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Revitalizing Collective Resources in Mountain Areas Through Community Engagement and Knowledge Cocreation

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The ongoing global and large-scale changes in markets, demographics, and use of resources are impacting mountain peoples and regions. In mountain areas, resources have been governed through community-based systems for resource management for centuries, ensuring stewardship and local decision-making over the resources. Due to the importance of such systems to mountain societies, there is a need to understand local effects of global changes and reconfigure community-based resource management (CRM) to meet local needs while tackling global challenges. Changes include biodiversity loss and the climate crisis, as well as increasing social and economic disparities. Studies on the role of knowledge cocreation in the process of CRM innovation in response to ongoing changes in mountain social–ecological systems are missing. This study aimed to explore the reconfigurations that enable CRM to foster sustainable development and thriving communities. The study focused on an intervention promoting community entrepreneurship in community-based tourism for the revitalization of collective resources in 2 mountain communities in Northern Italy. We adopted a transdisciplinary approach and a research action methodology to codesign the interventions and research. Data from focus groups, a survey, participatory activities, interviews, and participant observation were collected and analyzed using a qualitative content analysis method. Results show that emerging reconfigurations in CRM include recognition of new values and uses of collective resources, inclusion of new stakeholders, and innovation of the organizational model, shifting the perspective from resource management to resource governance. The study recommends striking a balance between pushing innovation and increasing power imbalances. It is important to pay attention to the inclusivity of the process and to avoid excessive commodification of resources.

Keywords: *transdisciplinarity; commons; transformation; social–ecological system; new stakeholders; new values and uses; community-based tourism; community-based resource management.*

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Introduction

Community-based resource management (CRM) in mountain contexts is, at the same time, very significant for sustainable management and very exposed to global and regional changes. For centuries, natural resources and infrastructure (eg forests, pastures, huts, mountain paths, irrigation systems) in mountain areas have been governed through community-based institutions in a collective and subsidiarity manner (Jodha 1986; Agrawal and Chhatre 2006; Greco 2014; Favero et al 2016). This often continues today, ensuring stewardship and local decision-making (Van Gils et al 2014). Such systems for common (pool or property) resource management are referred to as "commons" in the literature (Ostrom 1990). Commons originally aimed at tackling the need to access resources in situations of scarcity, low productiveness, and harsh climatic conditions (Casari 2007; Greco 2014; Gatto 2017). Even if socioeconomic conditions today have changed (eg less dependence on subsistence agriculture), commons are still grounded on cooperative mechanisms that reallocate gains from resource extraction and reinvest them to restore and strengthen local resources. This increases resilience to external factors (Randhir 2016), enables rural development (Bassi and Carestiato 2016), and addresses environmental sustainability (Sick 2008).

The ongoing global and large-scale changes in markets, demographics, technology, climate, and land use are having an impact on CRM today (Agrawal 2001; Payne et al 2020; Tucker et al 2021). Many mountain regions are experiencing increasing connectivity to their external environment (Cox 2014). Connectivity increases community heterogeneity,

population aging, and tertiarization of the economy, leading to the abandonment of traditional economic activities, such as extensive farming and animal husbandry (Jodha 2000; Bender and Kanitscheider 2012; Pisanelli et al 2012; Baur and Binder 2013; Löffler et al 2016; Gretter et al 2018; MacDonald et al 2020). At the local level, connectivity determines commodity trading, with resources being extracted and sold (eg timber) or rented (eg pastures and dairy huts) by the community to external enterprises through the market (Rosá 2014).

Commodity trading in commons systems in mountain areas has a series of interlinked consequences, requiring responsiveness to the interests and expectations of an increasing number of actors. First, it leads to a selective intensification of resource exploitation in response to market signals, thus increasing disparities between less attractive and more profitable areas (Jodha 2000; Payne et al 2020). Second, new resource uses and production patterns in mountains emerge (Jodha 2000; Tucker et al 2021). This causes a shift in resource dependence from traditional practitioners' subsistence to the satisfaction of self-determined needs (ie identity building, culture, landscape maintenance, nature protection) by a broader group of users, including visiting outsiders. New economic activities (ie tourism and recreation) emerge (Brossette et al 2022), and demands increase for commons to guarantee ecosystem service provision (Gretter et al 2018; Schirpke et al 2020). This shift may lead the commons to be underused (Brossette et al 2022), if the more heterogeneous interests and new stakeholders (ie actors and organizations) are not included in the decision-making process over resource management. Their inclusion is critical to maintaining equal and efficient provision and habitat stewardship.

The commons is an important social infrastructure (De Angelis 2018) based on trust and communication (Ostrom et al 1994). Therefore, consideration of more heterogeneous interests and thus of new actors in the decision-making process in commons also has a series of consequences. In commons systems, decisions are taken by the representatives of the commons institution that owns and manages the resource. Representatives are elected by community members on the basis of locally set rules, defined in the constitutional law of each commons (Casari et al 2019), and based on customary law and social rules. As a consequence, in such institutions, some groups of people, for example, the young, women, and new members of the community, are often underrepresented in the decision-making process with respect to their effective and potential contribution to CRM (Federici 2011). A debate therefore arises on the delicate process of opening the commons to new interests and stakeholders. On one hand, it potentially increases competing demands across stakeholders for land uses and can challenge the pillars of trust and communication on which the existence of the commons is founded. On the other hand, issues could arise if congruence is not established between those who contribute to and those who benefit from the commons, and if those concerned by the outcomes of decision-making processes do not have a say. If their interests are excluded, decisions made on resource governance in commons could have detrimental effects for ecosystems and society (Brossette et al 2022).

