Italian Journal of Animal Science

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/tjas20

# Enhancing the socio-cultural valuation of ecosystem services in Mountain animal production: a case study from piedmont's alpine valley (North-west Italy)

Chiara Costamagna, Valentina Maria Merlino, Danielle Borra, Lorenzo Baima, Paolo Cornale & Luca Maria Battaglini

**To cite this article:** Chiara Costamagna, Valentina Maria Merlino, Danielle Borra, Lorenzo Baima, Paolo Cornale & Luca Maria Battaglini (2024) Enhancing the socio-cultural valuation of ecosystem services in Mountain animal production: a case study from piedmont's alpine valley (North-west Italy), Italian Journal of Animal Science, 23:1, 842-858, DOI: 10.1080/1828051X.2024.2360583

**To link to this article:** https://doi.org/10.1080/1828051X.2024.2360583



Published online: 30 May 2024.

ITALIAN JOURNAL OF ANIMAL SCIENCE
2024, VOL. 23, NO. 1, 842–858
https://doi.org/10.1080/1828051X.2024.2360583

Taylor & Francis
Taylor & Francis Group

RESEARCH ARTICLE

OPEN ACCESS Check for updates

# Enhancing the socio-cultural valuation of ecosystem services in Mountain animal production: a case study from piedmont's alpine valley (North-west Italy)

Chiara Costamagna, Valentina Maria Merlino, Danielle Borra, Lorenzo Baima, Paolo Cornale* and Luca Maria Battaglini*

Department of Agricultural, Forest and Food Sciences, University of Turin, Grugliasco, Italy

**ABSTRACT**

The Italian Alpine region has a long-standing connection between the binary system of the tourism industry and silvopastoral sectors that offer different economic, ecological, and cultural benefits. This research investigates the perception of ecosystem services (ES) provided by mountain animal production among tourists in a specific mountain area (Upper Ellero Valley, North-West Italy). A total of 216 visitors were surveyed online between June and October 2022. The questionnaire was designed to explore the following aspects: (1) interviewees' socio-demographic characteristics; (2) the perceived impacts of alpine livestock systems on ecosystem services, including also the animal welfare variable; (3) the heterogeneity of hikers in response to their perception of ES and (4) the assessment of the individuals' opinion towards selected valorisation strategies of the herd-grazing production system.

The responses about the ES perception were analysed using the Principal Component Analysis. The new principal components were employed to cluster the sample in the function of individuals' perceptions of ecosystem services. Finally, the Correspondence Analysis was adopted to analyse the association between the three hikers' groups and the proposed strategies for mountain area valorisation. This research revealed a positive perception of visitors towards the impact of herds on the ES. In addition, different opinions emerged among clusters related to the valorisation strategies adoptable for mountain area development exploiting the positive connection between animal farming and the environment. These findings could have concrete implications on the definition of social and economic development strategies for the alpine mountain valleys, representing an important source of production for national mountain pasture livestock farming.

**HIGHLIGHTS**

1. Animal production provides ecosystem services for mountain area development;
2. Hikers have different perception towards ecosystems services, including the animal welfare;
3. The three obtained clusters of hikers perceived differently the valorisation strategies for increase agro-eco-tourism.

**ARTICLE HISTORY**
Received 19 December 2023
Revised 12 May 2024
Accepted 22 May 2024

**KEYWORDS**
Alpine tourism; hikers; principal component analysis; cluster analysis; valorisation; alpine pasture; mountain livestock farming; local breed

## Introduction

There has long been an interconnection between the tourism and forestry-pastoral sectors. However, this relationship often leads to conflicts, as tourism tends to dominate, sometimes to the detriment of the agricultural sector. Such conflicts have been well documented in the literature, as well as in the Italian context (Genovese et al. 2017). In recent years, the Alpine region has experienced a significant surge in tourism (Choudhary et al. 2023) due to the COVID-19 pandemic. Although tourism brings economic benefits to various alpine activities (Genovese et al. 2017; Sørensen and Grindsted 2021), it is crucial not to underestimate the importance of pastoral systems and the benefits they provide in terms of conserving and regulating ecosystems in the alpine region, including mountainous marginal areas, as well as preserving valuable traditions and cultural

CONTACT Valentina Maria Merlino valentina.merlino@unito.it
*These authors contributed equally to this work.

heritages (Battaglini et al. 2014; Ryschawy et al. 2017).

In the mountain territory, agro-zootechnical activities efficiently utilise natural resources (Bernués et al. 2019): in areas where traditional agriculture for human consumption is challenging, ruminant livestock efficiently converts the resources of marginal pastures into highly valuable and nutritious food sources (Hoffmann et al. 2014). In addition, these traditional farming systems show different territory-activity-specific externalities, contributing to creating and maintaining semi-natural habitats (Rodríguez-Ortega et al. 2014; Faccioni et al. 2019; Fraser et al. 2022). In this context, the role of local cattle breeds, well adapted to the Alpine landscape and efficient in using local resources, in contrast to cosmopolitan breeds, is crucial (Marsoner et al. 2018). The objectives of these livestock activities go beyond providing food for human consumption; they also contribute to ecological, environmental, cultural, and landscape aspects (Battaglini et al. 2014; Verduna et al. 2020), in particular in the mountain region (Briner et al. 2013; Wezel et al. 2021). Essentially, these utilities can be grouped in the "ecosystem services" (ES) that, following the definition provided by the Millennium Ecosystem Assessment (MEA 2005) project in 2005, refers to the direct and indirect benefits that ecosystems provide for human well-being (Small et al. 2017; Accatino et al. 2019; Dumont et al. 2019; Bruzzese et al. 2022; Ge et al. 2023). It is crucial to emphasise that these benefits, particularly in mountainous areas, are provided for human welfare without differences between the residents and non-residents of the ecosystems where the ES are externalised (Grêt-Regamey et al. 2012). The Economics of Ecosystems and Biodiversity (TEEB 2010) project classifies ecosystem services associated with agro-zootechnical systems into four categories: (i) provisioning services, including animal production, their diversity and quality, and animal genetic resources; (ii) habitat and biodiversity services, which encompass maintaining habitat for animal and plant biodiversity and conserving local breeds; (iii) regulating services, which involve aspects such as greenhouse gas emissions, water quality, soil fertilisation, pollination, extreme events such as landslides and fires, and control of invasive species; and (iv) cultural services, which encompass landscape, cultural, recreational, aesthetic, spiritual, and scientific research aspects (Costanza et al. 2017; Mazzocchi and Sali 2022). Each type of agro-zootechnical system can provide some of these services simultaneously; this is explained by the concept of multifunctionality in the agricultural sector, performing other functions besides producing raw materials (Huang et al. 2015). The relationship between the productive activity and the specific territory can generate not only private goods and services, such as the production of animal-derived food, but also public benefits that can be enjoyed by everyone (Nabarro and Wannous 2014), including regulating services, habitat and biodiversity services, and specific cultural services (Bernués et al. 2014; Bernués et al. 2015). However, livestock management and animal load influence the ecosystem services or disservices provided by the different farming systems (Bernués et al. 2022). For instance, as highlighted in the study by Wezel et al. (2021), the involvement of farmers in the proper management of mountain pastures can increase the biodiversity of species present.

Recent researches conducted in recent years has involved socio-cultural (Oteros-Rozas et al. 2014; Scholte et al. 2015; Schmidt et al. 2017), economic (Pisani et al. 2021; Liu et al. 2022), and also combined (Nieto-Romero et al. 2014; Bernués et al. 2014; Bernués et al. 2015; Faccioni et al. 2019; Balzan et al. 2020) ecosystem services of livestock farming systems. Such evaluation plays a vital role in decision-making for developing and managing agroecosystems. However, the value attribution of ES is usually made in the economic-monetary dimension, thus excluding other value dimensions (Bautista-Rodríguez et al. 2020) deriving, for example, by the public thinking to the importance of the agricultural sector for ecosystem balance and the global climate change (Pecher et al. 2018). To the best of our knowledge, there is a lack of recent research in the scientific literature that focuses on hikers' opinions as a means of enhancing the relationship between mountain pasture livestock farming and ES externalities. The novelty of this research lies in its exploration of how perceptions of ES influence the feasibility of initiatives for the economic and social development of the region. This contributes to better decision-making in the planning and managing mountain areas, also thanks to the direct involvement of hikers in the survey, who are active players in mountain tourism and are more aware of the environment and marginal production systems.

## Materials and methods

### *Case study*

The survey was conducted in the Upper Ellero Valley, a short stretch of the Ligurian Alps (North-West Italy). The limits of this valley coincide with the borders of Roccaforte Mondovì (Cuneo, Italy). The territory covers

an area of 8,485 hectares, between 540 and 2,630 m above sea level. The resident population is 2,064 (ISTAT. 2023).

The area is a summer destination for many hikers, which have increased with the emergence of COVID-19 in marginal areas such as the Piedmont alpine valleys (Mangano et al. 2023). Moreover, the Ellero Valley has always had a strong vocation for cattle breeding and mountain pasture, with a long family tradition of *margari* (a dialect name for cattle breeders who practice summer alpine grazing) living in the village.

The vegetation of the sub-mountain belt is predominantly occupied by chestnut forests alternating with strips of stable hay meadows, mainly located in the valley bottom (Bisio et al. 2015). While the Upper Valley is characterised by a clear transition between beech and grass pastures above 1500 m (Ortu et al. 2003). In addition, it has been concluded from a historiographic analysis (Pastorini et al. 1980; Ianniello 2009) that the number of cattle grazing from the early 1900s until the 1980s almost tripled to 1400 head. While today, more than 4000 bovines from different farm in the low valley spend the summer period on mountain pastures (data from a local survey conducted at the local health authority: ASLCN1 Mondovì).

