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Managing wolf impacts on sheep husbandry: a collaborative implementation and assessment of damage prevention measures in an agricultural landscape

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Wolves in Europe are expanding their range and significantly impacting farming livelihoods and landscapes. Damage prevention measures such as livestock guarding dogs and night-time enclosures have proven successful in mitigating losses. However, they are often implemented as top-down measures without a proper understanding of the farming dynamics they are meant to alter, making them unappealing and difficult to implement for farmers. Semi-extensive, small scale livestock farming systems are particularly vulnerable and diverse, requiring specific care and catered support when addressing issues related to wildlife management. In these contexts, it is crucial to employ adaptive management approaches that enable solutions to be collaboratively designed at the grassroots level. Here we propose a method for centring the experiences and knowledge of local farmers to co-produce damage prevention practices that better address their needs. We developed this approach in the course of the LIFE MEDWOLF project, which was implemented in the province of Grosseto, Italy, between 2012 and 2017. The project brought together local authorities, environmental associations, farming unions and individual farmers to develop tailor-made damage prevention measures and assess their technical and economic impact, through a stepwise process. Collaboration with 86 local farmers resulted in >50 modifications to the original project plan, and an overall 50% reduction of preyed livestock in farms that participated in the project. Our findings highlight the benefits of collaboratively designing, implementing, and monitoring damage prevention measures with farmers. Based on these results, we reflect on the importance of integrating local and scientific knowledge, on the implications this has had on stakeholder relations, and on the challenges that we faced in upscaling this management approach.

KEYWORDS

***Canis lupus*, co-production, damage prevention assessment, participatory processes, wolf predation**

1 Introduction

European wolves (*Canis lupus*) are undergoing a noticeable expansion process throughout the continent (Chapron et al., 2014; Boitani et al., 2022) and, particularly in the absence of adequate mitigation strategies (Gervasi et al, 2021b), their presence is often associated with livestock depredations (Naughton-Treves et al., 2003; Linnell and Cretois, 2018; Gervasi et al., 2021a). Damage mitigation ideally includes compensation and preventive measures such as livestock guarding dogs (LGDs) and night time enclosures, whose effectiveness and cost-efficacy should be regularly monitored (Miller et al., 2016). However, ensuring the technical functionality of such measures is rarely sufficient as their social acceptability and implementation can be affected by many factors. Farmers may resist implementing damage prevention measures (DPM) due to deeply-rooted feelings of distrust towards the authorities and conservation practitioners who promote their use, due to a sense on injustice for the initial investments, maintenance and labor costs that DPM require, and wider structural changes in farming systems associated with DPM adoption. The costs associated with the implementation and management of DPM have been systematically underestimated in conservation interventions (Widman et al., 2019), and this is particularly relevant for small scale subsistence sheep and goat farming. This type of farming has long suffered a crisis in Europe, mainly due to a fall in market prices, high production costs, and lack of professional incentives (Pulina et al., 2018).

Reflecting trends reported in most European countries, wolves in Italy have increased and expanded their range to the lowlands, being increasingly reported in agricultural landscapes, coastal areas and even in peri-urban areas (Galaverni et al., 2016; La Morgia et al., 2022). The impact of wolf predation on small-scale, semi-extensive farming systems has increased in the last decade and compensation programs have proven generally unsatisfactory to mitigate losses and discontent (Marino et al., 2016; Gervasi et al., 2021b), due to many reasons including the lack of involvement of the directly affected stakeholders (Salvatori et al., 2020). Although the wider community at the international or national level might express positive attitudes towards the conservation of wolves, the challenges faced by local communities that share their land with the predators are often disregarded by top-down policies (Carter and Linnell, 2016). Central Italy, where this work was carried out, presents several additional problems associated with the effects of climate change on the costs and availability of pasture and fodder, as well as on production performance (Moriondo et al., 2010). This, coupled with the overall market difficulties of products, culminated in the termination of numerous milk supply contracts by some important processing companies operating in some areas (ISMEA, 2019). It is against this backdrop that in recent decades Tuscan breeders have had to deal with the increasing presence of wolves and the impact they have on production. Tackling these issues, and aiming at addressing both conservation and development goals, effectively calls for multi-actor and multi-sector forms of collaboration developed through a stepwise approach, with each step including information sharing, consultation, collaboration and co-production (Brown, 2003).

With the aim of decreasing the negative impacts of wolves on livestock farming we implemented DPM in an agricultural area of central Italy, the Province of Grosseto, where wolf density had recently increased. Our aims were to: (1) assess the degree of satisfaction with the then applied regional policies and management approaches; (2) understand the willingness of farmers to modify their management systems and the challenges they faced in doing so; (3) trial the application of damage prevention measures in close collaboration with local farmers; and (4) assess the efficacy and the costs of the implemented DPM. Our method was based on the assumption that shared responsibility through the active involvement of the affected parties would be a central pillar of the project. We acted considering the potential benefits of participatory or adaptive co-management approaches that are meant to foster more just, equitable and flexible management solutions through iterative social learning (Armitage et al., 2006; Stringer et al., 2006). We also hoped that the results obtained through this pilot application would provide useful information to guide future management policies at the provincial, regional and national levels. We planned each step of the process in a collaborative manner, with a multi sectorial team composed by the NGO Istituto di Ecologia Applicata as coordinator, an external private organization based in Rome, the provincial offices of the three main agricultural unions (Cordiretti, Confagricoltura and Confederazione Italiana Agricoltori), the local branch of Legambiente NGO (an environmental NGO acting at the national and local levels) and the national World Wide Fund (WWF-IT), and the provincial administration office for agricultural and rural development (at the time responsible for wildlife damage monitoring). The diversity of stakeholders in the project is reflected in the authorship of this article, which brings together conservation and social scientists, public administration officials and agricultural trade union representatives and technicians.

