



Embedding plural values in value chains to enhance sustainability in the management of cork oak landscapes

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Abstract

Context The management of Portuguese agroforestry landscapes is currently focused on specialised cork and cattle production. Sustainable landscape management is increasingly discussed as an effective option to foster the multifunctionality of these landscapes. Such management requires consideration of

multiple values connected to the landscape and to the products stemming from it.

Objectives The aim of this study is to (1) assess the importance of specific values related to cork and to the cork production landscapes, (2) analyse how values differ across the value chain actors, and (3) compare the types of values associated to cork and the cork production landscapes.

Methods We combine value chain analysis with the concept of plural valuation in order to illuminate the values amongst value chain actors. We conducted interviews with 62 actors divided across the value chain using a semi-structured questionnaire.

Results We found that a broad range of instrumental, intrinsic and relational values were expressed by our respondents. Our results show an imbalance between the perception of the ecosystem health expressed by actors involved in the industrial transformation of cork compared to those directly involved with the landscape. This imbalance shows the necessity to find a common management ideal for cork production landscapes favouring multifunctionality.

Conclusions Our study shows the relevance of considering plural values when planning and implementing sustainable landscape management. Integrated into a landscape approach, value chain analysis is useful in reaching actors in order to uncover different points of view towards a single landscape. Our study suggests that focusing on the multifunctional nature of the cork production landscapes may be key in

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ensuring a sustainable future for this social-ecological system.

Keywords Montado · Cork · Plural values · Value chain · Multifunctionality · Landscape approach

Introduction

Biocultural landscapes are landscapes shaped by long-term, continuous interactions between nature and humans, most notably through farmers' local and traditional practices (Agnolletti and Rotherham 2015). Across Europe, these landscapes are often economically vulnerable and therefore at risk of being abandoned or transformed into homogenous landscapes intensively managed for short-term profitable land uses (Pungetti 2013; Plieninger et al. 2016). Examples of biocultural landscapes are wood-pastures in Sweden, now shifting from traditional cattle rearing and timber production to recreational uses, or mosaic landscapes in Romania, where land use diversified by topography (e.g. arable fields on the low-lands and grasslands and forests on the hills) is rapidly changing through drivers such as outmigration and agricultural modernisation. These drivers lead to an intensified use of the low-lands and abandonment of mountain pastures (Torralba et al. 2018a, b). In biocultural landscapes, the management of biological and cultural resources is closely interlinked, and the complex and rich sets of connections between nature and culture provide multiple values or relations, such as a feeling of connectedness to nature, maintaining livelihoods, or upholding cultural heritage.

The Intergovernmental Science-Policy Panel on Biodiversity and Ecosystem Services (IPBES) has spearheaded a values framework that recognises the essential role that culture, values, and communities play in achieving sustainable resource management (Díaz et al. 2018), and that is therefore helpful for understanding the multiple benefits coming from biocultural landscapes. This framework is built on the concept of plural valuation as a well-established approach for analysing people's values and behaviour in human-nature relationships (IPBES 2022). Evolving out of the popular ecosystem services concept, plural valuation is an attempt to redefine, broaden, and elaborate on the concept of value and valuation, as it takes the diversity of values that people assign to

nature into consideration (Jacobs et al. 2018; Christie et al. 2019). Plural valuation considers intrinsic, instrumental, and relational values linked to ecosystems, the management of which most commonly has included intrinsic and instrumental values (Chan et al. 2012). Intrinsic values entail a sense of value inherent to nature and without human judgement, while instrumental values consider nature or natural resources as a means to an end in order to secure human well-being (Pascual et al. 2017). Relational values are defined as "preferences, principles and virtues associated with relationships" between people and nature (Muradian and Pascual 2018), and are crucial for better understanding the complex interactions occurring within biocultural landscapes. Relational values are to a high degree expressed in place identity, social norms and spiritual beliefs (Pretty et al. 2009), and furthermore, they represent the importance, motivation and reasoning for making individual or societal choices "based on [their] consistency with core values, such as justice, care, virtue, and reciprocity" (Chan et al. 2016). When aiming for a sustainable development and management of landscapes, researchers are increasingly acknowledging and advocating for the necessity of place-based research where local people and land-users are included in the decision-making process and their values are being represented (Cebrián-Piqueras et al. 2020; Zafra-Calvo et al. 2020).

The rise of globally interconnected economies and markets has led to a distant governance of resources and a geographic displacement of land-use in terms of production and consumptions of goods. This development enhances the ongoing trend of landscape simplification through intensification and abandonment (Meyfroidt et al. 2013). However, it is not only the provisioning of food and fuel crops that are being displaced, but so are the relational values linked to the production landscape (Balázsi et al. 2019; Riechers et al. 2022). The most common drivers for this loss of biocultural landscapes and their relational values are related to the lack of agency (i.e. access to land, exclusion from local decision-making), overall industrialisation of agriculture, or financial incentives such as market liberalisation or public subsidies, the latter being an especially frequent driver in European context (Horcea-Milcu et al. 2018). The displacement of environmental and social impacts away from the place of consumption is furthermore creating a disconnect between production landscape, the product,

and the consumer (Ibarrola-Rivas et al. 2020). A way of establishing a connection between producer and consumer through the product is making the consumer aware of the reality of the production landscape. In other words, creating a type of value or strengthening the bond between consumers and the origin of products could inevitably change consumer behaviour towards supporting sustainable landscape management (García-Martín et al. 2022).

This study focuses on the region of Alentejo in south-central Portugal, which is considered a hotspot of biocultural diversity under pressure. This region is characterised by the montado landscape, which is comprised of open woodlands dominated by cork oak (*Quercus suber* L.) and holm oak (*Q. ilex* subsp. *ballota* Desf.) and typically grazed by livestock. The oak woodlands constitute the wealth of the land, carrying significant cultural, economic, and societal values (Garrido et al. 2017). Thus, the montado has been considered an archetype of high nature value farmland supporting exceptional levels of biodiversity and securing a rich supply of ecosystem services (e.g. carbon storage, wildfire protection, aesthetic values) (Ferraz-de-Oliveira et al. 2016; Plieninger et al. 2021). The montado is dependent on continuous human management practices, and current trends of abandonment are therefore detrimental for the future of this landscape (Bugalho et al. 2011). Since the 1950s, there has been a polarisation of land-use in south-western Iberia towards both intensification and abandonment of forest uses (Costa et al. 2009; Wolpert et al. 2020). Sites less profitable for cork production experience heavy livestock grazing with a subsequent loss of land-use multifunctionality (Pinto-Correia and Godinho 2013). Thus, the current management agendas of the montado are influenced by trade-offs between different landscape values (Torralba et al. 2018a). These trade-offs are leading to different management styles that often come at the expense of one another, such as the preference for cattle production over cork production (Pinto-Correia et al. 2019).