The significance of commons as a social–ecological structure for sustainable resource management, coupled with its exposure to change, makes it necessary to develop and reconfigure the commons systems in order to make use of their potential benefits for more distributed, equal, and sustainable mountain development (Dietz et al 2003). There is a need to understand local effects of global changes on commons and to coproduce community-based solutions to face such challenges (Ostrom et al 1999).

To this end, this study aimed to investigate how underused common resources in mountain areas can be revitalized to enable sustainable development during ongoing change. It did so by using a transdisciplinary approach known as knowledge cocreation. Specifically, the study aimed to answer the following research questions: What reconfigurations are needed for CRM to continue driving sustainable development in the light of ongoing changes and according to the needs of community members and external stakeholders? What is the outcome and what are the benefits and critical points of knowledge cocreation in terms of reconfiguring CRM? The study focused on 2 interventions supporting community entrepreneurship for the revitalization of collective resources owned and managed collectively by community-based institutions (referred to as collective resources in this article). The methodology applied was transdisciplinary action research, which aims to cocreate knowledge with society. This means that assessment of the intervention is iterative. In accordance with the literature on commons, this study adopted the social–ecological system framework (SESF) (McGinnis and Ostrom 2014). In addition, a novel integration of the SESF with sound science on social innovation evaluation was conducted (Secco et al 2019) in order to conceptualize and observe the categories and dynamics of reconfiguration. Two mountain communities in the Province of Trento (Italy) and their community-based institutions were the focus of the project and of this article.

Social innovation and knowledge cocreation in community-based management of mountain social–ecological systems

Our study drew on a set of frameworks that conceptualize the revitalization of collective resource management: the SESF (McGinnis and Ostrom 2014; Brossette et al 2022), social–ecological systems functioning in cycles (Westley et al 2013; Luthe and Wyss 2015), social innovation (Polman et al 2017; Kluvánková et al 2018; Bosworth et al 2020; Barlagne et al 2021), and knowledge coproduction (Gibbons et al 1994; Klein et al 2001; Nowotny et al 2001; Robinson and Tansey 2006; Hirsch Hadorn et al 2008, Lemos and Morehouse 2005 in Pohl et al 2010; Steger et al 2020, 2021). These frameworks are interlinked and provide a holistic perspective on sustainable revitalization of CRM as social–ecological systems. To date, research has applied a combination of 2 to 3 frameworks to CRM, for example, the SESF with social innovation (eg Kluvánková et al 2018) or the SESF with resilience theory (eg Brossette et al 2022). Yet, studies combining a transdisciplinary framework of social innovation in CRM in response to ongoing changes in mountain social–ecological systems are still missing (Otero et al 2020): Therein lies the novelty of this study.

Commons have been studied using the SESF, which theorizes situations wherein resource users extract resource units from a resource system. "The resource users provide

for the maintenance of the resource system according to rules and procedures determined by an overarching governance system and in the context of related ecological systems and broader social political–economic settings. The processes of extraction and maintenance [are] the most important forms of interactions and outcomes" (McGinnis and Ostrom 2014: 3). Since its introduction, this framework has been used extensively in literature to investigate the effects of change on commons (Delgado-Serrano and Ramos 2015; Brossette et al 2022). The SESF is closely linked to literature that conceptualizes social–ecological systems as functioning in cycles of exploitation, conservation, release, and reorganization (Luthe and Wyss 2015) through the interrelation of their ecological and social components: resource units, resource systems, actors, and governance (McGinnis and Ostrom 2014). Reconfiguration happens when a social–ecological system progresses through the cycles (Luthe and Wyss 2015). To do this, the system must undergo phases of intentional transformation, carried out by social actors, who have the capacity to learn and deliberately transform the governance structure of a social–ecological system to mitigate shocks and crises (Folke 2006). The inclusion of new stakeholders, other than those traditionally involved in commons, enables the system's reconfiguration (Westley et al 2013).

Due to the link to social components and learning in reconfiguration and transformation, the SESF and resilience theory are closely related to social innovation theory (Biggs et al 2010). Social innovation is defined as the process of reconfiguring social practices, that is networks, attitudes, and governance processes, in response to societal needs, with the aim of improving general societal wellbeing (Polman et al 2017). According to Kluvánková et al (2018) and Berkes and Davidson-Hunt (2010), social innovation in forest commons empowers the community through community-based entrepreneurship and sustainable resource use. Barlagne et al (2021) observed that social innovation in community forestry reconfigures the value of the resource and introduces new social practices, for example, community consultation about the future of the woodland. New social practices result in new networks of collaborative relationships by a broader range of actors involved in the intervention. Some scholars, however, have cautioned against social innovation as a panacea for sustainable development. This is because the literature has not fully considered the consequences of reconfigurations on the trade-offs among SESF elements, nor does it consider existing imbalances in power relations (Bock 2012; Secco et al 2019; Wittmayer et al 2021), in terms of the capacity of individuals or groups to achieve their goals even if opposed by others (DeWitt 2000). To address the issue of power relations, we introduced the transdisciplinary approach of knowledge cocreation (Schneider et al 2019). In fact, the epistemological approach at the foundation of knowledge cocreation is coherent with the importance accorded to social learning to guide transformation in a social–ecological system.