## Data collection

A structured questionnaire was submitted online using social media from June to October 2022. The questionnaire link was sent randomly *via* WhatsApp and Facebook by selecting online pages dedicated to walkers and the case study. The online survey was anonymous, and participants electronically signed an informed consent form before participating in the survey and after reading an information sheet describing the survey design and objectives. The criteria for inclusion of participants were: (i) individuals who agreed to participate and consented to the use of the data in the first question of the questionnaire; (ii) hikers over 18 years old; (iii) having visited the *Ellero Valley* at least 1 time. The questionnaire was composed of three sections (Montrasio et al. 2020) (Figure 1).

The first one included the respondents' socio-demographic variables and data about their knowledge of Ellero Valley (frequency of excursions in the studied area). The second section explored the individuals' knowledge about the concept of "ecosystem services" (question: "Have you ever heard of ecosystem services?"; binary answer: yes/no) and the perception of the impact of mountain livestock production on 24 items belonging to 4 ES categories and an additional category related to animal welfare (Table 1). This latter scale (Ecosystem scale, scale a) was adapted by combining the indexes of the ecosystem services belonging to the Provisioning, Habitat, and biodiversity, Regulating and Cultural categories (TEEB 2010; Yahdjian et al. 2015; Rodrigues et al. 2018) and 1 indicator related to animal welfare (Dumont et al. 2019). The inclusion of the Animal welfare (AW) variable was suggested by the research of Zuliani et al. (2016) in which a high interconnection between AW and ES was highlighted: particularly in mountain areas, if the herds are in a good state of animal welfare, they can contribute to the provision of ecosystem services, and vice versa. For scale a, the individual's opinion was measured using a 5-point Likert scale (from 0= very negative impact, to 4 very positive impact). Finally, in the last section, the respondent expressed their accordance (binary answer: yes/no) with 8 possible strategies (scale b) proposed as initiatives for the marginal mountain area valorisation (Varaldo et al. 2022).

## Data analysis

Descriptive analysis (frequency and percentage distribution) was performed on the socio-demographic aspects of the involved sample. The scales' reliability for internal consistency was tested using the Cronbach's alpha coefficient. The value of this statistical indicator is between 0 and 1. In the case of this study, Cronbach's index was accepted with a value higher than 0.6 (Varaldo et al. 2022). Then, respondents' knowledge of the concept of "ecosystem services" and the perceived impact (mean index) of alpine farming systems on ES and AW was analysed. To analyse data, the statistical procedure proposed by Yin et al. (2023) was adapted in the following steps and described in Figure 2:

1. The answers obtained from the Ecosystem services scale (scale a) were analysed by performing an exploratory Principal Component Analysis (PCA) with Varimax rotation (Hill 2011). This approach was adopted to identify different consumer perception dimensions based on latent factors (ES) that significantly influence customer orientation towards mountain-based production system (Blanc et al. 2020; Merlino et al. 2021). Only components with factor loadings higher than 0.5 were considered (Blanc et al. 2020). Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's-test were performed before factor analysis (Broen et al. 2015). Also, the

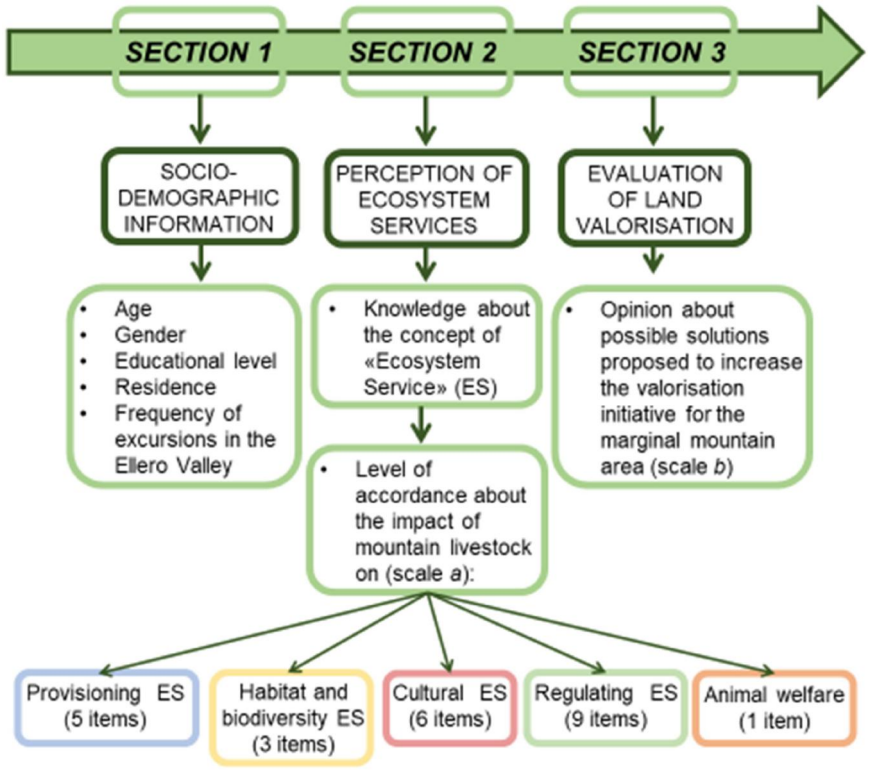


**Figure 1.** Questionnaire framework and structure.

reliability analysis for internal consistency was tested for each factor using the Cronbach's alpha and the Pearson correlation tests with a 0.7 threshold value (Yin et al. 2023). The correlation test was employed in the case of components explained by less than two items (Varaldo et al. 2022).

2. Next, the loadings for each obtained principal component were used as dependent variables in the TwoStep Cluster analysis that suggested the 3-groups solution as the best sample segmentation. Then, following Blanc et al. (2020), k-means analysis was applied. This processing was carried out to obtain different groups of homogeneous individuals in terms of ES perception (Vichi and Kiers 2001). Then, the ANOVA analysis was carried out to check the clusters' heterogeneity (Varaldo et al. 2022).
3. Finally, a Correspondence Analysis (CA) (Greenacre 2017) was conducted, following the methodology previously employed by Merlino et al. (2022) and Anastasiou et al. (2023). This statistical method was used to establish associations between clusters and the proposed solutions (labelled "scale b") for valorising mountain areas. It aimed to identify patterns and associations among the clusters (categorical variables) and valorisation solutions (nominal variables) while simultaneously graphically organising them within the same dimensional space, as described by Ayele et al. (2014) and Lana et al. (2017). From a contingency table, CA utilises the frequencies of rows and columns (comprising categorical and nominal variables) to position them in a geometric space based on Chi-square distances (Table 2). Greater proximity between points on the map signifies a stronger association between variables in the rows and columns, as Harcar and Spillan (2006) and Kaynak and Kucukemiroglu (2001) explain. The dimensions identified in CA can be interpreted by determining the primary contributors to the variance explained along each axis. The proportion of the variance explained by each dimension is called singular values (Beldona et al. 2005). In this work, each dimension was only accepted with a singular value higher than 0.20 (Hair et al. 1998).

All the statistical analyses were performed using the SPSS for Windows version 27.0 (SPSS Inc., Chicago, IL 60606).

## Results and discussion

### *Socio-demographic description*

The distribution of the hikers' sample within the Ellero Valley exhibited a relatively balanced distribution of

**Table 1.** Ecosystem services scale (scale a).

| Ecosystem Services category | Items | References |
|---|---|---|
| Provisioning (P) | 1. Impact on the quantity of foods of animal origin | 1. Bengtsson et al. 2019; Zhao et al. 2020; Bassi et al. 2021 |
| | 2. Impact on the variety of products and their typicity | 2. Bassi et al. 2021 |
| | 3. Impact on the organoleptic quality of foods of animal origin (colour, flavour, aroma, appearance, and texture) | 3. Bassi et al. 2021 |
| | 4. Impact on nutraceutical properties of products (contributions of health-beneficial components from proteins, fats, vitamins, minerals) | 4. Bassi et al. 2021 |
| | 5. Impact on the genetics of farmed animals (e.g. good adaptability of animals to the mountain environment) | 5. Montrasio et al. 2020; Zhao et al. 2020 |
| Habitat and biodiversity (HB) | 1. Impact on habitat maintenance for plant biodiversity (e.g. number of floristic species present) | 1. Cocca et al. 2012; Yahdjian et al. 2015 |
| | 2. Impact on habitat maintenance for animal biodiversity (number of species present, e.g. butterflies, dragonflies, small animals … ) | 2. Hönigová et al. 2012, Yahdjian et al. 2015; Montrasio et al. 2020 |
| | 3. Impact on maintenance of local breeds (e.g. breeds of cattle, sheep, goats at risk of extinction) | 3. Montrasio et al. 2020 |
| Regulating (R) | 1. Impact on greenhouse gas emissions (reduction of co2 emissions) | 1. Yahdjian et al. 2015; Bengtsson et al. 2019 |
| | 2. Impact on water quality (purification and its better infiltration into the soil without flowing and eroding) | 2. Hönigová et al. 2012; Montrasio et al. 2020; Zhao et al. 2020 |
| | 3. Impact on soil fertilisation (through animal manure) | 3. Hönigová et al. 2012, Balzan et al. 2020 |
| | 4. Impact on reduction of carbon emissions and consequent accumulation in soil | 4. Hönigová et al. 2012; Ward et al. 2016; Zhao et al. 2020 |
| | 5. Impact on rockfall prevention (presence of shrub roots and grasses) | 5. Hönigová et al. 2012 |
| | 6. Impact on soil erosion (trampling and animal load) | 6. Tasser et al. 2003; Montrasio et al. 2020; Zhao et al. 2020; Balzan et al. 2020 |
| | 7. Impact on fire protection (removal of flammable material such as dry shrubs, invasive plants such as brambles, etc.) | 7. Ruiz-Mirazo and Robles 2012; Montrasio et al. 2020; Rouet-Leduc et al. 2021; Celaya et al. 2022 |
| | 8. Impact on impollation (e.g. encouraging bees and other insects and promoting seed and pollen dispersal) | 8. Hönigová et al. 2012, Montrasio et al. 2020; Balzan et al. 2020 |
| | 9. Impact on control of infesting animals and plant species (e.g. reduction of unwanted animals such as wild boars, other unwanted species, shrubby plants invading pastures) | 9. Hönigová et al. 2012, Jonsson et al. 2014; Bengtsson et al. 2019; Montrasio et al. 2020; Balzan et al. 2020 |
| Cultural (C) | 1. Impact on the conservation of typical landscape (e.g. beauty and quality of pastoral environments) | 1. Montrasio et al. 2020 |
| | 2. Impact on the maintenance of cultural heritage (e.g. art, architecture, spiritual, etc.) | 2. Bengtsson et al. 2019 |
| | 3. Impact on cultural identity and sense of belonging (e.g. language, place names) | 3. Montrasio et al. 2020 |
| | 4. Impact on artistic inspiration and aesthetic appreciation | 4. Hönigová et al. 2012, Yahdjian et al. 2015; Montrasio et al. 2020 |
| | 5. Impact on cultural initiatives (local culture, local festivals) | 5. Bassi et al. 2021 |
| | 6. Impact on recreational activities and tourism (e.g. activities with schools, children, agro-tourism, etc.) | 6. Hönigová et al. 2012; Bengtsson et al. 2019; Montrasio et al. 2020 |
| Animal welfare (AW) | 1. Impact (positive) on the animal welfare | 1. Dumont et al. 2019 |