Despite the competing interests, the montado remains a source of important and economically valuable products, namely cork. Cork can be considered a landscape product, which is defined as a product embedded in a specific cultural landscape shaped by traditional management practices (García-Martín et al. 2020). The natural distribution of cork oak is limited

to the Iberian Peninsula, Sardinia and north-western Africa (Pausas et al. 2009). Whilst most of the process linked to cork production happens in Portugal, cork products are being traded across the globe, resulting in long value chains with localised, national producers and a range of global consumers (Sierra-Pérez et al. 2015). Actors along the value chain have a direct influence on the production and quality of the material they are handling, and indirectly on how the landscapes of production are managed (Sørensen et al. 2021). As such, value chain actors hold the potential for promoting a sustainable management of the montado landscape preserving the biocultural identity and associated values (Sayer et al. 2013; Surová et al. 2014). Recognising that a plurality of values in decision making is necessary for achieving a sustainable and future oriented landscape management, our study focuses on the different types of values that various actors possess (Plieninger et al. 2015; Muñoz-Rojas et al. 2019). By actor, we refer to any person that has a relation to the product or the landscape. The aim of our study is to identify the plural values that multiple actors relate to the cork-producing landscape, the montado, and to cork as a product. Our specific objectives are (1) to assess the importance of plural values related to the cork-producing landscape and to cork products, in this case wine bottle stoppers, (2) to analyse how plural values differ amongst the value chain actors, and (3) to compare the types of plural values associated to cork and the cork-producing landscape. Highlighting a case study from a rural region that is economically vulnerable (van Eupen et al. 2012; ESPON 2017) may provide important insights on the role that relational values play in the management of a traditional biocultural landscape (Batista et al. 2015; Surová et al. 2018). We argue that engagement with the multiple values of a landscape product and those of its landscape of production will contribute to expanding our understanding of the multiple relations and values of nature associated to both, revealing potential leverage points for more sustainable landscape management strategies (Ives et al. 2018; Plieninger et al. 2018).

Methods

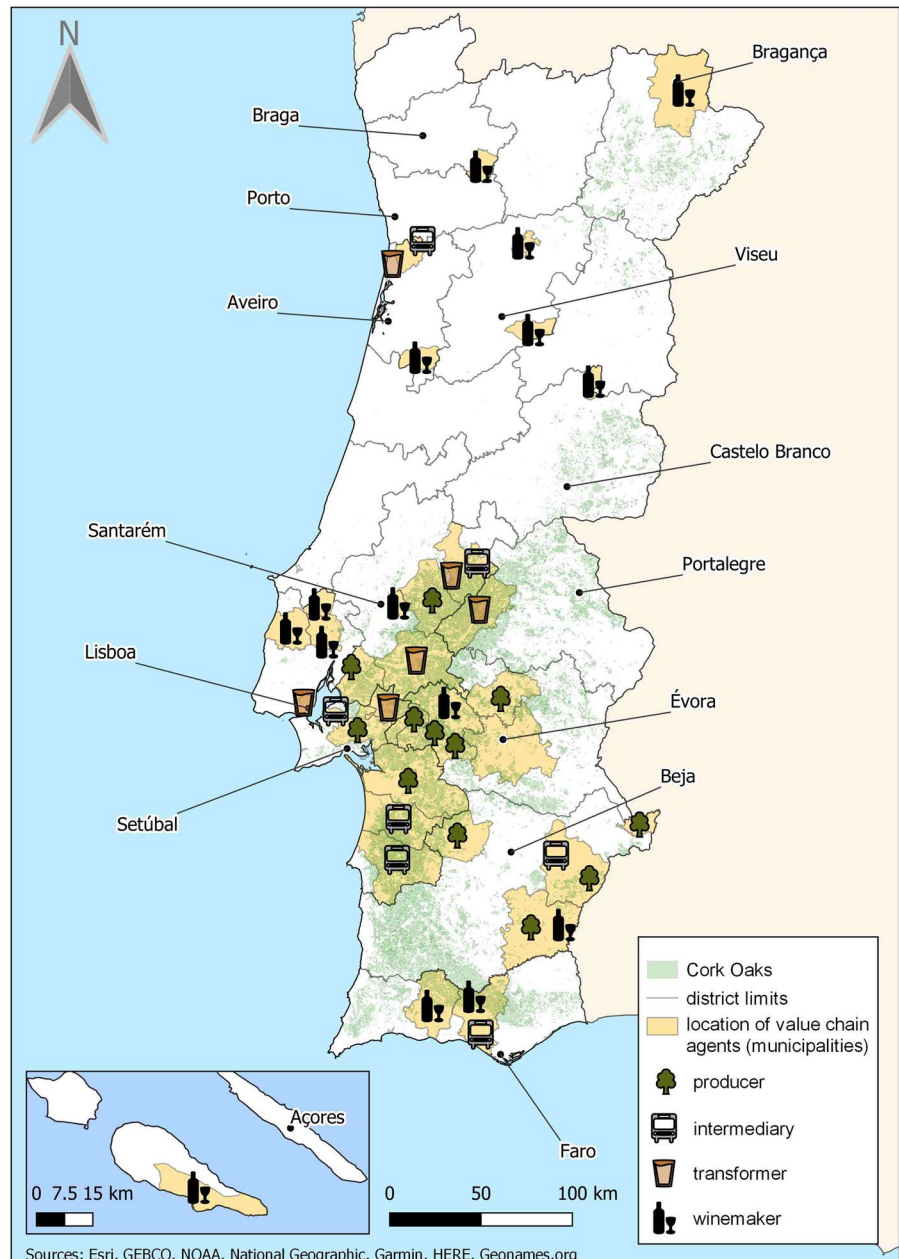
Case study

The montado of Portugal is limited to the southern and central part of the country, mainly to the regions

of Ribatejo (Santarém), Alentejo (Évora, Beja, Portalegre), and Algarve (Faro) (Fig. 1). The montado is characterised by an open woodland structure and is typically managed as a silvo-agro-pastoral system including livestock grazing, mainly by cattle. The montado exists in different species constellations with the particular dominance of either of two oak species, namely cork oak or holm oak (Pinto-Correia et al. 2011). The latter is the oak species responsible for

the sweet acorns that are used for animal feed. The first is the oak yielding a thick bark, cork, that can be stripped on a regular basis without killing the tree. This study refers to the montado dominated by cork oak. The extraction of cork has been commercially exploited since the seventeenth century after the material gained popularity for its sealing qualities (Mendes and Graca 2009). Cork oak trees are protected by legislation (Ministério Agricultura 2001). However,

Fig. 1 Overview of the representative locations of the value chain actors and distribution of cork oak in Portugal



there is no legal framework protecting the montado as a whole, leading to imbalances in the management of the system (Pinto-Correia and Fonseca 2009). The montado is under heavy pressure from overgrazing, over-harvesting, and forest clearing, affecting the phytosanitary conditions of the cork oak landscapes (Godinho et al. 2016). Furthermore, the high quality cork necessary for producing first-rate natural bottle stoppers has long been in decline due to increasing stress factors such as drought and insect infestations, and this is exacerbated by climate change (Sørensen et al. 2021). This process has resulted in a production of only a small amount of highly demanded, top quality material. Such rather restricted availability of high quality cork has favoured large companies with high purchasing power (Parejo-Moruno et al. 2021). However, the cork industry has become inventive in reducing the dependency on the demand of high-quality cork and thus the wine market. The low-quality cork is being used for producing agglomerate stoppers, and furthermore being processed into isolation materials and floorboards, finding novel use in niche production design worldwide (Gil 2015). Cork producers are increasingly adhering to the guidelines of the Forest Stewardship Council (FSC), which offers a transparent process of auditing the entire montado ecosystem, complying with sustainability standards that cover woodland management practices and harvesting methods (Bugalho and Silva 2014; Costa and Oliveira 2015). Such certification provides a way to bridge the gap between mutually distant consumers and production landscapes (Flinzberger et al. 2020).