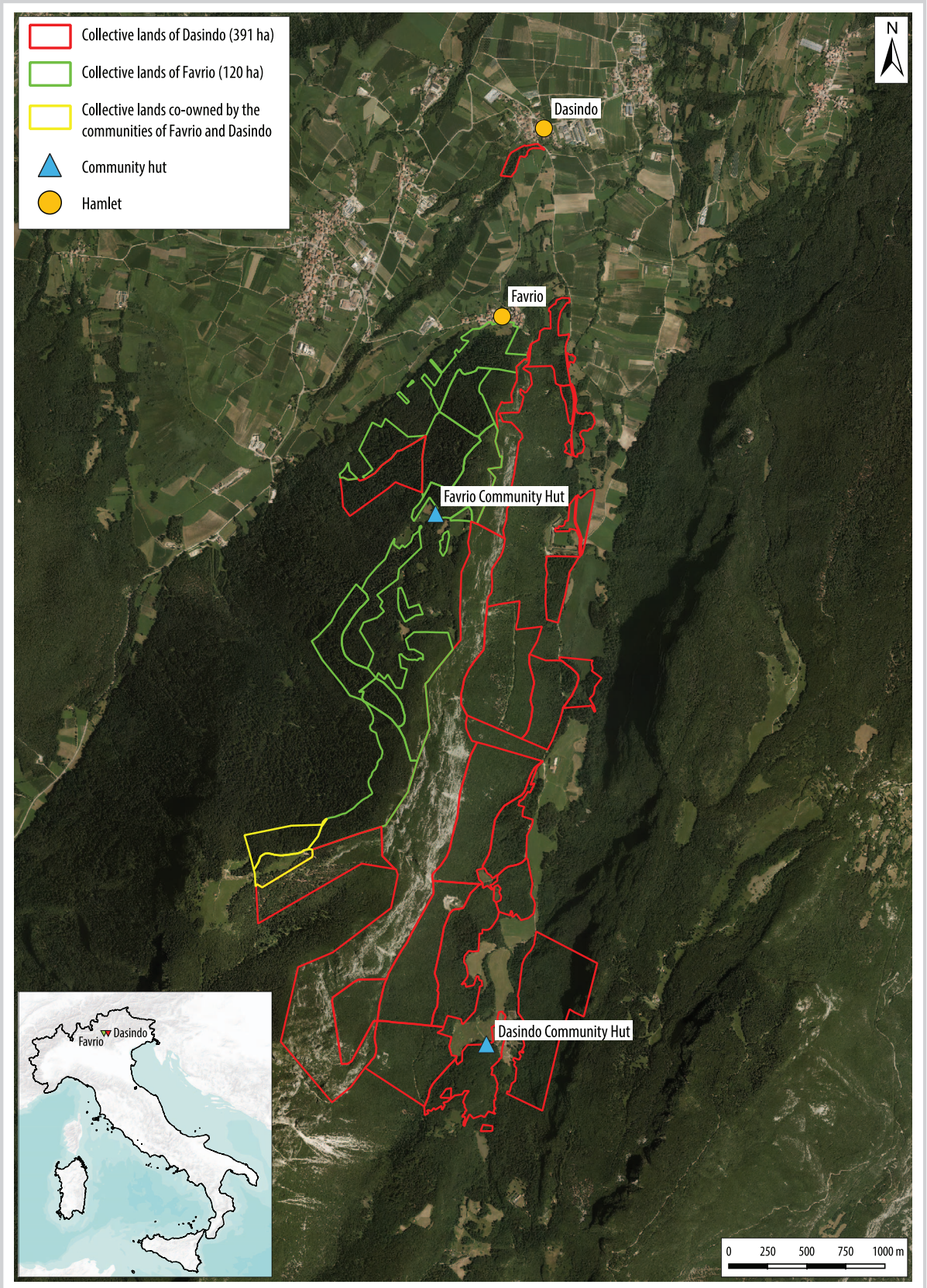
Cocreation of knowledge is understood as a collaborative endeavor of academic and nonacademic actors (Robinson and Tansey 2006; Lemos and Morehouse 2005 in Pohl et al 2010). As an approach, it belongs to the framework of transdisciplinary research (Klein et al 2001; Hirsch Hadorn et al 2008). It takes place in the context of application (Gibbons et al 1994; Nowotny et al 2001), and it is an iterative, ongoing process for generating holistic understanding of an issue (Berkes et al 2003; Jasanoff 2004; Armitage et al 2011; Shirk et al 2012). Steger et al (2021) modeled knowledge cocreation as science with society (SWS) into a set of iterative phases from exploration and partnership formation, through codesign and coproduction of research and action, to codevelopment of future opportunities. The authors also recognized SWS as strongly related to CRM. CRM entails a deep connection to Indigenous Peoples and local communities (IPLCs) as stewards and direct beneficiaries of the ecosystem services provided by community-owned resources (Chapman and Schott 2020). At the same time, it supports cross-scale activities and landscape and nature conservation, which benefit society in general (Berkes 2007; Ruiz-Mallén and Corbera 2013 in Steger et al 2020). In this context, CRM can often be affected by power relations of oppression and exclusion both within the communities due to the presence of elites (Haller et al 2020) and from external power centers (Adam et al 2021). Therefore, the process of knowledge cocreation must be carefully designed and assessed to avoid reproducing unequal power relations.

Description of case studies

The 2 interventions serving as a case study were embedded in a pilot project named "Revitalizing collective goods by empowering communities," which aimed to drive community-based tourism. Two communities were involved, Favrio and Dasindo, located in the Giudicarie area, Province of Trento, Northern Italy, with the respective CRM institutions known as *Amministrazioni Separate Usi Civici* (ASUCs [in English: separate administrations of civic-use lands]).