socio-demographic characteristics (Table 3). A total of 216 completed interviews were gathered (with a 66% of responses rate). The number of participants was representative of the 10% of the sample of individuals who visit the study area in the summer to practice trekking (in function of the results of a local survey conducted at the municipal authority of Roccaforte Mondovì). The consisted sample was composed by 122 females (56%) and 94 males (44%). Notably, the under-30 age group constituted the most prominent segment, accounting for 38.4%. In contrast, the two age groups spanning from 30 to 70 years were equally represented. A mere 2.8% of the entire respondent population belongs to individuals over 70 years old.

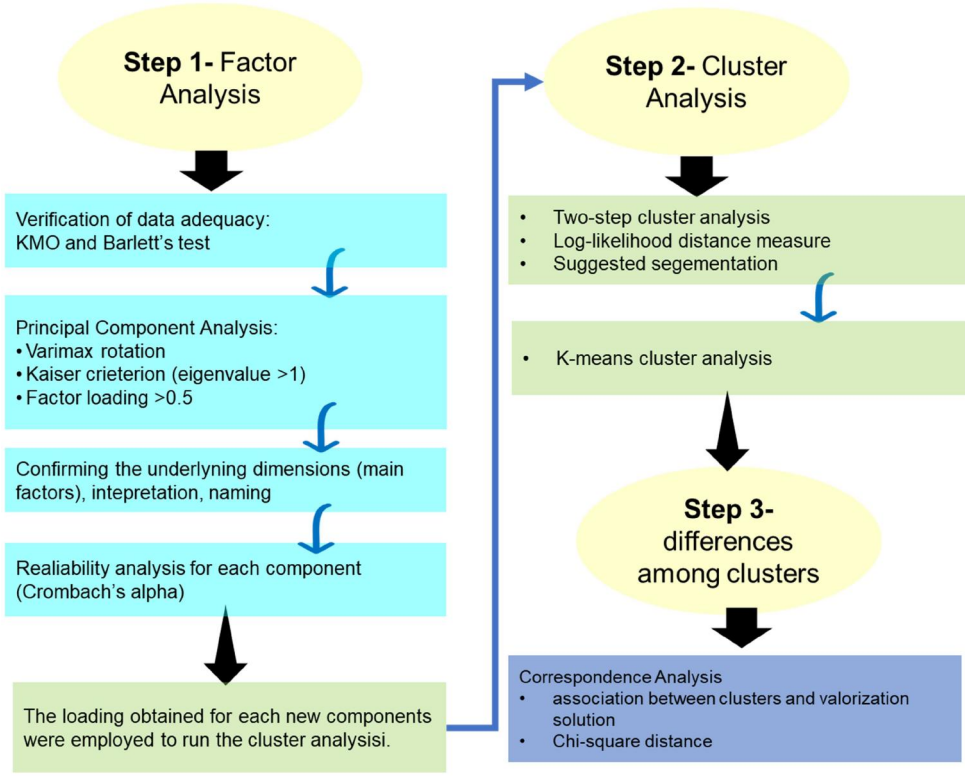


**Figure 2.** Adaptation of the schematic representation of the statistical method proposed by Yin et al. (2023).

**Table 2.** Valorisation initiatives scale (scale b).

| Items | References |
|---|---|
| 1. Do you think the presence of animals is indispensable for the alpine landscape? | 1. van Zanten et al. 2014; Wanner et al. 2021 |
| 2. Do you think that alpine pastures are beneficial to the ecosystem of the Alpine valley? | 2. Wanner et al. 2021 |
| 3. In your opinion, do the shepherds' activities promote tourism in the valley? | 3. Wanner et al. 2021 |
| 4. In your opinion, are the mountain pastures sufficiently valued? | 4. Wanner et al. 2021 |
| 5. To valorise the alpine vales, should typical cheese productions be incentivised? | 5. Montrasio et al. 2020; Pachoud et al. 2020 |
| 6. To valorise the alpine vales, should the development of initiatives for visits to the alpine pastures be encouraged? | 6. Zucaro et al. 2019 |
| 7. To valorise the alpine vales, it would be necessary to develop activities related to transhumance? | 7. Ghirardello et al. 2022 |
| 8. To valorise the alpine vales, it would be necessary to create routes and itineraries that make the alpine pastures reachable? | 8. Wanner et al. 2021 |

This outcome can be elucidated by the predominant use of social media as the primary channel for distributing the questionnaire, which is known to have limited usage among individuals in this age group (Udawatta et al. 2019).

Moreover, the sample was predominantly composed of individuals with high school and master's degrees. Finally, hikers were mainly residents of the municipalities bordering the study area (40.3%), followed by the residents of the municipality of the studied area (Roccaforte Mondovì) (33.8%). The sample composition was in line with the group of mountain tourists interviewed by Mazzocchi and Sali (2022) in terms of age, gender, and level of education. In addition, the socio-demographic characteristics of the considered sample was representative of other hiker's sample involved in scientific research, specifically in terms of age (Nemeth et al. 2021), gender (Ars 2013) and level of education (Ngxongo 2021).

### *Hikers' knowledge and preferences of ecosystem services*

The 36% of respondents declared to know the term "Ecosystem services". The perceived impact (mean index) of Alpine livestock systems on ES and AW by respondents is reported in Figure 3.

In general, the sample exhibited a medium-high perception of the mountain pasture livestock impact on ES, in accordance with previous findings (Faccioni et al. 2019; Montrasio et al. 2020).

**Table 3.** Percentage distribution of socio-demographic attributes in the sample.

| Socio-demographic variables | Item | % total of hiker sample |
|---|---|---|
| Age | < 30 | 38.4 |
| | 31 - 50 | 31.0 |
| | 51- 70 | 27.8 |
| | >70 | 2.8 |
| Gender | Male | 43.5 |
| | Female | 56.5 |
| Educational qualification | Primary school diploma | 0.5 |
| | Middle School diploma | 10.6 |
| | High school graduation | 51.4 |
| | First level degree | 11.1 |
| | II level degree | 25.0 |
| | Ph.D | 1.0 |
| | Post-Graduate Masters | 0.5 |
| Recidence | Roccaforte Mondovì | 33.8 |
| | Neighbouring municipalities | 40.3 |
| | Municipalities of the province | 17.1 |
| | Municipalities of the region | 4.2 |
| | Municipalities outside the region | 4.6 |
| Knowledge of the term "Ecosystem Services" | No | 64.0 |
| | Yes | 36.0 |


**Figure 3.** Average mean scores of preferences of perceived impacts of alpine livestock.

The lowest scores were recorded for water quality conservation and soil erosion mitigation. Hikers, therefore, considered that animal husbandry has neutral effects on these variables related to the sustainability of the Alpine environment; on the contrary, they evaluated animal husbandry as a practice that positively affects the higher nutritional and organoleptic quality of mountain products, as well as the preservation of animal welfare.

These two latter variables obtained the highest scores of impacts. This result enhances a perception of farming more oriented towards cultural and social aspects, rather than environmental ones (Oteros-Rozas et al. 2014). It would seem, however, assuming the contemporary positive evaluation of the effects on welfare and product quality, that hikers interpret these aspects as complementary from the perspective of an anthropocentric vision of the animal welfare (Faucitano et al. 2022), assuming the belief that the good condition of the animal generates better nutritional properties of the food (Massaglia et al. 2018). Therefore, this result showed an exaltation of the link between the animal, the territory, and the typical, more tangible and recognisable productions (Bernués et al. 2015).

### Principal component analysis

The Principal Component Analysis (PCA) conducted to analyse the visitors' perceptions of ecosystem services revealed that four distinct components could account for 66.9% of the variance (Table 4). For each component the Cronbach's alpha are reported, showing a coefficient consistently higher than 0.6, indicating appropriate internal consistency. Also, the Person correlation is adequate for the two-item component (Varaldo et al. 2022). The first component, named *livestock component,* contributes to 46.6% of the total variance and predominantly encompasses aspects closely associated with livestock production. Specifically, it was defined by the impacts of provisioning ecosystem services, preserving local breeds (about habitat and biodiversity ecosystem services), soil fertilisation facilitated by animal manure (related to regulatory ecosystem services), and animal welfare. This component enhances the positive effects of the relationship between animal breeding and the ecosystem in terms of helpful externalities for the environment and humans. In fact, the presence of native breeds, well adapted to the territory as they are more efficient in the use and maintenance of biodiversity (de Azambuja Ribeiro and González-García 2016), generates quality products and foods for humans (Boval and Dixon 2012; Zuliani et al. 2018). This perception is often supported by the general idea of the positive link between extensive livestock systems and the high level of animal welfare (Zuliani et al. 2018; Spigarelli et al. 2020).

