee production, and tourism opportunities, should consider the diverse values ascribed to coffee, seeing that such a decision is likely to largely influence people's livelihoods and connected values (Jiren et al., 2020).

Second, we encourage landscape management to be aware of people's diverse ecosystem product rankings and values that are at least partly grounded in their social–ecological context, to be able to adequately and sustainably plan future developments. We found that beneficiaries could be grouped into five clusters based on their ecosystem product rankings, and that these groups differed in their social–ecological context. Previous research had already shown that future development under different scenarios differed substantially between the four social–ecological kebele groups (Duguma et al., 2022). Smallholders in our study area, and in heterogeneous landscapes elsewhere, should thus not be treated as a homogeneous group, but rather differentiated based on their social–ecological context.

5 | CONCLUSION

Whereas presenting and interpreting results based on disaggregated data was challenging due to its multidimensionality, our plural approach proved useful in better understanding the relative importance of ecosystem products, values ascribed to ecosystem products and the relationship between them. For our Ethiopian case study, we found that maize and teff were ranked as most important, and direct use and relational value were the most important value types. Beneficiaries often ascribed multiple values to each ecosystem product, and exchange value alone did not reflect well the general importance that beneficiaries ascribed to ecosystem products. We derived five beneficiary groups that each prioritized different sets of ecosystem products. The social–ecological context of the kebele groups that were positively associated with each of the five beneficiary groups reflected relatively well the respective relative importance of certain ecosystem products. Whereas the relative importance of value types overall was consistent between the five groups (direct use value > relational value > exchange value > intrinsic value), beneficiaries in each of the five groups ascribed different types of values to their prioritized ecosystem products. These varied from group to group and were not necessarily consistent with the value types that were generally ranked highest by the beneficiary groups. Our study undertook an approach to assessing reasons behind ecosystem product rankings and highlights the continued need for plural valuation, in order to match the complex benefits of ecosystem products in social–ecological systems. Based on our results, we recommend that sustainable landscape management in Ethiopia should take into account people‘s diverse ecosystem product rankings and values as well as other types of values ascribed to ecosystem products apart from exchange value.

AUTHOR CONTRIBUTIONS

Maria Brück and David J. Abson conceived the ideas and designed the methodology; Birhanu Bekele Negash and Dadi Feyisa Damu collected the data; Maria Brück and David J. Abson analysed the data. All authors interpreted the data and contributed critically to the drafts and gave final approval for publication. Our study brings together authors from a number of different countries, including scientists based in the country where the study was carried out.

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CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

The data supporting this study are openly available in https://pubdata.leuphana.de at https://doi.org/10.48548/pubdata-51.

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DATA SOURCES

These are the references referred to in the Supporting Information 1.

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SUPPORTING INFORMATION

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

Table S1. The eight kebeles (smallest administrative units in Ethiopia) and one town that were sampled in our study, plus their woredas (districts) and social–ecological kebele groups.

Figure S1. Dendrogram of hierarchical clustering analysis based on picture-based rankings of 11 ecosystem products ($n=297$). The five clusters were derived considering group interpretability and a range of statistical tests.

Figure S2. Pearson residuals of each cell of the contingency table of clusters (columns) and occupation (rows), visualized in a correlogram. The size of the circle indicates the magnitude of the residual. Positive residuals are in blue and specify an attraction (positive association) between the corresponding row and column variables. Negative residuals are in red, implying a repulsion (negative association) between the corresponding row and column variables. Clusters were 1 = livestock owners, 2 = cereal croppers, 3 = forest users, 4 = diverse users, 5 = cash croppers.

Figure S3. Pearson residuals of each cell of the contingency table of clusters (columns) and social–ecological kebele groups (rows), visualized in a correlogram. Clusters were 1 = livestock owners, 2 = cereal croppers, 3 = forest users, 4 = diverse users, 5 = cash croppers. Social–ecological kebele groups were 1 = pasture-cropland, 2 = khat-cropland, 3 = woody vegetation, 4 = accessible-wealthy.

Table S2. Ecosystem products produced and consumed in each beneficiary group, plus ecosystem product richness. For each beneficiary group, we calculated the share of participants that produced/consumed each ecosystem product. Richness indicates the number of ecosystem products produced or consumed on average per participant in each group.

Figure S4. Deviations from overall mean importance for each ecosystem product within each of four value types (indicated by deviations in number of tokens), for the cereal croppers. Participants were asked to indicate a weighted ranking of 11 ecosystem products for each value type by distributing 30 tokens. The lighter the colour, the more tokens were attributed to the ecosystem product compared to the overall mean, hence the more important the ecosystem product within the value type for the beneficiary group. Ecosystem products sorted by their overall median rank based on the picture-based ranking.

Figure S5. Deviations from overall mean importance for each ecosystem product within each of four value types, for the cash croppers.

Figure S6. Deviations from overall mean importance for each ecosystem product within each of four value types, for the livestock owners.

Figure S7. Deviations from overall mean importance for each ecosystem product within each of four value types, for the forest users.

Figure S8. Deviations from overall mean importance for each ecosystem product within each of four value types, for the diverse ES users.

Data S1. Questionnaire.

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