The Giudicarie area is characterized by steep hills and valleys and a highly fragmented and distributed settlement structure with several small communities. At the settlement level, small communities collectively own forest and pastureland and the connected mountain huts in the midmountain (Greco 2014), which are managed by the CRM institution. Due to socioeconomic changes, this link has weakened, and the relationship between communities and their commons and territory has loosened. In Favrio and Dasindo, CRM institutions have issues with the generational turnover of their members. Moreover, the community-owned structures (ie community huts) are underused by the community members; restoration, when done, is through the work of volunteers among the community (Riserva di Biosfera Alpi Ledrensi e Judicaria 2021). The hamlets of Favrio and Dasindo—located between the wild and very little anthropized Lomasona Valley and the slopes of Misone mountain (see Figure 1)—show a general trend of losing such traditional ties, although their assets are still actively managed by the ASUCs. A debate on the current and future value of commons and their revitalization has been ongoing in the Giudicarie area in recent years (see Box 1). Supported by a core team of 4 skilled young people, who were partly involved in a related project, the 2 ASUCs codesigned a project funded by the provincial government. The project aimed to raise inhabitants' awareness of the importance of CRM for landscape quality, nature conservation, and community wellbeing. It also aimed to

FIGURE 1 Map showing the location of the study areas in Italy, the location of Favrio and Dasindo hamlets, the perimeters of collective lands of Dasindo (red) and Favrio (green), coproperty (yellow), and the location of the two community huts. (Source: PAN Studio Associato based on data from Province of Trento, 2021, as well as Esri, US Geological Survey, and National Oceanic and Atmospheric Administration)



BOX 1: Details of the project

Location: Favrio (46°00′01.29″N; 10°51′25.29″E); Dasindo (46°00′41.15″N; 10°51′36.18″E), less than 5 km distance from each other.

Community size (number of inhabitants over 18 years old): 76 (Favrio) and 113 (Dasindo).

Collective resource management (liable institutions): ASUC Dasindo and ASUC Favrio for the collectively owned lands of Lomasona Valley and Misone mountain, respectively, partly overlapping the area managed by the Sarca Nature Reserve (Natura 2000 IT3120069 Lomasona Peatland biotope) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve of the Ledro Alps and Judicaria; regional government for forest management competences.

Collective resources: Forest, pastures, protected areas, 2 community huts, roads, and hiking paths. Collective land extent is 120 ha (Favrio) and 391 ha (Dasindo).

Previous related projects: A previous project in 2018, Fuochi nelle malghe (English: Fire in the huts), tried to spark this debate through public meetings and a feasibility study to raise community awareness for the revitalization of collectively owned structures (Riserva di Biosfera Alpi Ledrensi e Judicaria 2021). The project results highlighted the potential of these structures for community tourism. In parallel, the ASUC of Dasindo promoted a strategy for the enhancement of commons in the Lomasona Valley, aimed at conserving the environmental value of the area and promoting its sustainable land use. The community of Favrio concretely expressed its desire to enhance the distinctive features of its hamlet and the Misone mountain through the organization of a trail and a festival around the promotion of milk production culture. Both communities have demonstrated interest in the project idea discussed in Fuochi nelle malghe.

Duration of project: 24 months (February 2021–February 2023).

12 partners from public bodies, civil society, and business: ASUC Dasindo, ASUC Favrio, Eurac Research, Comune di Comano Terme, Comune di Fiavè, Ecomuseo della Judicaria, Associazione Provinciale delle ASUC, Fondazione Don Guetti, University of Trento, Piano Giovani di Zona Giudicarie Esteriori, Federazione Trentina della Cooperazione, Cooperativa Fuoco—**and the work of 5 consultants (2 project and participatory managers, 1 architect, 2 community engagement and tourism activators), and 1 researcher.**

Budget and funding: The initiative is 95% funded by the Autonomous Province of Trento (department for development of mountain areas), granting each ASUC US$ 32,166.92. The remaining 5% of budget is cofinanced by each ASUC. Most important, the activities of the projects also involve several hours of volunteering from the ASUC managing members, the members of the communities of Favrio and Dasindo, the researcher involved (who conducts the activities within her PhD project), and additional hours by the consultants.

activate community entrepreneurship around the revitalization of collective resources and their management as drivers of community-based sustainable development (see full description in Box 1).

Methods and materials

Steps in community engagement and knowledge cocreation

Following the structure of the knowledge coproduction model (ie SWS model) developed by Steger et al (2021), several activities were carried out during the interventions in 2021 and 2022 (Table 1). Because of the approach adopted, the assessment of interventions was embedded in the activities themselves. The aims and assessment techniques of each phase were codesigned and discussed within the project core team. The core team involved 3 types of actors: (1) the ASUC council members representing the communities of Favrio and Dasindo; (2) the project management core group representing the external local stakeholders (ie external to the 2 communities but active at the local level, in the Giudicarie area), local farmers, producers, and agritourism owners, professionals (eg forestry technicians, natural resource management advisers, community development advisers, architects), and members of local associations and organizations (eg cultural, touristic, neighboring ASUCs); and (3) academia (ie a researcher).