In contrast, the second component, which explains 9.5% of the total variance, is the *environmental component*. This orientation pattern primarily includes assessments related to ecological aspects, specifically habitat maintenance for plant and animal biodiversity (related to habitat and biodiversity ecosystem services), greenhouse gas emissions, water quality, carbon soil accumulation, landslide prevention, soil erosion, and pollination (linked to regulatory ecosystem services). Unlike the intensive ones, the bucolic vision that emerges from pastoral systems causes an appreciation of the first regarding the optimistic effect that these have on the environment (Stampa et al. 2020). However, it is also confirmed that the picture of the positive impact of these systems on the environment is only sometimes validated by scientific evidence relating to individual ecosystem services (Pogue et al. 2018).

The third component, constituting 6.5% of the total variance, is the *cultural component*. It included all impacts associated with intellectual and traditional ecosystem services, encompassing the conservation of a characteristic landscape, the preservation of cultural

**Table 4.** Principal component analysis.

| | | Principal Component | | | |
|---|---|---|---|---|---|
| Category | Ecosystem services | Livestock component | Environmental component | Cultural component | Risk prevention component |
| P | Quantity of foods of animal origin | 0.526 | | | |
| P | Variety of products and their typicality | 0.767 | | | |
| P | Organoleptic quality of foods of animal origin | 0.825 | | | |
| P | Nutraceutical properties of the products | 0.797 | | | |
| P | Genetics of bred animals | 0.757 | | | |
| P | Maintenance of local breeds | 0.605 | | | |
| P | Soil fertilisation | 0.61 | | | |
| AW | Animal welfare | 0.712 | | | |
| HB | Maintenance of habitat for plant biodiversity | | 0.648 | | |
| HB | Habitat maintenance for animal biodiversity | | 0.621 | | |
| R | Pollination | | 0.642 | | |
| R | Greenhouse gas emissions | | 0.631 | | |
| R | Water quality | | 0.796 | | |
| R | Reduction of carbon emissions and consequent accumulation in the soil | | 0.718 | | |
| R | Landslide prevention | | 0.744 | | |
| R | Soil erosion | | 0.693 | | |
| C | Conservation of the typical landscape | | | 0.613 | |
| C | Maintenance of cultural heritage | | | 0.805 | |
| C | Cultural identity and sense of belonging | | | 0.646 | |
| C | Artistic inspiration and aesthetic appreciation | | | 0.744 | |
| C | Cultural initiatives | | | 0.784 | |
| | Recreational activities | | | 0.666 | |
| R | Fire protection | | | | 0.691 |
| R | Control of animals and weed plant species | | | | 0.637 |
| *Crombach' alpha* | | *0.856* | *0.745* | *0.723* | |
| *Pearson correlation* | | | | | *R = 0.849* |

heritage, cultural identity, a sense of belonging, artistic inspiration, aesthetic appreciation, cultural initiatives, and recreational activities. This appreciation could be ascribable to the vision of local pastoral systems as an ancient practice that must be preserved through the different forms proposed to define the cultural dimension of ES, like the practice of transhumance (Ghirardello et al. 2022), to maintain the integrity of the historical and cultural heritage of an ecosystem (Gandini and Villa 2003; Fish et al. 2016).

Lastly, the *risk prevention* component, explaining 4.3% of the total variance, incorporated two variables related to the impacts of regulatory ecosystem services, specifically the fire protection and the control of animals and weed plant species. In this case, hikers perceived the presence of animals and the shepherd/herdsman as the best management strategy for the territory to reduce abandonment and the vulnerability of the mountain area (Ruiz-Mirazo and Robles 2012; Rouet-Leduc et al. 2021; Bullock et al. 2021).

## Hikers' profiles

The results of the k-means analysis are reported in Table 5. The three-clusters solution resulted in the better solution by the TwoStep test. The ANOVA test highlighted how the individuals belonging to the three clusters differed significantly in their perception of ES. Similarly, other studies (Bruzzese et al. 2022; Muñoz-Ulecia et al. 2022) classified the sample into clusters with different impressions and preferences on this topic.

The socio-demographic description of the three obtained clusters is reported in Table 6.

The first cluster (23.6% of the total respondents), called "Environmentally conscious livestock sensitivity", was composed of individuals more sensitive to livestock and environmental components. These individuals considered livestock a positive element affecting the environmental maintenance and balances in the marginal area. Therefore, the connection between the two components, *livestock,* and *environment*, creates a flow of mutual advantages that is also utilised by humans to meet their own needs (Fu et al. 2013). The individuals belonging to this group were characterised by a higher proportion of younger individuals, with 41.9% falling under 30. Interestingly, within this cluster, individuals aged over 70 represent 7%, but they constitute 50% of the total number of respondents over 70 years old. Women represented the majority of this cluster (53.5%). In addition, most of this group had a medium-high level of education. Notably, 46.5% of the respondents in this cluster hail from the municipality of Roccaforte Mondovì (study area). As described by Valli et al. (2023) and Bifaretti et al. (2023), young people and women are more sensitive to environmental issues and critical of animal production (Sanchez-Sabate et al. 2019). In this research, in addition, the positive opinion towards extensive livestock systems may be influenced by the idea in the collective imagination of the more environmentally friendly practice of the mountain pasture (Stampa et al. 2020).

The second cluster (17.6%), named "Cultural appreciation of livestock farming" was composed by individuals sensitive to the cultural benefits provided by livestock farmers and their herds. Individuals therefore attributed mountain farming mainly an advantageous role in handing on the cultural heritage of the valley.

Therefore, one should not underestimate the possible tourism benefit through the different forms in which cultural heritage can manifest itself (Montrasio et al. 2020); examples of this are: a) the practice of transhumance, b) the ancient cheese ripening facilities ("Selle"), c) possible mountain tours, e) dialect expressions. Furthermore, one cannot forget the importance of the hiker's aesthetic appreciation of the valley itself, which certainly can create a spiritual connection and, thus well-being for human beings (Huynh et al. 2022). This group consisted mainly of women (62.5%) and individuals aged between 31 and 50 (37.5%). Most of the walkers in this group had a higher education qualification (56.3%). Since most of the respondents are not residents of the study area, preference falls on aspects that may be of interest for cultural tourism.

**Table 5.** Hikers' profiles and ANOVA results.

| Components | Environmentally conscious livestock sensitivity | Cultural appreciation of livestock farming | Holistic ecosystem service perspective | *F* | *p*-value |
|---|---|---|---|---|---|
| Livestock component | 0.254 | −1.139 | 0.238 | 34.556 | *** |
| Environmental component | 0.100 | −1.082 | 0.283 | 30.93 | *** |
| Cultural component | −0.297 | 0.309 | 0.027 | 3.576 | * |
| Risk prevention component | −1.290 | −0.06 | 0.536 | 117.106 | *** |

**Table 6.** Percentage distribution of socio-demographic attributes in the three clusters of respondents.

| Variables | | Environmentally conscious livestock sensitivity | Cultural appreciation of livestock farming % | Holistic ecosystem service perspective |
|---|---|---|---|---|
| Age | <30 | 41.9 | 34.4 | 38.3 |
| | 31–50 | 34.9 | 37.5 | 29.0 |
| | 51–70 | 16.3 | 25.0 | 31.8 |
| | >70 | 7.0 | 3.1 | 0.9 |
| Gender | Male | 46.5 | 37.5 | 64.5 |
| | Female | 53.5 | 62.5 | 35.5 |
| Educational qualification | Primary school diploma | – | – | 0.9 |
| | Middle School diploma | 9.3 | 9.4 | 8.4 |
| | High school graduation | 51.2 | 56.3 | 53.3 |
| | First level degree | 11.6 | 6.3 | 14 |
| | II level degree | 27.9 | 25.0 | 22.4 |
| | Ph.D | – | 3.1 | – |
| | Post-Graduate Masters | – | – | 0.9 |
| Recidence | Roccaforte Mondovì | 46.5 | 28.1 | 29.9 |
| | Neighbouring municipalities | 32.6 | 50 | 43.9 |
| | Municipalities of the province | 16.3 | 12.5 | 16.8 |
| | Municipalities of the region | 2.3 | 3.1 | 4.7 |
| | Municipalities outside the region | 2.3 | 6.3 | 4.7 |
| Knowledge of the term "Ecosystem Services" | No | 62.8 | 78.1 | 60.7 |
| | Yes | 37.2 | 21.9 | 39.3 |

Finally, the third cluster (58.8%), "Holistic ecosystem service perspective", has a more all-inclusive view of the impact of these livestock systems on all categories of ecosystem services; thus, believing that all the proposed benefits are provided to the Upper Ellero Valley ecosystem. In this group the 38.3% were under 30 and were mainly men (64.5%). Most respondents are graduates (53.3%), and 43.9% come from the municipalities surrounding Roccaforte Mondovì. The perception of the young men interviewed was certainly broader than in the first two clusters, not limiting themselves to seeing mountain pasture livestock farming as a supplier only of raw materials and positive returns for the environment or solely of cultural benefits. It is assumed that this vision was due to the multifunctional role of livestock farming, especially extensive livestock farming (Muñoz-Ulecia et al. 2022).