Data collection

In order to represent the different actors involved in the production and the consumption of cork, we followed a value chain approach sensu Bockel and Tallec (2005). We included 62 respondents at different stages in the cork value chain in our study: Cork producers ($n=17$), intermediaries ($n=14$), industrial transformers ($n=16$), and winemakers ($n=15$) as cork consumers. We identified respondents through the directory of members from the largest organisation representing the cork sector in Portugal, the Portuguese Cork Association (APCOR), and through the

Portuguese Vine and Wine Institute (IVV). The cork producers and intermediaries were located mainly in Ribatejo and Alentejo (Fig. 1). The intermediaries were responsible for the first selection and purchase of raw material in the field, as well as for preparing the cork for further industrial transformation. Most transformers and industrial transformation facilities were located in the region of Aveiro ($n=10$). The winemakers were located in 11 of the 14 wine districts in Portugal including the Açores. Along the value chain stages, the respondents were predominantly managers, owners or technicians/employees with high responsibility. Age of the respondents was on average 49 years, and there was predominance of men (78.5%) over women (21.5%). Among cork producers, the size of the montados was diverse, the average size was of 1863.12 ha, ranging from 60 to 11000 ha. Such size range and diversity in landholdings in farm size is representative of the Portuguese montado, which is largely dominated by large family farms, typically between 200 and 2000 ha in size (Muñoz-Rojas et al. 2019). An overview of the represented municipalities and the distribution of the respective actors can be seen in table form in Online Appendix A, as well as further details about the respondents (e.g. age, gender, farm size, function) in Online Appendix B.

We performed our interviews between February and May 2021. The interviews were performed by Portuguese native speakers who either contacted the respondent via phone or via email. The interviews were later translated into English by the same facilitators. The function of each interviewee in their role as value chain actor can be found in Online Appendix B. The interviews were conducted on the basis of semi-structured questionnaires that included two sections: One section was related to cork as a product and another was related to the montado as the cork-producing landscape. Both sections included closed questions with answer categories offered on a Likert-type scale, and a single open-ended question enquiring on the subjective importance of cork and of the montado (Online Appendix C). The Likert-scale questions were focused on assessing the importance of the different benefits provided by cork and the montado, and the open question was focused on eliciting the plural

values associated to cork and the montado. To assess the importance of the benefits derived from cork, the questions included aspect related to product quality, product and landscape identity, and economic importance (Petrick 2002; Woodall 2003). The questions for the montado were based on an adaptation of landscape values as categorised by García-Martín et al. (2017), as well as themes from livelihoods research (Gaspar et al. 2007; Guerra & Pinto-Correia 2016). The statements for both cork and the montado were categorised according to the plural values framework. The respondents were asked to indicate their level of agreement with a statement related to each topic on a scale from 0 (“completely disagree”) to 4 (“completely agree”). The open-ended question aimed to capture the subjective importance of cork and the montado as ascribed by the respondents. The use of this type of open-ended question has been widely used to capture plural values (Arias-Arévalo et al. 2017; Fagerholm et al. 2020).

Data analysis

We performed different statistical analyses according to each research question. To assess the importance ascribed to the benefits derived from cork and the montado expressed in the Likert-type scale

questions, we illustrated these through mean values and standard deviation. In order to compare levels of importance perceived by the different value chain actors, we carried out Kruskal Wallis tests, including Dunn’s post hoc tests with Bonferroni adjustments. Furthermore, we performed Kendall’s Coefficient of Concordance tests (Kendall’s W) for effect sizes. In order to elicit on the plural values, we coded the replies from the open-ended questions into instrumental, relational, and intrinsic values according to the plural valuation framework (Chan et al. 2016; Díaz et al. 2018). Examples of the coding can be found in Table 1. We considered single aspects of cork and the montado to be associated with more than one value type, thus each response could be coded into more than one value category. In order to ensure consistency in the coding, all responses were coded twice by the first two authors. We used U Mann–Whitney tests to assess how frequently the different types of values were mentioned. Quotes marked in brackets were used to illustrate the values, and each quote referred to the responsive value chain actor with P (producer), I (intermediary), T (transformer), and W (winemaker). The analyses were done with IBM SPSS Statistics v. 28.0.1.0 and XLSTAT.

Table 1 Examples of coding according to the plural valuation framework, x marking presence of value in the statement

	Instrumental	Intrinsic	Relational	Statement	Justification
Cork					
	x	x		“For its performance and because it justifies the conservation of the montado”	Performance of the material (INS), ecosystem conservation (INT)
	x	x	x	“Economic importance, environmental heritage, beauty”	Economic importance (INS), environmental heritage (INT), beauty (R)
	x		x	“This business is my life. My father worked in this area, and I now try to continue the business and the legacy”	Business (INS), family legacy (R)
Montado					
	x	x	x	“I have a great respect for nature. Cork oaks, with their many years to become adult trees, I feel they are important and economically in the long run they can be an asset”	Respect for nature (INT), feeling of importance (R), financial asset (INS)
			x	“Way of life”	Lifestyle (R)
	x			“It gives me my income, is the source of my business”	Income, business (INS)

Instrumental value (INS), intrinsic value (INT), relational value (R)

Results

Values associated to cork and the montado

Cork

Amongst our respondents, all three types of plural values (instrumental (INS), intrinsic (INT), relational (R)) were assigned a high total mean value. The perceived values related to cork had a minimum mean value of 2.79/4 (SD ± 0.93) and a maximum of 3.74/4 (SD ± 0.48) (Fig. 2 and Online Appendix D). The lowest score was assigned to the statement “cork is a source of inspiration for how to live one’s life”, and the highest score was assigned to the statement “cork makes Portugal known abroad”, both relational values (R). Overall higher values were assigned to statements regarding regional economic importance (INS) (3.61/4, SD ± 0.78) and to cork contributing to a local identity (R) (3.45/4, SD ± 0.64). The statement regarding the potential of cork to keep the population in the interior Portuguese regions scored the second lowest value (INS) (2.95/4, SD ± 1.12). This statement had the greatest standard deviation together with “cork has a low environmental impact” (INT) (3.45/4, SD ± 1.11). In general, there was a low variability in the results as shown by the standard deviations, indicating a

certain consensus amongst the different value chain actors.