The methodology of this study is rooted in qualitative empirical social–ecological science. To enable knowledge cocreation in both research and intervention aims, we chose a set of complementary qualitative and participatory methods for data collection (Table 1) in the case study area (Yin 1994; Brossette et al 2022; Grundel et al 2022). These were a focus group interview with each community, to which external local stakeholders were also invited (Figure 2); a self-administered anonymous survey of the 2 communities; participant observation during cocreation activities; 2 participatory mapping and cocreation workshops (Figure 3); and 10 follow-up semistructured interviews. Focus groups involved in total 61 community members (32% of the population of the 2 communities), of whom 26 were female, and 15 external local stakeholders. The survey had 43 respondents (23% of the population of the 2 communities), of whom 13 respondents were female and 12 respondents were under 45 years old. The workshop aimed to involve the most active and interested stakeholders, while semistructured interviews aimed to follow up on the survey and focus groups to increase topic exhaustivity. The participatory events were preceded by a convivial event (ie a festival) for the core team to informally establish relations with the community and explore the perceived value of commons. The festival included explorative walks to the collective resources for interested visitors and festival participants, organized and led by community members (Figure 4).

Assessment of community engagement and knowledge cocreation

The study adopted a process-oriented and iterative assessment approach, which focused on how the process of exploration and reorganization of CRM—through the intervention—was organized and implemented. This type of evaluation helps to draw lessons from the first phases of action and activities and to adjust the ongoing processes and practices (Secco et al 2020). Therefore, due to this being an ongoing project in the early stage of the interventions, impacts of the intervention on the area are not yet visible.

To build categories of assessment, we followed an abductive approach (Timmerman and Tavory 2012). Initially, we considered the whole set of SESF second-tier categories for the assessment. In the process of data analysis, in line with Brossette et al (2022), we excluded irrelevant categories and added 2 relevant ones, "RS3—desired future for the community" and "I6—desired actions, strategies" (Table 2).

TABLE 1 Phases of the intervention and research, corresponding aim, assessment technique (where relevant), sample size, and type.

Date	Phase	Aim	Participants' selection criteria	Number (*N*) and type of respondents (CM, ES)
May 2021	A convivial event (ie festival) aimed at exploring rural commons in the field	Opening the gate to the community and engaging it around the project; exploring the value of rural commons	No selection criteria: open invitation through advertising on posters and social media	CM and ES
July 2021	Two focus groups in Favrio and Dasindo	Identifying resources that are perceived to be taken care collectively; assessing the changing values of commons and envisioning their future in the community development process	Inhabitants of the 2 settlements; project partners (see Box 1)	61 CM + 15 ES
	Survey of community members through a self-administered questionnaire		Inhabitants of the two settlements	43 CM
November 2021 and May 2022	Two workshops	Consulting the community on targets for community-based tourism reach, and the activities that should be included; participatory drafting of a community map	Inhabitants of the two settlements; project partners	25 CM + 7 ES
August–December 2021	Follow-up semistructured interviews	Consulting the stakeholders to start the development of the experimentation of community tourism	Relevant stakeholders identified by the core team because of their knowledge, role, and expertise relating to CRM and community-based tourism	2 CM + 8 ES

Note: CM, community members; ES, external local stakeholders.

FIGURE 2 Intervention and research activities included focus group interviews in each community to identify collective resources, their changing values, and their future. (Photos by Juri Bottura)

FIGURE 3 Two workshops were dedicated to participatory mapping and cocreation activities to revitalize collective resources. (Photo by Cristina Dalla Torre)

We then combined the SESF variables with the 3 social innovation dimensions of reconfiguration defined by Polman et al (2017), operationalized by Secco et al (2020), and tested by Barlagne et al (2021): values and uses of the resource, stakeholders, organizational models. This constitutes a novelty of our study, as it allowed the connection of social–ecological system descriptive categories with the social innovation dimensions (Table 2, column 4) in order to address our research objectives.

The collected data are of a "soft" type, such as perception, vision, expectation, and preferences of stakeholders and involved actors. Such data are considered to be particularly relevant in the evaluation of social innovation, having extensive use in forestry (Secco et al 2019; Grundel et al 2022). Data collected were subjected to a structuring content analysis (Mayring 2014), with the aim of extracting and summarizing qualitative data material according to the previously defined categories (Table 2). According to the selected variables and their definitions, we were able to paraphrase, generalize, and summarize the coded text passages as suggested by Mayring (2014). The result of the analysis was a topic-related summary of the data for the selected SESF categories, analyzed according to the social innovation dimensions of reconfiguration.

Results

Outputs of community engagement and knowledge cocreation

Here, we briefly present the outputs of the different intervention phases and activities. The focus groups and surveys in each community were centered on identifying a variety of resources considered to be important for the community to take care of collectively; assessing how the values of these resources are changing; and envisioning their future and revitalization in the perspective of community development. Each focus group was carried out by dividing the participants into groups, each moderated by a core team member taking notes on a flipchart. Focus was placed on creating a group discussion to identify as many different resource values as possible, and to create a platform for communication among participants and discovery of these values and different interests. The reported resources and visions were interpreted according to the SESF categories (see Table S1, *Supplemental material*, https://doi.org/10.1659/mrd.2022.00013.1.S1). The resources identified in the focus

FIGURE 4 During the festival, convivial moments with the community and walks were functional to build relations with the communities and to explore collective resources and issues at stake. (Photos by Cristina Dalla Torre)

TABLE 2 Categories of analysis.