Generally, the three obtained clusters were different in terms of different perceptions of the benefits provided by the breeding in the considered area and some socio-demographic characteristics. Oteros-Rozas et al. (2014) found that the importance of individual ecosystem services varied over a person's lifetime, while our study establishes only one relationship between age and perceptions in the case of the first cluster. Gender, however, plays a role, with women showing a more specific perception of ecosystem service impacts on animal welfare (Fortnam et al. 2019; Blanc et al. 2020). Educational qualifications were found to be less discriminating, in contrast to Montrasio et al. (2020), where respondents with a medium-high level of education perceived the impacts of production systems more positively. García-Llorente et al. (2020) found that individuals with higher education preferred cultural ecosystem services, while those with lower education levels favoured supply ecosystem services. Geographically, the residents of Roccaforte Mondovì feature prominently in the first cluster, while the second and third clusters have a higher representation of residents from neighbouring municipalities. Notably, the last cluster includes more individuals from the province's municipalities. This suggests that one's proximity to the study area may influence their perception of the ecosystem services (Liu et al. 2016; Mikusiński and Niedziałkowski 2020).

## Land valorisation

The results of the Correspondence analysis are described in Figure 4. The eigenvalues (estimated dimensions, single values, inertia, and proportion explained by each dimension) and appropriate dimensionality determination of the CA [(clusters x valorisation strategies) are reported in Table 7. The accepted dimensions are highlighted in bold.

According to Hair et al. (1998), a one-dimensional solution can be accepted (dimension with 90.70% of the total variance of the axis explained).

As show in Figure 4, the cluster "Environmentally conscious livestock sensitivity" considered the presence of animals, together with the possibility of reaching the herds on the Alpine pastures, as important strategies for the territory valorisation (van Zanten et al. 2014). The individuals of this group were aware about the

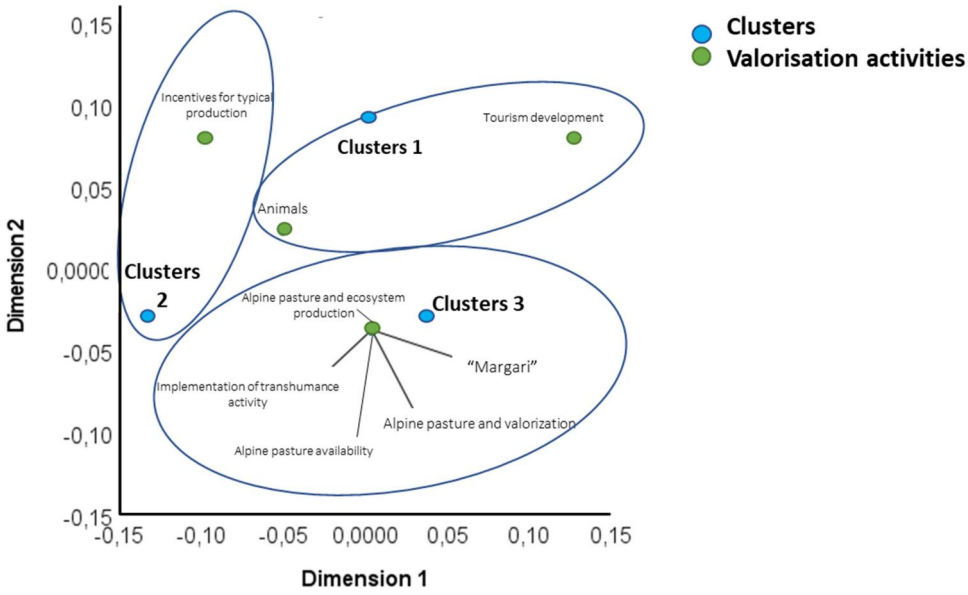


**Figure 4.** Results of correspondence analysis.
**Cluster 1** = Environmentally conscious livestock sensitivity; **Cluster 2** = Cultural appreciation of livestock farming; **Cluster 3** = Holistic ecosystem service perspective.
**Association between the questions (scale b) and the obtained variables = ANIMALS**: Do you think the presence of animals is indispensable for the alpine landscape?; **ALPINE PASTURE AND ECOSYSTEM PRODUCTION:** Do you think alpine pastures benefit the ecosystem of the alpine valley?; **MARGARI**: In your opinion, do the shepherds' activities promote tourism in the valley?; **ALPINE PASTURE VALORISATION:** In your opinion, are the mountain pastures sufficiently valued?; **INCENTIVES FOR TYPICAL PRODUCTION:** Should typical cheese productions be incentivised to valorise the alpine vales?; **TOURISM DEVELOPMENT:** To valorise the alpine valleys, should the development of initiatives to visit the alpine pastures be encouraged?; **IMPLEMENTATION OF TRANSHUMANT ACTIVITY:** To valorise the alpine vales, it would be necessary to develop activities related to transhumance?; **ALPINE PASTURE AVAILABILITY:** To valorise the alpine valleys, it would be required to create routes and itineraries that make the alpine pastures reachable?

**Table 7.** Eigenvalues and appropriate dimensionality determination of the dimensions.

| Dimensions | Singular value | Inertia | Proportion explained % | Cumulative proportion % | Chi Square | Sign. |
|---|---|---|---|---|---|---|
| **1** | **0.455** | **0.344** | **0.907** | **0.986** | 170.966 | *** |
| 2 | 0.067 | 0.004 | 0.093 | 1.000 | | |
| Total | | 0.348 | 1.000 | 1.000 | | |

The accepted dimensions are highlighted in bold. The *p*-value refers to the statistical significance level.
***<0.001.

influence of mountain pasture livestock farming on the ecosystem (Fraser et al. 2022), preserving the characteristic landscape (Bernués et al. 2015) and the very possibility for tourists to use the valley. Similar results were found in the study by Schirpke et al. (2016).

Instead, the cluster "Cultural appreciation of livestock farming", was more associated with the initiatives that encourages local dairy production. In fact, a typical food product, such as cheese, can be a helpful tourism resource (Montrasio et al. 2020). This perspective probably emerged from the association of dairy production with the traditional aspects of the territory (Merlino et al. 2022). However, regarding the categorisation of SEs, typical food is not traced back to cultural SEs, but to supply SEs.

Finally, the cluster "Holistic ecosystem service perspective", instead considered combining different strategies for an effective valorisation of the territory based on the tourist and support of the mountain pastures ecosystem. The tools were: *margari*, transhumance, and the creation of itineraries. In fact, the hikers in this cluster demonstrate that they have a holistic vision both in terms of perception of the ES and regarding tourist valorisation. In fact, this group of individuals considered the presence of the herds advantageous for the ecosystem and the presence of the herdsmen themselves. As regards the proposed activities, they were associated with initiatives related to transhumance and the creation of routes to reach the mountain pastures. It is therefore demonstrated: a) the desire for the mountain pastures to be better valorised and preserved and b) the need to collectively strengthen all the strategies for the creation of the agro-eco-tourism (Giaccio et al. 2018; Hatan et al. 2021; Ferreira and Sánchez-Martín 2022).

## Implications

The study underscores the significance of mountain alpine livestock system in shaping hikers' perception

definition of ecosystem services meaning, acknowledging the practical implications of environment, social and economic preservation of marginal area. In fact, the results refect tangible implications for elaborating social and economic development strategies in Alpine Mountain valleys, the nerve centres of national mountain livestock farming. Specifically, the enhancement proposals widely shared by the interviewees, such as local dairy productions, guided tours, activities during transhumance, and finally the creation of trails with appropriate signs, imply the preparation of targeted development plans to meet the needs of consumers (Zucaro et al. 2019). In particular, in the study by Montrasio et al. (2020) it is highlighted that tying the production of a typical cheese to tourist events is an effective method, not only for supplementing the income of *margari*, but also for enhancing the valley. To implement this, it is hypothesised that the implementation of local policies that allow the development of a type of hiking related to the presence of herds on alpine pastures is useful. Oteros-Rozas et al. (2014) discussed the need for policy action to conserve alpine nomadism and thus influence the provision of SE.

Assessing the potential implications for future tourism related to these peripheral farming practices is imperative.

## Conclusion

The results of this research shed light on a relatively lesser-known perspective of ecosystem services in Alpine valleys. Despite its limited recognition, walkers show a positive attitude towards the impact of herds on ecosystem services (ES), expressing a strong interest in exploiting herd systems to further enhance the area. Moreover, different views emerged regarding the potential benefits of herds and the use of these aspects within various tourism development strategies. This research underscores the importance of addressing private strategies and implementing effective public policies to promote social and economic development in Alpine mountain valleys. Private strategies should focus on promoting sustainable tourism practices that capitalise on the potential benefits of herds and their positive impact on ES. Local businesses, tourism operators, and herders can collaborate to create sustainable tourism experiences focused on herds. Public policies should prioritise conservation and sustainable management of natural resources, while also promoting socio-economic development in the region. Therefore, public policies should focus on providing financial support and incentives for businesses to adopt sustainable practices, developing destination management plans that balance conservation with sustainable development, and finally promoting stakeholder collaboration for peaceful management and coexistence in protected areas. Due to the correspondence obtained from the three clusters of hikers and the valorisation strategies cited in the questionnaire, the planning of the following proposals by public institutions and the valley's farmers is suggested: (a) the creation of itineraries to reach the mountain pastures in order to see the cattle, (b) the return to the production and the commercialisation of typical dairy products of the area and (c) the creation of tourist and cultural initiatives linked to the practice of transhumance.

In conclusion, the varying degrees of sensitivity observed between clusters probably stem from undiscovered personal influences. Although not directly explored in the questionnaire, it is plausible that local ecological knowledge plays a role in shaping these perceptions. This latter element, together with the limited area of research exploration, represents the research's main limitations.