The montado

Responses on the different relational values of the montado ranged from a minimum mean value of 1.91/4 (SD ± 1.17) to a maximum value of 3.79/4 (SD ± 0.45) (Fig. 3 and Online Appendix E). The highest score was assigned to the statement “it is necessary to preserve the montado for future generations”. The lowest score was assigned to the statement “the montado is a sacred place for religious beliefs and spirituality”, where also the lowest number of respondents replied (n=43). The statement “the montado is a place where to have fun with friends and family” scored the second minimum mean value 3.05/4 (SD ± 0.94). There was a general agreement indicated by standard deviations lower than 0.94. For intrinsic values, the minimum mean value was 3.13/4 (SD ± 1.03) was assigned to “the montado contributing to a low risk of wildfire”, and a maximum score of 3.80/4 (SD ± 0.41) to the statement “the montado contributes to climate mitigation through CO₂ sequestration”. For instrumental values, the minimum mean value was 2.76/4 (SD ± 0.90) to “the montado is rich in medicinal plants”. This statement also obtained a low number of responses (n=46). The maximum

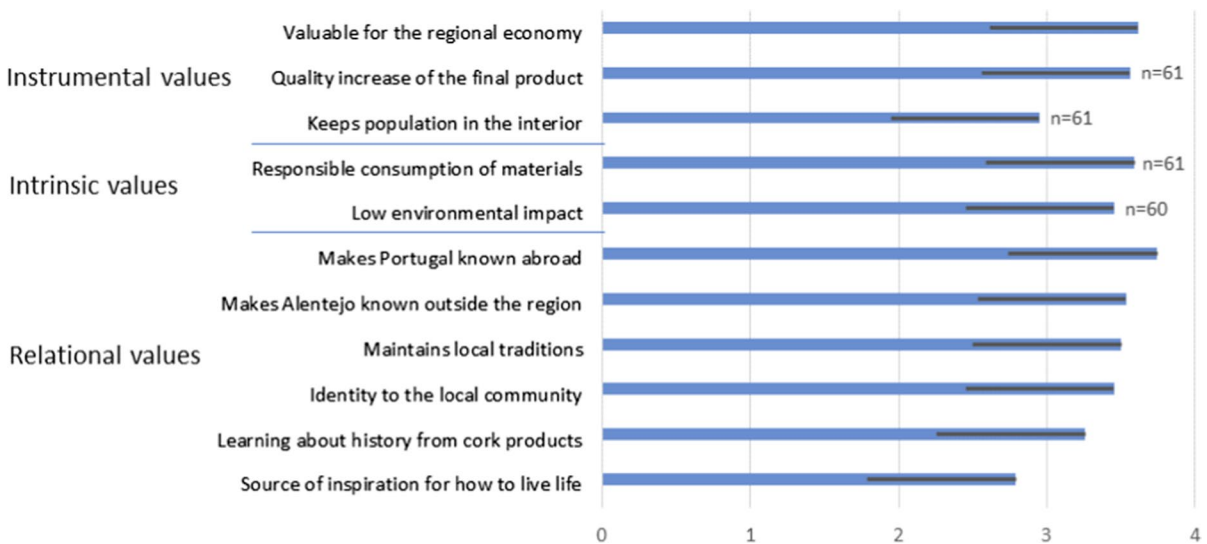


Fig. 2 Mean value amongst respondents towards cork. Error bars show the standard deviation. 0=completely disagree, 1=disagree, 2=neither agree nor disagree, 3=agree, 4=completely agree. Unless n is otherwise stated, N=62

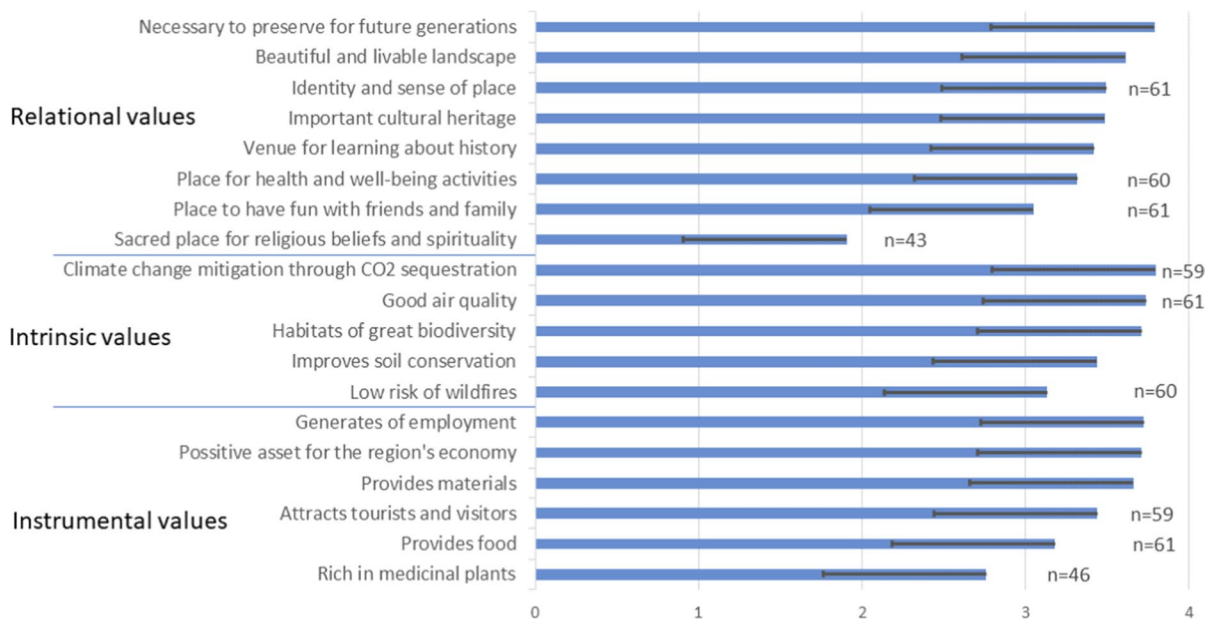


Fig. 3 Mean value amongst respondents towards the montado. Error bars show the standard deviation. 0=completely disagree, 1=disagree, 2=neither agree nor disagree, 3=agree, 4=completely agree. Unless n is otherwise stated, N=62

mean value was 3.73/4 ($SD \pm 0.48$), corresponding to the statement identifying the montado as a source of employment.

Differences in values across the value chain

Cork

Comparing the values expressed by each of the value chain actors, we found significant differences within five statements (Table 2, Online Appendix F). Within the instrumental values attached to cork, we found that winemakers assigned the lowest value (mean 3.00, $SD \pm 1.35$) compared to transformers who assigned the highest one (mean 3.94, $SD \pm 0.25$) regarding the statement referring to cork as valuable for the regional economy. Despite the significant differences amongst actors, there was a high level of agreement towards the statement ($K=0.43$). For the intrinsic values, cork producers (mean 2.81, $SD \pm 1.56$) differed significantly from intermediaries (mean 3.79, $SD \pm 0.80$) regarding cork as having a low environmental impact. Within the relational values, three statements had significant differences. For the statement regarding cork making Alentejo known outside the region, the producers assigned the

lowest value (mean 3.35, $SD \pm 0.49$) compared to the intermediaries who assigned the highest one (mean 3.86, $SD \pm 0.36$). For the statement “cork maintains local traditions”, winemakers and transformers differed significantly from each other, the winemakers assigned the lowest value (mean 3.07, $SD \pm 1.03$) and transformers the highest one (mean 3.75, $SD \pm 0.58$). Regarding the statements with no significant differences between actors, the top three statements with the highest level of agreement (Kendall’s W) were “cork makes Portugal known abroad” ($W=0.54$) (R), “cork increases the quality of the end product” ($W=0.45$) (INS), and “cork inspires to a responsible consumption of materials” ($W=0.41$) (INT).