SESF first-tier dimensions	SESF second-tier dimensions	Meaning	SI dimensions of reconfiguration
Resource system (RS)	RS1—Clarity of system boundaries	Differentiation between spaces, lands, and resources that are under collective, private, or public property rights	New stakeholders
	RS2—Type of resource (human built, natural)	Built, natural, tangible, intangible	New values and resource uses
	RS3—Desired future for the community	Desired future vision expressed by study participants	
Governance system (GS)	GS1—Government organizations	Public administration and commons institutions involved and role	New stakeholders
	GS2—Nongovernment organizations	Other organizations involved (private, associations, cooperatives) and role	
	GS3—Collective-choice rules (inclusion of women, newcomers, youth)	Citizens, civil society involved and role	
Actors (A)	A1—Number of actors	Number of actors involved in the discussion around revitalization of commons	
	A2—Importance of resource (dependence)	Importance of the resource for the actors involved	New values and resource uses
	A3—Appropriate leadership/ entrepreneurship	Entrepreneurship, leadership activities conducted in the commons and how they are perceived by study participants	New organizational models
Action situation	I1—Harvesting	Types of activities to extract value from the resource	New values and resource use
	I2—Information sharing among users	How information is shared	New organizational models
	I3—Deliberation processes	What decisions are taken and how	
	I4—Conflicts	Presence of conflicts, divergence, discussions, any open critical issues	
	I5—Investment activities	Type of investment that actors (personal time, paid time, experimentations) are making	New values and resource uses
	I6—Desired actions, strategies	Desired actions and strategies expressed by study participants to reach the desired future (RS3)	New organizational models

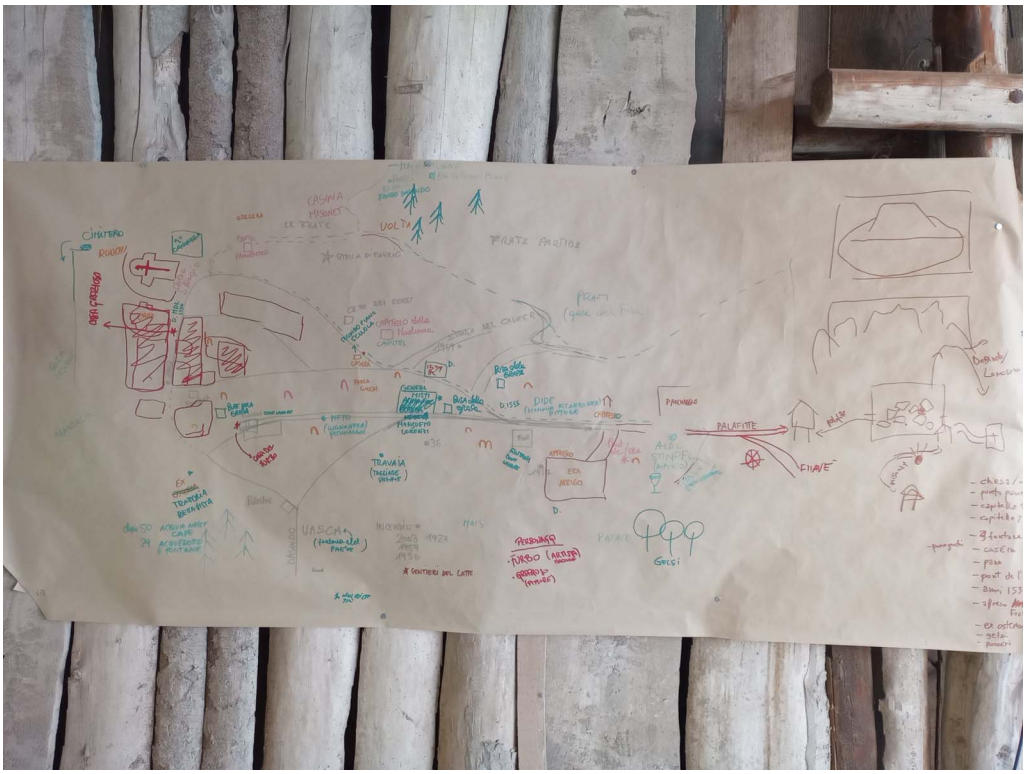
Note: SI, social innovation.

groups were used as a knowledge base for the 2 consecutive workshop activities, where the information was processed and spatially located (Figure 5). The workshops, followed by the semistructured interviews, served to define in a participatory way the desired target and activities for the community-based tourism project to functionally revitalize collective resources and the visions expressed initially. Figure 6 shows the advertising material for the designed and scheduled activities for the start of the community-based tourism project in summer 2022.

Reconfigurations in collective resource management

Reconfiguration of resource value and use: From data collected during the focus groups and survey, we observed that there is a shared perception both among community members and external local stakeholders that the importance of the resource (A2) (ie collective goods) is changing. Traditionally, collective resources were a source of sustenance for community members. The traditional practitioners harvested (I1) resource units (eg wood for heating and building, hay for animals, etc). Currently, collective resources are becoming significant (A2) as recreational and relational assets for community members and other local inhabitants of the area (eg forest for hiking and biking, collective huts for community gatherings) to increase physical, mental, and relational wellbeing. Current users are then called to contribute to conservation of resource quality through maintenance and care activities (I5). Accordingly, the type of resource under collective care (ie forests, pastures, collective huts) does not change (RS2), even though new intangible values are connected to it (ie identity building, culture, community belonging, nature

FIGURE 5 This map of collective resources is the product of the participatory mapping activity. (Photo by Cristina Dalla Torre)



conservation). Maintenance and care activities involving investment (I5) (eg of time, skills, some monetary investments) are thus directed to increase resource quality and capacity to provide ecosystem services more than to guarantee its sustainable management for self-sustenance of the community in the long term. For example, in an interview, a local farmer and community member stated that his activity of harvesting grass to produce fodder for cows (I1) is an important investment (I5), because it prevents pastures from rewilding and thus maintains the landscape and prevents hydrological risk and difficulties in coexistence between humans and wild animals. The care aspects are considered to be more important than fodder production, which would be less costly to harvest in other, more accessible and productive pastures.