## Acknowledgment

the author Valentina Marina Merlino worked at this study within the Agritech National Research Center and received funding from the European Union Next GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 D.D. 1032 17/06/2022, CN00000022). This research reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

## Ethical statement

The research adhered to the principles outlined in the Declaration of Helsinki. All participants acknowledged an informed consent statement to participate in the study. The online survey was conducted anonymously, and respondents were required to provide consent before participating.

## Disclosure statement

None.

## Funding

Not applicable.

## ORCID

Valentina Maria Merlino http://orcid.org/0000-0003-1894-2058
Paolo Cornale http://orcid.org/0000-0003-0150-342X
Luca Maria Battaglini http://orcid.org/0000-0002-2136-3826

## Data availability statement

The datasets used and/or analysed during the current study are available from the corresponding author upon request.

## References

Accatino F, Tonda A, Dross C, Léger F, Tichit M. 2019. Trade-offs and synergies between livestock production and other ecosystem services. Agric Syst. 168:58–72. doi: 10.1016/j.agsy.2018.08.002.

Anastasiou E, Balafoutis AT, Fountas S. 2023. Applications of extended reality (XR) in agriculture, livestock farming, and aquaculture: a review. Smart Agricul Technol. 3:100105. doi: 10.1016/j.atech.2022.100105.

Ars MS. 2013. Evaluation of hikers' pro-environmental behaviour in Triglav National Park. Slovenia. Eco. Mont. 5(1):35–42.

Ayele D, Zewotir T, Mwambi H. 2014. Multiple correspondence analysis as a tool for analysis of large health surveys in African settings. Afr Health Sci. 14(4):1036–1045. doi: 10.4314/ahs.v14i4.35.

de Azambuja Ribeiro EL, González-García E. 2016. Indigenous sheep breeds in Brazil: potential role for contributing to the sustainability of production systems. Trop Anim Health Prod. 48(7):1305–1313. doi: 10.1007/s11250-016-1109-3.

Balzan MV, Sadula R, Scalvenzi L. 2020. Assessing ecosystem services supplied by agroecosystems in Mediterranean Europe: a literature review. Land. 9(8):245. doi: 10.3390/land9080245.

Bassi I, Carzedda M, Grassetti L, Iseppi L, Nassivera F. 2021. Consumer attitudes towards the mountain product label: implications for mountain development. J Mt Sci. 18(9):2255–2272. doi: 10.1007/s11629-020-6616-z.

Battaglini L, Bovolenta S, Gusmeroli F, Salvador S, Sturaro E. 2014. Environmental Sustainability of Alpine Livestock Farms. Ital J Anim Sci. 13(2):3155. doi: 10.4081/ijas.2014.3155.

Bautista-Rodríguez SC, Melgarejo-Carreño VA, Pardo MC. 2020. Challenges and trends in the valuation of ecosystem services in agro-ecosystems: a systematic revision. Trop Subtrop Agroecosyst. 23(1):1–32. doi: 10.56369/tsaes.2665.

Beldona S, Morrison A, O'Leary J. 2005. Online shopping motivations and pleasure travel products: a correspondence analysis. Tour Manag. 26(4):561–570. doi: 10.1016/j.tourman.2004.03.008.

Bengtsson J, Bullock JM, Egoh B, Everson C, Everson T, O'Connor T, O'Farrell PJ, Smith HG, Lindborg R. 2019. Grasslands—more important for ecosystem services than you might think. Ecosphere. 10(2):e02582. doi: 10.1002/ecs2.2582.

Bernués A, Alfnes F, Clemetsen M, Eik LO, Faccioni G, Ramanzin M, Ripoll-Bosch R, Rodríguez-Ortega T, Sturaro E. 2019. Exploring social preferences for ecosystem services of multifunctional agriculture across policy scenarios. Ecosyst Serv. 39:101002. doi: 10.1016/j.ecoser.2019.101002.

Bernués A, Rodríguez-Ortega T, Alfnes F, Clemetsen M, Eik LO. 2015. Quantifying the multifunctionality of fjord and mountain agriculture by means of sociocultural and economic valuation of ecosystem services. Land Use Policy. 48:170–178. doi: 10.1016/j.landusepol.2015.05.022.

Bernués A, Rodríguez-Ortega T, Ripoll-Bosch R, Alfnes F. 2014. Socio-cultural and economic valuation of ecosystem services provided by mediterranean mountain agroecosystems. PLoS ONE. 9(7):e102479. doi: 10.1371/journal.pone.0102479.

Bernués A, Tenza-Peral A, Gómez-Baggethun E, Clemetsen M, Eik LO, Martín-Collado D. 2022. Targeting best agricultural practices to enhance ecosystem services in European mountains. J Environ Manage. 316:115255. doi: 10.1016/j.jenvman.2022.115255.

Bifaretti A, Pavan E, Grigioni G. 2023. Consumer attitudes and concerns about beef consumption in Argentina and other south american countries. Agriculture. 13(3):560. doi: 10.3390/agriculture13030560.

Bisio L, Giachino PM, Allegro G, Giuntelli P. 2015. I Coleotteri Carabidi della Val Ellero e della Val Maudagna. Rivista Piemontese di Storia Naturale. 36:171–214.

Blanc S, Massaglia S, Borra D, Mosso A, Merlino VM. 2020. Animal welfare and gender: a nexus in awareness and preference when choosing fresh beef meat? Ital J Anim Sci. 19(1):410–420. doi: 10.1080/1828051X.2020.1747952.

Boval M, Dixon RM. 2012. The importance of grasslands for animal production and other functions: a review on management and methodological progress in the tropics. Animal. 6(5):748–762. doi: 10.1017/S1751731112000304.

Briner S, Huber R, Bebi P, Elkin C, Schmatz DR, Grêt-Regamey A. 2013. Trade-offs between ecosystem services in a mountain region. E&S. 18(3):35–54. doi: 10.5751/ES-05576-180335.

Broen MPG, Moonen AJH, Kuijf ML, Dujardin K, Marsh L, Richard IH, Starkstein SE, Martinez–Martin P, Leentjens AFG. 2015. Factor analysis of the Hamilton depression rating scale in Parkinson's disease. Parkinsonism Relat Disord. 21(2):142–146. doi: 10.1016/j.parkreldis.2014.11.016.

Bruzzese S, Blanc S, Merlino VM, Massaglia S, Brun F. 2022. Civil society's perception of forest ecosystem services. A case study in the Western Alps. Front Psychol. 13:1000043.https://www.frontiersin.org/articles/. doi: 10.3389/fpsyg.2022.1000043.

Bullock JM, McCracken ME, Bowes MJ, Chapman RE, Graves AR, Hinsley SA, Hutchins MG, Nowakowski M, Nicholls DJE, Oakley S, et al. 2021. Does agri-environmental management enhance biodiversity and multiple ecosystem services?: A farm-scale experiment. Agriculture, Ecosystems & Environment. 320:107582. doi: 10.1016/j.agee.2021.107582.

Celaya R, Ferreira LMM, Lorenzo JM, Echegaray N, Crecente S, Serrano E, Busqué J. 2022. Livestock management for the delivery of ecosystem services in fire-prone Shrublands of Atlantic Iberia. Sustainability. 14(5):2775. doi: 10.3390/su14052775.

Choudhary B, Kareem S, Qadir A, Hussain S. 2023. Mountain destinations and COVID-19: an overview of impacts and implications. In: Dube K, Nhamo G, Swart M, editors. COVID-19, Tourist Destinations and Prospects for Recovery: Volume One: a Global Perspective. Cham: Springer International Publishing; p. 101–112. doi: 10.1007/978-3-031-22257-3_6.

Cocca G, Sturaro E, Gallo L, Ramanzin M. 2012. Is the abandonment of traditional livestock farming systems the main driver of mountain landscape change in Alpine areas? Land Use Policy. 29(4):878–886. doi: 10.1016/j.landusepol.2012.01.005.

Costanza R, De Groot R, Braat L, Kubiszewski I, Fioramonti L, Sutton P, Farber S, Grasso M. 2017. Twenty years of ecosystem services: how far have we come and how far do we still need to go? Ecosyst Serv. 28:1–16. doi: 10.1016/j.ecoser.2017.09.008.

Dumont B, Ryschawy J, Duru M, Benoit M, Chatellier V, Delaby L, Donnars C, Dupraz P, Lemauviel-Lavenant S, Méda B, et al. 2019. Review: associations among goods, impacts and ecosystem services provided by livestock farming. Animal. 13(8):1773–1784. doi: 10.1017/S1751731118002586.

Faccioni G, Sturaro E, Ramanzin M, Bernués A. 2019. Socio-economic valuation of abandonment and intensification of Alpine agroecosystems and associated ecosystem services. Land Use Policy. 81:453–462. doi: 10.1016/j.landusepol.2018.10.044.

Faucitano L, Martelli G, Nannoni E, Manteca X. 2022. Fundamentals of animal welfare in meat animals and consumer attitudes to animal welfare. In: Purslow PP, editor. New aspects of meat quality: from genes to ethics. Duxford, UK: Woodhead Publishing; p. 537–568. ISBN 9780081005934. https://www.sciencedirect.com/science/article/pii/B9780323858793000210.

Fish R, Church A, Winter M. 2016. Conceptualising cultural ecosystem services: a novel framework for research and critical engagement. Ecosyst Serv. 21:208–217. doi: 10.1016/j.ecoser.2016.09.002.

Fortnam M, Brown K, Chaigneau T, Crona B, Daw TM, Gonçalves D, Hicks C, Revmatas M, Sandbrook C, Schulte-Herbruggen B. 2019. The gendered nature of ecosystem services. Ecol Econ. 159:312–325. doi: 10.1016/j.ecolecon.2018.12.018.

Fraser MD, Vallin HE, Roberts BP. 2022. Animal board invited review: grassland-based livestock farming and biodiversity. Animal. 16(12):100671. doi: 10.1016/j.animal.2022.100671.