The montado

We found significant differences between the value chain actors in all but five statements (Table 3, Online Appendix G). The intermediaries assigned highest importance in all value categories. The producers and the winemakers assigned the lowest importance in almost all cases. Together with producers and winemakers, the transformers were significantly different to the intermediaries in five cases. Only by the statement “the montado attracts tourists”, the

Table 2 Mean and standard deviation of cork values according to each value chain actor

	Producer Mean (SD±)	Intermediary Mean (SD±)	Transformer Mean (SD±)	Winemaker Mean (SD±)	N	Kruskal– Wallis X ²	P	Kendall’s W
Instrumental values								
Valuable for the regional economy	3.71 (0.47)^{ab}	3.79 (0.43)^{ab}	3.94 (0.25)^a	3.00 (1.25)^b	62	10.44	0.02	0.43
Quality increase of the final product	3.44 (0.63)	3.57 (0.64)	3.50 (0.63)	3.73 (0.59)	61	2,71	0.44	0.45
Keeping the population in the interior	2.88 (1.27)	3.07 (1.00)	2.94 (0.85)	2.93 (1.12)	61	0.43	0.93	0.09
Intrinsic values								
Responsible consumption of materials	3.44 (0.63)	3.71 (0.61)	3.75 (0.58)	3.47 (0.74)	61	4.02	0.26	0.41
Low environmental impact	2.81 (1.56)^b	3.79 (0.80)^a	3.62 (1.03)^{ab}	3.64 (1.11)^{ab}	60	8.02	0.05	0.29
Relational values								
Makes Portugal known abroad	3.59 (0.51)	3.86 (0.36)	3.75 (0.58)	3.80 (0.41)	62	3.50	0.32	0.54
Makes Alentejo known outside the region	3.35 (0.49)^b	3.86 (0.36)^a	3.75 (0.45)^{ab}	3.20 (0.68)^{ab}	62	10.80	0.01	0.39
Maintains local traditions	3.41 (0.69)^{ab}	3.79 (0.43)^{ab}	3.75 (0.58)^a	3.07 (1.03)^b	62	10.29	0.02	0.32
Identity to the local community	3.41 (0.51)	3.57 (0.51)	3.62 (0.72)	3.20 (0.68)	62	5.26	0.15	0.27
Learning about history from cork products	3.18 (0.53)	3.57 (0.51)	3.38 (0.62)	2.93 (0.96)	62	5.56	0.14	0.24
Source of inspiration for how to live life	2.53 (0.80)^{ab}	3.21 (0.98)^a	3.06 (0.85)^{ab}	2.40 (0.91)^b	62	8.46	0.04	0.05

Results from the Kruskal–Wallis test indicate significant differences in the importance amongst each actor. Values marked in bold are statistically significant ($P < .05$). Dunn’s post hoc test (Bonferroni adjustment) indicates (in superscript) how each actor is different from the other. Values sharing a letter are not significantly different. Kendall’s W indicates the level of concordance between actors, 0 = total disagreement and 1 = total agreement

transformers alone were significantly different to the other respondents. In cases where the producers were not significantly different, winemakers were, such as by the statements “the montado provides habitats of great biodiversity” and “the montado is a place where to have fun with friends and family”. On the opposite, producers were significantly different regarding the statement “the montado is a positive asset for the region’s economy”, whereas all other respondents were not significantly different to each other. Despite the significant differences between the value chain actors, the level of concordance (Kendall’s W) was relatively medium (0.40–0.51). Table 2 Mean and standard deviation of cork values according to each value chain actor. Results from the Kruskal–Wallis test indicate significant differences in the importance amongst each actor. Values marked in bold are statistically significant ($P < 0.05$). Dunn’s post hoc test (Bonferroni adjustment) indicates (in superscript)

how each actor is different from the other. Values sharing a letter are not significantly different. Kendall’s W indicates the level of concordance between actors, 0 = total disagreement and 1 = total agreement.

Plural values of cork and the montado

According to the open-ended questions, our respondents associated values to cork and the montado from all three domains, namely instrumental, intrinsic, and relational values (Fig. 4). In both cases, instrumental values were the ones most frequently mentioned (97% for cork; 82% for the montado), followed by relational values (76% for cork; 58% for the montado) and intrinsic values (16% for cork; 40% for the montado). We found statistically significant differences amongst all value chain actors for each of the three value domains ($P < 0.05$, Online Appendix H).

Table 3 Mean and standard deviation of montado values according to each value chain actor