Reconfiguration of stakeholders for revitalization of collective resources: In focus groups and in the survey, community members stated that to revitalize collective resources through community entrepreneurship around tourism, there is a need to include a larger number (A1) and heterogeneity of actors other than those that are legally liable to the CRM or those that are elected as representatives of the commons. According to the communities, potentially beneficial collaborators include: entrepreneurs from nearby villages who have solid experience and skills in slow and community tourism offers (GS2); professionals in regional development and nature conservation (GS2); organizations (GS3) that deal with bureaucratic processes; and local and regional governments (GS1). The importance of such collaborations was confirmed in the interviews. Such collaborations are considered to be crucial to alleviate the community from the burden of administrative and bureaucratic tasks of collective action and thus allow a focus on the social, bonding components of care and maintenance. Throughout the intervention, the network of stakeholders involved became more heterogeneous. Initially, it was mainly community members that participated in focus groups and surveys, with external local stakeholders observing from an outside perspective. However, some of the actors identified by the communities in the focus groups and surveys as important collaborators became increasingly engaged in the project.

Reconfiguration of organizational models: Community members who farm the collective lands as entrepreneurs (A3) stated that through their work they care for the lands' biodiversity and preserve the landscape from abandonment. This is achieved by harvesting the grass from the pastures and extensive pastoralism on Monte Misone, in Lomasona Valley, and in the surroundings of the 2 hamlets, and by marketing their products (A3). Nevertheless, the perception emerged, through survey, focus groups, and interviews, that there is a lack of entrepreneurship skill within the community (A3). One community member interviewed stated that building a community entrepreneurship initiative as a new organizational model is a delicate passage, as the process creates trade-offs between entrepreneurs and those members who have cared for collective resources on a voluntary basis. Data show that community members consider the education of visitors and community members, especially young people, about existing forms of CRM to be very important for revitalizing collective resources (I2). Community members in the focus group stated that deliberation processes (I3) currently tend toward reappropriation of collective rights over the land, nature, and landscape conservation from polluting sources (eg car traffic in the Lomasona Valley), and increasing the

FIGURE 6 The first outputs of knowledge cocreation and intervention: advertising materials for the revitalization of collective resources through community-based tourism. (A) A poster advertising a collective cheese-making activity and lunch at the community hut. (B) A poster promoting a walking theater performance created by a theater collective with the participation of local communities and held in a space that symbolizes collective identity.

engagement of inhabitants toward care for the collective goods. Some conflicts (I4) were identified in the interviews. These relate to increasing land fragmentation and different interests within the community (eg clearing rewilded spaces versus keeping specific tree species), and to different models of agricultural production (eg intensive and industrial versus extensive and based on short value chains). The intervention assessed in this study represents a step in reconfiguring the organizational model in terms of opening the decision-making process to increase awareness and empowerment of the communities toward collective resource care. The intervention created the conditions for the elected delegates to have a discussion with community members and external local stakeholders about the future of the commons and its contribution to local sustainable development.

Lessons learned

The study aimed to investigate how collective resources can be revitalized through knowledge cocreation. It did so by examining an initiative supporting community entrepreneurship in collective resources management of mountainous areas. Two main research questions guided the analysis: Which reconfigurations enable, according to community members and external stakeholders, sustainable development in CRM given the ongoing changes? What benefits and critical points are connected to using knowledge cocreation as a method to approach CRM?

The intervention increased the awareness of the actors involved to understand that the revitalization of collective goods requires awareness about their changing importance and value, and it confirms the shifts identified by Brossette et al (2022). In the cases analyzed, the observed changes of values and uses of collective resources can be linked to general trends in socioeconomic changes toward tertiarization and an increase of commodity trading in mountain areas (Jodha 2000; Bender and Kanitscheider 2012; Löffler et al 2016; Payne et al 2020). Time is increasingly organized according to work and leisure (Pisanelli et al 2012; Baur and Binder 2013; MacDonald et al 2020). Within these conditions, through this study, we learned that changing demands for recreation and ecosystem service provision (Schirpke et al 2020; Brossette et al 2022) are an enabling factor for social innovation (Secco et al 2019). Within tourism, there is an increasing trend toward appreciating slowness, nature, genuine food, and community experiences. This is coupled with the presence of a network of external governmental and nongovernmental stakeholders sensitive

toward such forms of tourism, including small extensive agricultural businesses, social cooperatives, cultural associations, and destination management organizations. With these considerations in mind, the project has brought together community members and external local stakeholders. The focus has thus shifted from collective resource management to a perspective of governance, where both formal and informal institutions influence decisions taken on the use and value of collective resources in the process of their revitalization (Agrawal 2001; Baur and Binder 2013; Favero et al 2016). In fact, the community has collectively invested time and (some) money and, through collective experimentation, has shared risks (Kluvánková et al 2018; Barlagne et al 2021). This collective endeavor has triggered the creation of a different vision of rural development (Bassi and Carestiato 2016), where agriculture operates synergistically with tourism and care of landscape to solve issues of unsustainability linked to intensive agricultural practices that pollute air, soil, and water. In the future, the project could set in motion a virtuous cycle of increasing service provision in the community, increasing attractiveness, and expanding solutions for issues related to the underuse of commons, such as demographic challenges and lack of opportunities for socialization (Berkes and Davidson-Hunt 2010; Brossette et al 2022).