Fu B, Wang S, Su C, Forsius M. 2013. Linking ecosystem processes and ecosystem services. Current Opinion Environ Sustain. 5(1):4–10. doi: 10.1016/j.cosust.2012.12.002.

Gandini GC, Villa E. 2003. Analysis of the cultural value of local livestock breeds: a methodology. J Animal Breeding Genetics. 120(1):1–11. doi: 10.1046/j.1439-0388.2003.00365.x.

García-Llorente M, J. Castro A, Quintas-Soriano C, Oteros-Rozas E, Iniesta-Arandia I, González JA, García del Amo D, Hernández-Arroyo M, Casado-Arzuaga I, Palomo I, et al. 2020. Local perceptions of ecosystem services across multiple ecosystem types in Spain. Land. 9(9):330. doi: 10.3390/land9090330.

Ge B, Wang C, Song Y. 2023. Ecosystem services research in rural areas: a systematic review based on bibliometric analysis. Sustainability. 15(6):5082. doi: 10.3390/su15065082.

Genovese D, Culasso F, Giacosa E, Battaglini LM. 2017. Can livestock farming and tourism coexist in mountain regions? A new business model for sustainability. Sustainability. 9(11):2021. doi: 10.3390/su9112021.

Ghirardello L, Walder M, de Rachewiltz M, Erschbamer G. 2022. Cultural sustainability from the local perspective: the example of transhumance in South Tyrol. Sustainability. 14(15):9052. doi: 10.3390/su14159052.

Giaccio V, Giannelli A, Mastronardi L. 2018. Explaining determinants of agri-tourism income: Evidence from Italy. TR. 73(2):216–229. doi: 10.1108/TR-05-2017-0089.

Greenacre M. 2017. Correspondence analysis in practice. Chapman and hall/crc. London: Academic Press.

Grêt-Regamey A, Brunner SH, Kienast F. 2012. Mountain ecosystem services: who cares? Mt Res Dev. 32(S1):S23–S34. doi: 10.1659/MRD-JOURNAL-D-10-00115.S1.

Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL. 1998. Multivariate Data Analysis. Prentice hall, Upper Saddle River, NJ.

Harcar T, Spillan JE. 2006. Exploring Latin American family decision-making using correspondence analysis. J World Business. 41(3):221–232. doi: 10.1016/j.jwb.2006.01.009.

Hatan S, Fleischer A, Tchetchik A. 2021. Economic valuation of cultural ecosystem services: the case of landscape aesthetics in the agritourism market. Ecol Econ. 184:107005. doi: 10.1016/j.ecolecon.2021.107005.

Hill BD. 2011. The sequential Kaiser-Meyer-Olkin procedure as an alternative for determining the number of factors in common-factor analysis: a Monte Carlo simulation. [Dissertation & Theses]. Oklahoma State University ProQuest; p. 1–24.

Hoffmann I, From T, Boerma D. 2014. Ecosystem services provided by livestock species and breeds, with special consideration to the contributions of small-scale livestock keepers and pastoralists. FAO, Rome. http://www fao org/3/a-at598e pdf.

Hönigová I, Vačkář D, Lorencová E, Melichar J, Götzl M, Sonderegger G, Ouškova V, Hošek M, Chobot K. 2012. Survey on grassland ecosystem services. Report to the EEA—European Topic Centre on Biological Diversity, Prague: nature Conservation Agency of the Czech Republic.

Huang J, Tichit M, Poulot M, Darly S, Li S, Petit C, Aubry C. 2015. Comparative review of multifunctionality and ecosystem services in sustainable agriculture. J Environ Manage. 149:138–147. doi: 10.1016/j.jenvman.2014.10.020.

Huynh LTM, Gasparatos A, Su J, Dam Lam R, Grant EI, Fukushi K. 2022. Linking the nonmaterial dimensions of human-nature relations and human well-being through cultural ecosystem services. Sci Adv. 8(31):eabn8042. doi: 10.1126/sciadv.abn8042.

Ianniello A. 2009. Mutualità e solidarietà sociale a Roccaforte Mondovì. Centro per la cultura cooperativa. 1–141.

ISTAT. 2023. http://dati.istat.it/Index.aspx?QueryId=18540/. [accessed 2023 Dec 13].

Jonsson M, Bommarco R, Ekbom B, Smith HG, Bengtsson J, Caballero-Lopez B, Winqvist C, Olsson O. 2014. Ecological production functions for biological control services in

agricultural landscapes. Methods Ecol Evol. 5(3):243–252. doi: 10.1111/2041-210X.12149.

Kaynak E, Kucukemiroglu O. 2001. A comparative study of family decision making in US and Turkish households by correspondence analysis. J Target Meas Anal Mark. 9(3): 254–269. doi: 10.1057/palgrave.jt.5740020.

Lana RM, Riback TIS, Lima TFM, da Silva-Nunes M, Cruz OG, Oliveira FGS, Moresco GG, Honório NA, Codeço CT. 2017. Socioeconomic and demographic characterization of an endemic malaria region in Brazil by multiple correspondence analysis. Malar J. 16(1):397. doi: 10.1186/s12936-017-2045-z.

Liu H, Hou L, Kang N, Nan Z, Huang J. 2022. The economic value of grassland ecosystem services: a global meta-analysis. Grassland Res. 1(1):63–74. doi: 10.1002/glr2.12012.

Liu Y, Zhang L, Wei X, Xie P. 2016. Integrating the spatial proximity effect into the assessment of changes in ecosystem services for biodiversity conservation. Ecol Indic. 70: 382–392. doi: 10.1016/j.ecolind.2016.06.019.

Mangano S, Piana P, Spotorno M. 2023. Tourism, environment and italian internal areas at the time of COVID-19: new challenges and opportunities. In: Das RC, editors. Economic, environmental and health consequences of conservation capital. Singapore: Springer. p. 259–271. https://doi.org/10.1007/978-981-99-4137-7_19.

Marsoner T, Egarter Vigl L, Manck F, Jaritz G, Tappeiner U, Tasser E. 2018. Indigenous livestock breeds as indicators for cultural ecosystem services: a spatial analysis within the Alpine Space. Ecol Indic. 94:55–63. doi: 10.1016/j.ecolind.2017.06.046.

Massaglia S, Merlino VM, Borra D. 2018. Marketing strategies for animal welfare meat identification: comparison of preferences between millennial and conventional consumers. Calitatea-Acces La Succes. 19(1):305–311.

Mazzocchi C, Sali G. 2022. Tourists' perception of ecosystem services provided by mountain agriculture. Sustainability. 14(19):12171. doi: 10.3390/su141912171.

MEA. 2005. Ecosystems and human well-being: synthesis. Washington, DC: Island Press.

Merlino VM, Fracassetti D, Di Canito A, Pizzi S, Borra D, Giuggioli NR, Vigentini I. 2021. Is the consumer ready for innovative fruit wines? Perception and acceptability of young consumers. Foods. 10(7):1545. doi: 10.3390/foods10071545.

Merlino VM, Massaglia S, Blanc S, Brun F, Borra D. 2022. Differences between Italian specialty milk in large-scale retailing distribution. Economia Agro-Alimentare/Food Economy—Open Access. 24(2):1–28. doi: 10.3280/ecag2022oa13173.

Merlino VM, Renna M, Nery J, Muresu A, Ricci A, Maggiolino A, Celano G, De Ruggieri B, Tarantola M. 2022. Are local dairy products better? Using principal component analysis to investigate consumers' perception towards quality, sustainability, and market availability. Animals (Basel). 12(11): 1421. doi: 10.3390/ani12111421.

Mikusiński G, Niedziałkowski K. 2020. Perceived importance of ecosystem services in the Bia\lowieża Forest for local communities—does proximity matter? Land Use Policy. 97:104667. doi: 10.1016/j.landusepol.2020.104667.

Montrasio R, Mattiello S, Zucaro M, Genovese D, Battaglini L. 2020. The perception of ecosystem services of mountain farming and of a local cheese: an analysis for the touristic valorization of an inner Alpine area. Sustainability. 12(19): 8017. doi: 10.3390/su12198017.

Muñoz-Ulecia E, Bernués A, Ondé D, Ramanzin M, Soliño M, Sturaro E, Martín-Collado D. 2022. People's attitudes towards the agrifood system influence the value of ecosystem services of mountain agroecosystems. PLoS ONE. 17(5):e0267799. doi: 10.1371/journal.pone.0267799.

Nabarro D, Wannous CJ. 2014. The potential contribution of livestock to food and nutrition security: the application of the One Health approach in livestock policy and practice. Rev Sci Tech. 33(2):475–485.

Nemeth N, Adams VM, Byrne JA. 2021. Factors affecting the preparedness of overnight hikers in national parks: insights from Tasmania, Australia. J Outdoor Recreation Tour. 35:100388. doi: 10.1016/j.jort.2021.100388.

Nieto-Romero M, Oteros-Rozas E, González JA, Martín-López B. 2014. Exploring the knowledge landscape of ecosystem services assessments in Mediterranean agroecosystems: insights for future research. Environ Sci Policy. 37:121–133. doi: 10.1016/j.envsci.2013.09.003.

Ngxongo NA. 2021. The impact of climate change on visitor destination selection: a case study of the Central Drakensberg Region in KwaZulu-Natal. Jàmbá: Journal of Disaster Risk Studies. 13(1):1161–1171. doi: 10.4102/jamba.v13i1.1161.

Ortu E, David F, Caramiello R. 2003. Rôle de l'homme dans l'histoire de la végétation de la vallée Ellero (Alpes maritimes, Italie). Comptes Rendus Biologies. 326(7):631–637. doi: 10.1016/S1631-0691(03)00155-0.