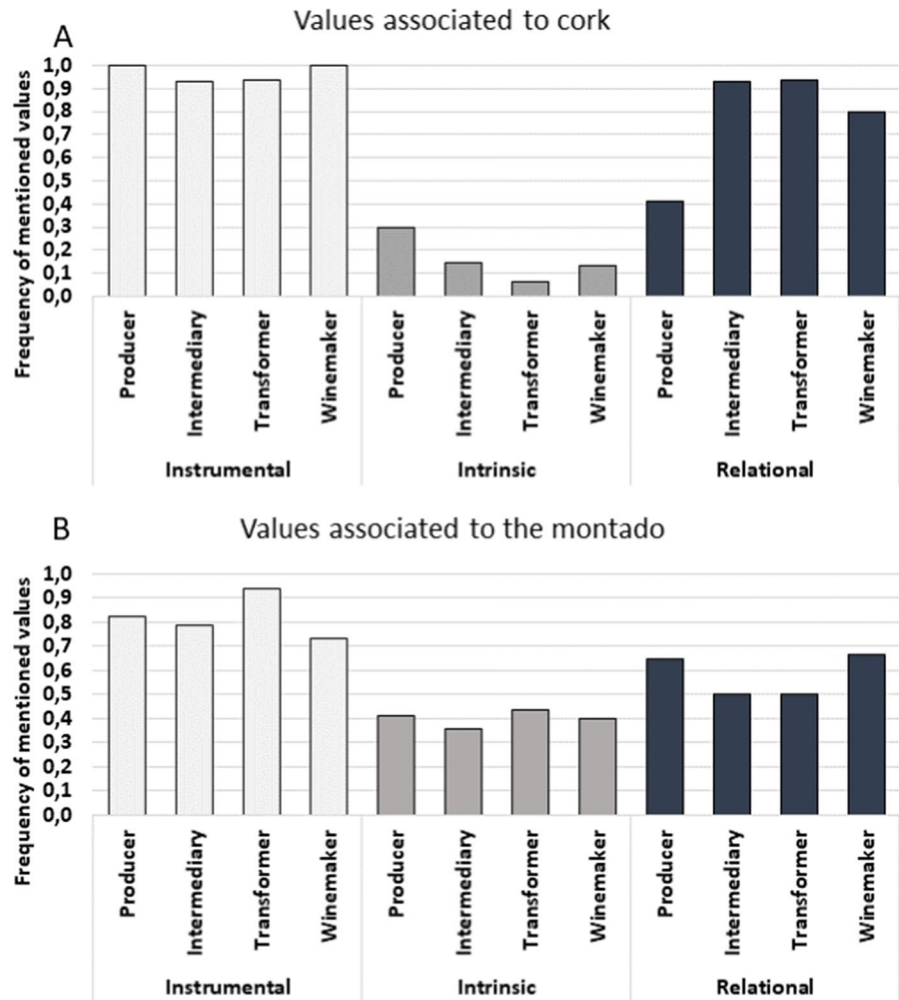
	Producer Mean (SD ±)	Intermediary Mean (SD ±)	Transformer Mean (SD ±)	Winemaker Mean (SD ±)	N	Kruskal– Wallis X ²	<i>p</i> -value	Kendall’s W
Relational values								
Necessary to preserve for future generations	3.76 (0.44)	4.00 (0.00)	3.81 (0.40)	3.60 (0.63)	62	5.50	0.14	0.50
Beautiful and liveable landscape	3.41 (0.62)^b	4.00 (0.00)^a	3.69 (0.60)^{ab}	3.40 (0.63)^b	62	12.21	0.007	0.36
Identity and sense of place	3.29 (0.59)^b	3.93 (0.27)^a	3.50 (0.82)^{ab}	3.29 (0.61)^b	61	12.47	0.006	0.31
Important cultural heritage	3.29 (0.59)^b	3.93 (0.27)^a	3.44 (0.81)^{ab}	3.33 (0.74)^{ab}	62	10.59	0.01	0.32
Venue for learning about history	3.24 (0.56)^b	4.00 (0.00)^a	3.25 (0.68)^b	3.27 (0.80)^b	62	15.78	0.001	0.25
Place for health and well-being activities	3.35 (0.61)	3.69 (0.89)	3.12 (0.89)	3.14 (0.66)	60	7.27	0.06	0.13
Place to have fun with friends and family	3.25 (0.78)^{ab}	3.64 (0.50)^a	2.63 (1.15)^b	2.73 (0.88)^b	61	12.38	0.006	0.08
Sacred place for religious beliefs and spirituality	2.00 (1.00)	2.50 (1.85)	1.43 (1.02)	2.00 (0.34)	43	3.91	0.27	0.05
Intrinsic values								
Climate change mitigation through CO ₂ sequestration	3.71 (0.47)	4.00 (0.00)	3.88 (0.34)	3.62 (0.51)	59	7.30	0.06	0.53
Good air quality	3.65 (0.49)^{abc}	4.00 (0.00)^a	3.88 (0.34)^c	3.43 (0.51)^b	61	13.94	0.003	0.42
Habitats of great biodiversity	3.59 (0.68)^{ab}	3.93 (0.27)^a	3.87 (0.34)^{ab}	3.47 (0.52)^b	62	9.95	0.02	0.42
Improves soil conservation	3.24 (0.75)^b	4.00 (0.00)^a	3.56 (0.51)^{ab}	3.00 (0.76)^b	62	19.39	< 0.001	0.24
Low risk of wildfires	2.41 (1.10)^b	4.00 (0.00)^a	3.13 (1.15)^{ab}	3.21 (0.70)^b	60	21.98	< 0.001	0.15
Instrumental values								
Generates employment	3.65 (0.61)	3.93 (0.27)	3.75 (0.45)	3.60 (0.51)	62	4.13	0.25	0.45
Positive asset for the region’s economy	3.47 (0.62)^b	4.00 (0.00)^a	3.69 (0.48)^{ab}	3.73 (0.46)^{ab}	62	8.78	0.03	0.51
Provides materials	3.41 (0.51)^b	4.00 (0.00)^a	3.81 (0.40)^{ab}	3.47 (0.52)^b	62	15.81	0.001	0.40
Attracts tourists and visitors	3.35 (0.61)^{ab}	3.92 (0.28)^a	3.25 (0.78)^b	3.31 (0.63)^{ab}	59	10.15	0.02	0.24
Provides food	3.00 (0.94)^b	4.00 (0.00)^a	2.69 (1.14)^b	3.14 (0.95)^b	61	19.78	< 0.001	0.12
Rich in medicinal plants	2.65 (0.93)^b	3.78 (0.44)^a	2.33 (0.50)^b	2.50 (0.93)^b	46	17.32	< 0.001	0.04

Results from the Kruskal–Wallis test indicate significant differences in the importance amongst each actor. Values marked in bold are statistically significant ($P = < .05$). Dunn’s post hoc test (Bonferroni adjustment) indicates (in superscript) how each actor is different from the other. Values sharing a letter are not significantly different. Kendall’s W indicates the level of concordance between actors, 0 = total disagreement and 1 = total agreement

Regarding cork, instrumental values were the most dominant amongst all value chain actors who mainly highlighted the economic importance of cork. However, relational values rendered high importance from transformers, intermediaries and winemakers, emphasising that cork is a “natural product” [P15, I13, T1], a “sustainable material” [T11] with “unique characteristics” [I9] and that is “incomparable” to other materials [I12]. It has also been considered to hold a

high “cultural and sentimental value” [P8, T10] and to be a “100% Portuguese product” [T7] that “we should be proud of” [T12]. In relation to wine, respondents expressed that “cork is the only product that guarantees conservation and quality in time of the product” [W4] and referred to the unique properties of cork to “treat the wine as a living product” [W1] and “adding value to it [wine] as it [cork] is perceived as a quality statement” [W15]. Producers expressed less

Fig. 4 Relative frequency of value domains associated to cork (A) and to the montado (B) by the value chain actors



importance for relational values directly linked to the cork, but higher levels to the montado. Here, the producers also ascribed relatively high levels of intrinsic values to cork compared to the other actors as “it [cork] justifies the conservation of the montado” [P1] and is perceived as an “environmental heritage” [P3] that “allows for the sustainability of the montado to be maintained” [P9].

All three value types were expressed when describing the montado as a “unique product” and “a symbol of a region with historical value” [P9], “a national identity” [T12], “a complete ecosystem”, which offers “a space for multiple products” [P9, I1] and thus “must be maintained” [I2]. Amongst several producers and intermediaries, the montado was described as “a way of life” [P15, I3, I5], stressing relational aspects but also the importance of instrumental values as the montado

comprises the basis of the livelihood of many respondents: “It is the main income of my forestry exploitation” [P11], “it is a passion and source of income” [P12], “it is the source of my business [I11], “it contributes to the economy and to my work” [I12], “it is our wealth” [I13], and “the montado sustains many different economic activities” [T2]. The need and urgency to maintain the montado was expressed through all value domains very clearly in one single quote: “Without the montado, there would be no cork neither would the surrounding ecosystem” [T3].

Discussion

With this study, we aimed to contribute to the research on the potential of landscape approaches to

foster sustainable landscape management. We have done so by providing a case study with empirical insights on the plural values that are integrated in complex social-ecological systems such as a multi-functional landscape with a huge biocultural diversity (Guimarães et al. 2018). Along the value chain of a landscape product, we were able to highlight similarities and differences amongst value chain actors involved with production, industrial transformation, and consumption, as well as identify the values that each actor ascribed to both the product, cork, and to its landscape of origin, the montado. Thus, we demonstrate how combining a value chain approach sensu Bockel and Tallec (2005) with social-ecological theory can connect actors and elicit on their various relations towards the same arena.