The observed changes in value and use of resources were linked to the recognition of new stakeholders in deliberation and investment processes. These new stakeholders (listed in Box 1) are, for instance, the core project team and partners, associations and organizations in the area whose members are partly external to the community, and agritourism operators. The recognition of new stakeholders, values, and uses of collective goods has led the ASUC councils to recognize the need to discuss and agree on a hybrid use of collective goods. This reconfiguration implies consideration of supralocal networks and therefore the reconsideration of system boundaries beyond land borders, since intangible values and nature conservation efforts do not always coincide with common land boundaries. This constitutes a potential critical point, where social innovation creates trade-offs (Bock 2012; Secco et al 2019; Wittmayer et al 2021). The reconfiguring of a system's boundaries implies reconsidering who belongs to the community of the commons, besides direct collective rights-holders as defined by commons constitutional law. Concretely, this means that community members and new stakeholders need to negotiate a use that is both good for the IPLC and profitable for the community enterprise initiative. This delicate process could increase conflicts and require support from facilitators who are aware of power relations within the community and external to the community, as it quite radically changes custom rules and dynamics in place.

Our findings and interpretations must also be discussed in terms of the role of knowledge cocreation in the process of innovation and the implied power relations. In this context, it is worth noting that the explorative phase comprising the festival and the 2 focus groups, as in the SWS model of Steger et al (2021), had high participation and engagement rates. These events were fundamental to understanding the perspective of the local population on the future of their village, as well as several criticalities. The IPLC expressed the importance of continuing to work on the intrinsic sense of community, on the ability of the village to share resources, and on the capacity of the commons to contribute to community cohesion beyond property rights allocation. The self-administered anonymous survey was assessed as an appropriate method to collect perceptions, as it allowed expression free from the pressure of existing power relations (Adam et al 2021). The intervention proved to be particularly appropriate for involving youth and women, who are usually excluded from decision-making processes (Federici 2011; Casari et al 2019). Nevertheless, 2 critical points of the knowledge cocreation process should be noted: Those who do not agree completely or are in conflict with some proposed initiatives might not participate in public meetings, making it difficult to be fully aware of their different opinions (Haller et al 2020). Moreover, although the process aims to be participatory and inclusive, the core project team acts as a filter toward the community, and direct links to the IPLC are limited to participatory events and surveys (Pohl et al 2010).

Therefore, we must discuss the role of knowledge cocreation when it implies the "intrusion" of external actors into the IPLC (Grundel et al 2022). In an intervention, project consultants and researchers may find themselves in a situation of "divided identity" (Ravetz 2001: 391), where they simultaneously act as academics, facilitators, and intermediaries. They become, more or less intentionally, stakeholders among those they are observing. Knowledge cocreation involving IPLCs should be centered on enhancing local capacity for self-determination in research and resource management (Chapman and Schott 2020). At the same time, however, there is a progressive pressure on CRM to tackle universal needs and global challenges (Ostrom et al 1999; Agrawal 2001; Berkes 2007), which local elites may obstruct in the name of self-determination. CRM represents a complicated problem of the multilevel commons, requiring knowledge cocreation to place attention on the existence of power relationships in order to generate impact (Schneider et al 2019) and to think in a systemic way (Gretter et al 2018).

Discussion and way forward

Due to the significance of CRM for sustainable development in mountain contexts, our study aimed to investigate revitalization and innovation processes that can be used to cope with ongoing socioeconomic changes through a process-oriented iterative approach. As CRM is very sensitive to power relations, the study adopted the transdisciplinary approach of knowledge cocreation. The study showed that emerging reconfigurations in CRM to revitalize collective resources and increase the community's bond to them include recognition of new values and uses of collective resources, inclusion of new stakeholders, and new organizational models.

The application of the SESF as an analytical tool was appropriate due to its schematic structure, but it was nonetheless also difficult to operationalize. The empirical dynamics in a social–ecological system show complex and systemic interactions among its elements and between the elements and external drivers. Therefore, future studies and interventions should apply methodologies that support systems thinking and modeling into feedback loops and cycles.

Our key messages for practitioners, policymakers, and decision-makers, when using knowledge cocreation for the revitalization of collective resources, is to carefully:

1. Codesign innovations that do not increase power imbalances between elites in CRM or external powers and those traditionally excluded from decision-making processes, even though they contribute to CRM;
2. Create an inclusive and equal process of innovation for the good of the community and, at the same time, assess the evolution of customary rules and dynamics that have guaranteed the survival of the community and its bonds to resources; and
3. Codesign the innovation process to reconfigure the value and use of collective resources according to changing needs while avoiding the risk of resource overcommodification.

Attention and care must be given to preserving the nature of CRM based on collective trust and endeavor and maintaining high social value. It is necessary to link the revitalization of collective resources with the creation of new forms of income for the local population, since this can reverse the increasingly negative dynamics linked to depopulation and loss of services. However, placing revitalization of collective resources at the center of the rural development strategy may increase the risks of their commodification and overexploitation and therefore distort the nature of such resources, removing them from collective enjoyment. This study helped to recognize the contributions made by CRM to thriving mountain systems: based on collective engagement, democratic and participatory processes, stewardship, and negotiation with central powers.

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Supplemental material

TABLE S1 Identified collective resources, visions, and actions organized according to SESF categories.

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