Oteros-Rozas E, Martín-López B, González JA, Plieninger T, López CA, Montes C. 2014. Socio-cultural valuation of ecosystem services in a transhumance social-ecological network. Reg Environ Change. 14(4):1269–1289. doi: 10.1007/s10113-013-0571-y.

Pachoud C, Da Re R, Ramanzin M, Bovolenta S, Gianelle D, Sturaro E. 2020. Tourists and local stakeholders' perception of ecosystem services provided by summer farms in the Eastern Italian Alps. Sustainability. 12(3):1095. doi: 10.3390/su12031095.

Pastorini FM, Salsotto A, Bignami GR. 1980. Alpicoltura in Piemonte. Indagini e ricerche sull'attività pastorale e ricensimento dei pascoli montani. Unione Camere Commercio Industria Artigianato Agricoltura Del Piemonte.

Pecher C, Bacher M, Tasser E, Tappeiner U. 2018. Agricultural landscapes between intensification and abandonment: the expectations of the public in a Central-Alpine cross-border region. Landscape Res. 43(3):428–442. doi: 10.1080/01426397.2017.1315062.

Pisani D, Pazienza P, Perrino EV, Caporale D, De Lucia C. 2021. The economic valuation of ecosystem services of biodiversity components in protected areas: a review for a framework of analysis for the Gargano National Park. Sustainability. 13(21):11726. doi: 10.3390/su132111726.

Pogue SJ, Kröbel R, Janzen HH, Beauchemin KA, Legesse G, De Souza DM, Iravani M, Selin C, Byrne J, McAllister TA. 2018. Beef production and ecosystem services in Canada's prairie provinces: a review. Agric Syst. 166:152–172. doi: 10.1016/j.agsy.2018.06.011.

Ferreira DIR, Sánchez-Martín J-M. 2022. Agricultural Landscapes as a Basis for Promoting Agritourism in Cross-Border Iberian Regions. Agriculture (Basel). 12(5):716. doi: 10.3390/agriculture12050716.

Rodrigues V, Estrany J, Ranzini M, de Cicco V, Martín-Benito JMT, Hedo J, Lucas-Borja ME. 2018. Effects of land use and seasonality on stream water quality in a small tropical catchment: the headwater of Córrego Água Limpa, São Paulo (Brazil). Sci Total Environ. 622-623:1553–1561. doi: 10.1016/j.scitotenv.2017.10.028.

Rodríguez-Ortega T, Oteros-Rozas E, Ripoll-Bosch R, Tichit M, Martín-López B, Bernués A. 2014. Applying the ecosystem services framework to pasture-based livestock farming systems in Europe. Animal. 8(8):1361–1372. doi: 10.1017/S1751731114000421.

Rouet-Leduc J, Pe'er G, Moreira F, Bonn A, Helmer W, Shahsavan Zadeh SAA, Zizka A, van der Plas F. 2021. Effects of large herbivores on fire regimes and wildfire mitigation. J Appl Ecol. 58(12):2690–2702. doi: 10.1111/1365-2664.13972.

Ruiz-Mirazo J, Robles AB. 2012. Impact of targeted sheep grazing on herbage and holm oak saplings in a silvopastoral wildfire prevention system in south-eastern Spain. Agroforest Syst. 86(3):477–491. doi: 10.1007/s10457-012-9510-z.

Ryschawy J, Disenhaus C, Bertrand S, Allaire G, Aznar O, Plantureux S, Josien E, Guinot C, Lasseur J, Perrot C, et al. 2017. Assessing multiple goods and services derived from livestock farming on a nation-wide gradient. Animal. 11(10):1861–1872. doi: 10.1017/S1751731117000829.

Sanchez-Sabate R, Badilla-Briones Y, Sabaté J. 2019. Understanding attitudes towards reducing meat consumption for environmental reasons. a qualitative synthesis review. Sustainability. 11(22):6295. doi: 10.3390/su11226295.

Schirpke U, Timmermann F, Tappeiner U, Tasser E. 2016. Cultural ecosystem services of mountain regions: modelling the aesthetic value. Ecol Indic. 69:78–90. doi: 10.1016/j.ecolind.2016.04.001.

Schmidt K, Walz A, Martín-López B, Sachse R. 2017. Testing socio-cultural valuation methods of ecosystem services to explain land use preferences. Ecosyst Serv. 26(Pt A):270–288. doi: 10.1016/j.ecoser.2017.07.001.

Scholte SSK, Van Teeffelen AJA, Verburg PH. 2015. Integrating socio-cultural perspectives into ecosystem service valuation: a review of concepts and methods. Ecol Econ. 114:67–78. doi: 10.1016/j.ecolecon.2015.03.007.

Small N, Munday M, Durance I. 2017. The challenge of valuing ecosystem services that have no material benefits. Global Environ Change. 44:57–67. doi: 10.1016/j.gloenvcha.2017.03.005.

Sørensen F, Grindsted TS. 2021. Sustainability approaches and nature tourism development. Annals Tourism Res. 91:103307. doi: 10.1016/j.annals.2021.103307.

Spigarelli C, Zuliani A, Battini M, Mattiello S, Bovolenta S. 2020. Welfare assessment on pasture: a review on animal-based measures for ruminants. Animals (Basel). 10(4):609. doi: 10.3390/ani10040609.

Stampa E, Schipmann-Schwarze C, Hamm U. 2020. Consumer perceptions, preferences, and behavior regarding pasture-raised livestock products: a review. Food Qual Preference. 82:103872. doi: 10.1016/j.foodqual.2020.103872.

Tasser E, Mader M, Tappeiner U. 2003. Effects of land use in alpine grasslands on the probability of landslides. Basic Appl Ecol. 4(3):271–280. doi: 10.1078/1439-1791-00153.

TEEB. 2010. Mainstreaming the economics of nature: a synthesis of the approach, conclusions and recommendations of TEEB. Geneva: UNEP.

Udawatta M, Ng E, Westley Phillips H, Chen J-S, Wilson B, Prashant GN, Nagasawa DT, Yang I. 2019. Age-related differences in social media use in the neurosurgical community: A multi-institutional study. Clin Neurol Neurosurg. 180:97–100. doi: 10.1016/j.clineuro.2019.03.027.

Valli C, Maraj M, Prokop-Dorner A, Kaloteraki C, Steiner C, Rabassa M, Solà I, Zajac J, Johnston BC, Guyatt GH, et al. 2023. People's values and preferences about meat consumption in view of the potential environmental impacts of meat: a mixed-methods systematic review. Int J Environ Res Public Health. 20(1):286. doi: 10.3390/ijerph20010286.

Varaldo A, Borra D, Vassallo E, Massimelli F, Massaglia S, Merlino VM. 2022. A study on perceptions towards organic and local production, and individuals' socio-demographic and geographical affiliation influencing fruit and vegetable purchasing preferences of EU households. Horticulturae. 8(8):670. doi: 10.3390/horticulturae8080670.

Verduna T, Blanc S, Merlino VM, Cornale P, Battaglini LM. 2020. Sustainability of four dairy farming scenarios in an alpine environment: the case study of Toma di Lanzo Cheese. Front Vet Sci. 7:569167. [Internet]. [accessed 2023 Nov 8 https://www.frontiersin.org/articles/. doi: 10.3389/fvets.2020.569167.

Vichi M, Kiers HA. 2001. Factorial k-means analysis for two-way data. Comp Statistic Data Analysis. 37(1):49–64.

Wanner A, Pröbstl-Haider U, Feilhammer M. 2021. The future of Alpine pastures—Agricultural or tourism development? Experiences from the German Alps. J Outdoor Recreation Tour. 35:100405. doi: 10.1016/j.jort.2021.100405.

Ward SE, Smart SM, Quirk H, Tallowin JRB, Mortimer SR, Shiel RS, Wilby A, Bardgett RD. 2016. Legacy effects of grassland management on soil carbon to depth. Glob Chang Biol. 22(8):2929–2938. doi: 10.1111/gcb.13246.

Wezel A, Stöckli S, Tasser E, Nitsch H, Vincent A. 2021. Good pastures, good meadows: mountain farmers' assessment, perceptions on ecosystem services, and proposals for biodiversity management. Sustainability. 13(10):5609. doi: 10.3390/su13105609.

Yahdjian L, Sala OE, Havstad KM. 2015. Rangeland ecosystem services: shifting focus from supply to reconciling supply and demand. Frontiers in Ecol & Environ. 13(1):44–51. doi: 10.1890/140156.

Yin H, Fang SE, Mirosa M, Kearney T. 2023. Dairy purchase behaviors: increasing understanding of Chinese consumers using a consumer involvement segmentation approach. J Dairy Sci. 106(12):8523–8537. doi: 10.3168/jds.2022-22843.

van Zanten BT, Verburg PH, Koetse MJ, van Beukering PJH. 2014. Preferences for European agrarian landscapes: A meta-analysis of case studies. Landscape Urban Plann. 132:89–101. doi: 10.1016/j.landurbplan.2014.08.012.

Zhao Y, Liu Z, Wu J. 2020. Grassland ecosystem services: a systematic review of research advances and future directions. Landscape Ecol. 35(4):793–814. doi: 10.1007/s10980-020-00980-3.

Zucaro M, Genovese D, Battaglini LM. 2019. Percezione dei Servizi Ecosistemici dell'Allevamento di Montagna. Un'Indagine in Val Di Susa (To). Quaderno SoZooAlp n. 10:37–47.

Zuliani A, Romanzin A, Bovolenta S. 2016. Animal welfare and ecosystem services in mountain areas. Options Méditerranéennes. Série A: séminaires Méditerranéens. 116:337–340.

Zuliani A, Esbjerg L, Grunert KG, Bovolenta S. 2018. Animal welfare and mountain products from traditional dairy farms: how do consumers perceive complexity? Animals (Basel). 8(11):207. doi: 10.3390/ani8110207.