The importance of cork and the montado

Cork and the montado are intrinsically linked. Cork is a value asset for all actors involved in the value chain, thus reinforcing findings from previous empirical studies (von Essen et al. 2019; Sørensen et al. 2021). Cork has unique properties, which enhance the quality of the final product such as wine in our case study. The use of cork also facilitates awareness about responsible consumption of natural products, which can be regarded as a valuable feature to the final product, offering the potential for a higher end-price if consumers are willing to pay for this (Lysák et al. 2019). The potential of cork as an asset giving a sense of identity to the local community as well as being a material for maintaining local traditions indicates a strong sense of a local or regional identity based on the cork harvesting and processing practices (Pereira 2007). These aspects are evident in the responses and the high importance assigned to the relational value category suggests the strong presence of more-than instrumental or economic value of the cork product. Cork holds the potential of transferring knowledge of its landscape of origin as it travels through the value chain. On the other hand, the existence of cork strengthens local and regional traditions linked to the material, proving the interdependence of product and landscape.

The montado is perceived as a multifunctional landscape that includes multiple values. The strongest agreement between the value chain actors regards the necessity to preserve the montado for future

generations, as it contributes to a common identity of a region rich in cultural heritage. The montado is thus regarded as a beautiful and liveable landscape with deep-rooted traces of land-use histories, resulting in a distinctive character underpinned by a valuable cultural landscape (Plieninger et al. 2021). Agreeing with the findings of Garrido et al. (2017) for Spanish wood-pastures, the ability of the montado to sequester carbon, improve air quality, and ensure high levels of biodiversity are assigned the highest importance as an intrinsic value. Amongst instrumental values, the highest importance was ascribed the montado as generating source of employment and thus being vital for upholding the region's economy.

Due to the fluctuating quality of cork, and the gradual decline of the montado farming system, small-scale cork producers experience financial uncertainties (Parejo-Moruno et al. 2021). These producers are increasingly shifting from cork production to cattle rearing, which is supported by the EU Common Agricultural Policy. On the other hand, large producers often have the market advantages and are intensifying the production of cork (Sierra-Pérez et al. 2015). These shifts in management can become detrimental for the overall ecosystem (Aroso et al. 2017). The montado has the potential to offer a great diversity of products besides cork and cattle, such as honey, acorns, or aromatic plants (Berrahmouni et al. 2007). Various studies have identified the size of the farm as one of the most important factors for the management of silvopastoral systems (Torralba et al. 2018b). Due to the limited size of our sample, an in-depth analysis of the differences between the different types of landowners was not possible. However, according to our results, producers agree on the comparatively lower importance of the montado for food production (i.e. cereal crops and vegetables for human consumption) and aromatic plants used for herbal medicine, suggesting a low utilisation of these products or lack of attention to these values (Lovrić et al. 2020). The lack of knowledge or use of wild plants can be considered a loss of biocultural diversity, which is part of the make-up of cultural landscapes such as the montado (Camejo-Rodrigues et al. 2003; Quave et al. 2012). In summary, there is a broad understanding of the montado as a multifunctional system that should be preserved for future generations. However, trends in management point in directions of an uneven development between values and action.

Utilising the potential of a diverse system, actors in the cork value chain, but especially producers, should pay attention to diversified options for generating an income in order to ensure long term sustainability of the ecosystem.

Variation in importance between the value chain actors in relation to cork

Our results show two distinct patterns of disagreement between the value chain actors. When it comes to the importance of cork for the regional economy, transformers express a higher importance than winemakers. The fact that most winemakers are widespread across Portugal is contrasting the transforming industry, which is mostly located within one single district, Aveiro, far away from the cork producing areas (Lopes and Branco 2013; Sørensen et al. 2021). The same pattern is clear regarding cork maintaining local traditions. Even though our respondents agree that cork stoppers have a high importance for the final product (i.e. wine) due to its unique properties, winemakers have long introduced alternative stoppers made from plastic or aluminium because of the varying quality of cork as well as a competitive wine market (Mendes and Graca 2009). This pattern of disagreement between transformers and winemakers thus suggests a division of means in terms of raw material and use of the final product. Transformers are more closely connected geographically, indicating an understanding for the benefits of the region, be it Aveiro or Alentejo. Winemakers, on the other hand, are spatially dispersed all over Portugal, suggesting that these have a more distant relation to the benefits of cork production to the region of origin. Furthermore, the shift in material also hints at a gap between transformers and winemakers, as transformers would be expected to continue working with cork and innovating products, whereas winemakers have changed material away from cork.

The second pattern of disagreement is found between producers and intermediaries. The intermediaries ascribe the highest value to cork making Alentejo known outside of the region, which may be explained by the fact that they are in most cases physically moving cork out of the producing regions across both national and international scales (Sierra-Pérez et al. 2015). In terms of the low environmental impact of cork, producers assign the lowest value compared

to intermediaries. This could be related to a more informed and critical perspective from producers on the direct impacts of the increasing trend of intensified cork-oriented management in the montado. On the contrary, it is surprising to see how the intermediaries ascribe the lowest environmental impact to cork, specially since some of the most relevant environmental impacts, for example in relation to water consumption for handling and processing the cork, take place at this stage of the value chain (Sørensen et al. 2021). In this case, their responses might be related to, on the one hand, a less sound knowledge of the ecological context of the montado and, on the other hand, the relativisation of the environmental impact of cork compared to synthetic alternatives.

Despite the patterns of disagreement, it is worth noticing the levels of agreement of those statements where actors did not differ significantly from each other. The statement most agreed upon by all actors was categorised as a relational value followed by instrumental and intrinsic ones. In our study, this proves the point of relevance that relational value has regarding the connection between a product and the production landscape. That cork makes Portugal known abroad is definitely a fact that could be used to strengthen the connection between landscape and the end consumer in the global value chain of cork.

Variation in importance between the value chain actors in relation to the montado

As for the montado, there are also differences amongst actors, namely between producers and intermediaries, but also between winemakers and intermediaries. In general, the intermediaries assign the highest importance to all statements, giving the impression of a montado that is able to sustain all values equally. By looking at the producers' assessments, it becomes clear that they disagree or assign a lower importance and thus give a picture of the montado that aligns with several studies concluding on contrasting values within wood-pasture systems (Plieninger et al. 2015). The fact that producers ascribe a lower importance to the montado as a cultural heritage might hint to a change in the traditional mindset of the montado farmer, historically considering themselves as heritage stewards, as described by Pinto-Correia et al. (2019) looking into current discourses in the montado. The shift in discourses are most likely driven by

recent and ongoing changes in the land use management and market agendas in the context of the cork oak montado (shift from traditional towards specialized modern production farming, which is less multifunctional and linked to income-based management decisions). As different actors have different interests in the same landscape, it is necessary to go into detail of the exact relation that each value chain actor has towards the montado, elaborating on current shifts in the prevalent discourses. Including actor views as part of integrated landscape management requires first of all that various values are uncovered amongst all parties involved (Sayer et al. 2013). Furthermore, there are crucial steps of socialisation and internalisation linked to the acceptance of differences in order to create a common ground for incorporating the diversity of values into decision-making (Kenter et al. 2019).

Regarding the intrinsic values, our findings point towards cork producers and winemakers as being well aware of an ecosystem that is not in its best shape. The general risk of wildfire exists, especially in areas with high understory shrub growth, and in the period of post-harvest period when the cork oaks are more vulnerable (since the cork-bark protects the tree from wildfires). The responses yielding a low importance to the montado as a system resilient against wildfires, as well as possessing the potential for improving soil conditions, support the widespread perception of a degraded landscape, where traditional management of montados is shifting towards either more intensive management practices in the more productive areas or abandonment of land in less productive areas, leading to uncontrolled growth of understorey vegetation—two antagonistic processes that increase the vulnerability of montados to wildfire (Guerra and Pinto-Correia 2016).

Lastly, in relation to instrumental values, we found differences between intermediaries and the other actors of the value chain. Similarly to previous differences between actors in the value chain, the differences might be related to the limited and subjective view of the system by each of the actors. In the current economic context of a favourable market for cork production (Sørensen et al. 2021), intermediaries perceive the montado as a productive and profitable source of cork, which is positive for the regional employment and economy. In contrast, other actors of the value chain have more moderate opinions. That might be related to an increased awareness to the

progressive simplification and specialization of the system, which would produce more cork while reducing the a broad range of materials potentially coming from the montado, such as firewood, food, livestock (Pinto-Correia et al. 2011).

Plural values of a landscape product and the landscape of production

Plural valuation adds to the understanding of value of cork and its production landscape. Amongst our responses from the open-ended question, instrumental values were mentioned most frequently, followed by relational and intrinsic ones. The presence of all three types of value suggests a complex relationship between the landscape and its users. Based on a large review of societal values of silvo-pastoral systems, Surová and Pinto-Correia (2022) conclude that society, i.e. defined as “...people who live, work or otherwise interacts with the regions where these landscapes can be found...” (2022:105), “...is aware of the multi-functional role of these silvo-pastoral systems and desires them to be maintained” (2022:110). Agreeing with our findings, there is a common understanding about the interconnected relationships within the montado and that these cannot exist independently.

In our case, relational values show a shift between value chain actor and the product and the landscape of production. For cork, we see more relational values expressed by those actors directly handling the product, whereas the cork producer, as well as the winemaker, less frequently express relational values associated to the product. For instance, the importance of cork is rather linked to business than to an appreciation of the material properties, e.g. “due to its income, allowing an increase in the results of our agricultural exploration” (P2) and “because we use a natural product and apply it to another natural product [wine], enhancing the value chain” (W2). However, the relational value of cork amongst producers and winemaker relates rather to the justification of the montado as the cork-producing ecosystem upholding the production for a profitable business, e.g. “important source of income that allows the sustainability of the montado to be maintained” (P9) and “because it is a natural product and a national treasure” (W10). Thus, the level of relational value amongst producers and winemakers becomes higher when it comes to the

landscape of production, and concurrently the levels from the intermediaries and transformers decrease. These results suggest that producers and winemakers have a stronger relational connection to the montado than the intermediaries and transformers. This is contrasting to the results showing that intermediaries and transformers would largely agree on all statements expressing the montado as a healthy ecosystem. However, those who work close or even live in the montado are aware of the imbalances occurring considering their intimate relation to the overall montado ecosystem (Guimarães et al. 2018). The intermediaries and transformers rather know the montado through the contact to the raw material and the final product and thus only a fraction of the whole system.

The montado of Portugal has long been the scenery of tensions and conflicts resulting in a fragile and unbalanced ecosystem (Muñoz-Rojas et al. 2019). In order to meet societal demands regarding user dependent nature conservation and to re-engage society with the landscape, it is necessary to consider the multiple values of those who are dependent on the landscape. The awareness and interest of society sensu Surová and Pinto-Correia (2022) to preserve the montado and to continue profiting from its main components, such as cork, must be stressed in inclusive land and forest management strategies and action plans. A simplification of the landscape towards either intensified production of cork or cattle will lead to an erosion of relational values due to the disengagement and lack of agency from those actors who are involved in the landscape (Riechers et al. 2020).

A multi-functional landscape management must be made possible for all parties involved, and not put extreme pressure on just one component of the system. Our approach shows an unbalance in the value chain of cork, where producers and winemakers show large relational values towards a landscape that has the potential of offering many sources of income. Those parts of the value chain, which have specialised in one of the main profitable goods should care more about a sustainable management of the landscape, as this is most important in order to secure their livelihood in the long run as well. The fact that all value chain actors strongly agree to preserve the montado for future generations is expressing the necessity for adopting local landscape approaches in order to maintain the montado as a sustainable social-ecological system.

Embedding plural valuation could be a strong support in managing the montado. Social conflicts or competing discourses (Pinto-Correia et al. 2019) could be minimised by identifying common values (Kenter et al. 2019) by including multiple actors starting from a common concern entry point (Sayer et al. 2013). For instance, agreeing with our findings, cultural heritage and identity of both people and landscape has proved to be most important in other empirical cases regarding woodlands in Portugal and Spain (Surová and Pinto-Correia 2016; Garrido et al. 2017). As our findings suggest, there is an enormous potential based on relational values for creating engagement with multiple actors (Klain et al. 2017; Brugnach et al. 2021). For instance, by promoting the multiple products stemming from this landscape, thus widening the consumer range, could create an awareness of the landscape of origin supporting local or regional values. Certification or other mechanisms of trust-building and raising awareness within the food system could even promote a wide-spread distribution, as seen in the case of FSC branded cork (Bugalho and Silva 2014). Relational values thus fill a niche in the debate of instrumental and intrinsic values for valuating nature by complementing these in defining priorities for management (Chan et al. 2016; Arias-Arévalo et al. 2017).

Conclusions

Landscape approaches seek to find ways in which to manage landscapes in sustainable and inclusive ways. Whilst ensuring the inclusivity of actor perspectives, plural valuation is a way to elicit on the values and priorities of these in order to create plans for active and sustainable management of landscape resources. In our case study, we tested value chain analysis against the concept of plural valuation and showed that this combination can offer valuable insights on the management of a specific product from a distinct cultural landscape. We were able to show mismatches of perceptions between the actors of the value chain, opening up for common foci of concern. The montado has the potential to become a biodiverse and multifunctional ecosystem with a large range of products if management is decided to favour this. If not, the schism between intensive cork extraction and cattle rearing will have detrimental consequences for

the montado in the long run. Our findings support the inclusion of plural values as a basis for environmental decision making, accepting the influence of relational values as enriching and complementary to intrinsic and instrumental values. Including a plurality of values means including a broad range of landscape users and listening to their arguments with respect to their socio-cultural identity tied to the landscape.

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Data availability The anonymised raw data used for the analysis in this manuscript will be made publicly available on the Zenodo platform upon publishing of the manuscript.

Declarations

Competing interest The authors have no financial or non-financial interests to disclose.

Ethical approval This research involved interviews. Before the interview, the interviewees were informed about the purpose of the study, handed the relevant contact details to the researchers as well as to the Central Ethics Committee at the University of Kassel. At the beginning of each interview, the interviewees were asked for their consent to contribute and to continue to the interview.

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