In this paper we describe the collaborative method we applied to select, implement and monitor the functionality and costs of damage prevention measures with a group of local farmers in the Province of Grosseto. We reflect on the process' aim of integrating local and scientific knowledge and on the implications this has on stakeholder relations.

2 Study area: the province of Grosseto, Italy

The Province of Grosseto (440,262 ha) holds the largest share of farms in the Tuscany region (22.4% of all its livestock farms and 41% of all its sheep farms) (ISTAT, 2013). In 2012 there were 1,811 livestock farms in the province, 60% owned sheep; 42% cattle; 23% equines and 7% goats. The landscape is dominated by pockets of semi-agricultural land interspersed with wooded areas. Livestock, and particularly sheep dairy production, represents a significant share of the local economy, with an average of 50 heads/km^2 (Gervasi et al., 2022), and is represented mainly by small-scale, semi-extensive farming systems.

Wolves began re-colonizing Grosseto in the early 1980s (Boitani and Ciucci, 1993), having been nearly eradicated by the late 1960s (Cagnolaro et al., 1974). Wolf presence was estimated to be at least with 13 packs in 2013–2014, and 22–24 packs in 2017 (Ricci et al., 2018). Wolves feed on locally abundant wild prey as well as livestock, which appears to be a secondary food source in their diet (Bargagli, 2006). When the LIFE MEDWOLF project started, DPM were adopted by a few isolated cases and without substantial support and monitoring from local authorities. Livestock damages were compensated through a series of regulations that changed over time (Marino et al., 2016) causing high levels of dissatisfaction by farmers that resulted in illegal wolf killings and exposure of wolf carcasses.

3 Methods

In this paper we present a method for centring the knowledge and experiences of livestock owners to co-produce damage prevention practices that better address their needs.

The project had initially planned to provide farmers with mobile electric fences at least 1.2m in height, scientifically proven to be effective in reducing damage in different contexts of pasture grazing (Salvatori and Mertens, 2012; Bruns et al., 2020). However, these were ill received by farmers when they were consulted, and the project was thus heavily reframed to adapt to farmers' preferences and needs. The partnership between conservation technicians, farming unions, local authorities and farmers included as much flexibility as possible and envisaged the possibility of co-producing and modifying technical details through a series of steps (Figure 1), thus testing a procedure for inclusive, cooperative and shared decision-making across sectors. The methodology for each step is described in detail below.

3.1 Selection of farmers and mitigation measures

We began with a preliminary assessment of the damage levels on the farms by consulting available registries of damages (step 1a) and by conducting a total of 150 face-to-face interviews (step 1c) with a random sample of sheep owners with >20 head of sheep, including 16 sheep owners who had declared recurrent damages (>6) during the period 2007–2012. We also held focus groups with local farmers in the municipalities with higher levels of damages to collect information about their opinions and points of view (Ricci, 2013). The interviews were carried out by staff from the provincial administration and the farming trade unions, following a sequence of open-ended questions, and lasted on average 2.8 hours (range 2–4). They were aimed at: (1) collecting information about depredation events that had been left out by largely incomplete official damage registries; (2) understanding the farming conditions and practices employed at the time of the depredation events; and (3) understanding farmers' opinions of the insurance-based damage compensation system in place at the time (Marino et al., 2016). The interviews were also aimed at improving the outreach of the institutions on the ground and providing learning opportunities to their staff, who had the chance to experience, first hand, day to day farming realities as well as farmers' grievances and accounts of wolf depredations. All the interviews were analyzed by one of the authors only (SR) and the information gathered was used to define criteria for ranking farmers that might be interested in receiving damage prevention measures. Through a public call published by the Provincial administration and further promoted by the agricultural unions to their associates (step 2a), farmers were invited to express their interest in receiving DPM to be installed with the support of a technician. The farms that expressed interest were ranked according to the following criteria (step 2a; see Supplementary Material for details):

- (i) proximity of the farm to depredation hotspots, prioritizing farms at greater risk based on their location;
- (ii) the size of farms, prioritizing professional farmers who owned more livestock;
- (iii) the type of livestock farmed, prioritizing sheep farms based on the knowledge that 94% of attacks in the previous decade involved sheep (Marino et al., 2016);
- (iv) past experiences of depredations, prioritizing farms that experienced recurrent depredations and therefore most urgently needed to implement damage mitigation strategies.

Once the ranking system was applied (step 2b), and according to the funds available, we evaluated that allocating 2,500€ per farm would allow the participation of some 70 farms. The higher-ranking farmers were visited individually by technicians of the farming trade unions to discuss their participation in the project (step 2c), and collaboratively identify DPM that were suitable to the farm's socio-ecological context and to the farmer's needs, preferences and labor capacities (steps 3a and b).

3.2 Collaborative implementation of measures

The farmers' trade unions were responsible for purchasing the material needed (step 4a). Farmers contributed to the installation of the selected measures, financially and/or with their own labor, and signed a commitment to use and maintain in good condition the materials received for at least five years after the project's end (step 4b). Farmers who received livestock guarding dogs (LGDs) were regularly visited by technicians contracted by the project who supported the dog's training and assisted farmers in addressing behavioral issues and needs. The dogs' health and sanitary requirements were also covered by the project until the dogs reached 18 months of age and could be considered adult. Farmers who received fixed or mobile fences were supported with technical assistance during the fences' construction and in case of unforeseen difficulties (step 4c). After the implementation of the chosen DPM, farms were visited every six months by the project staff or contracted technicians to monitor the functionality and correct use of the measures using a structured questionnaire (step 4d).

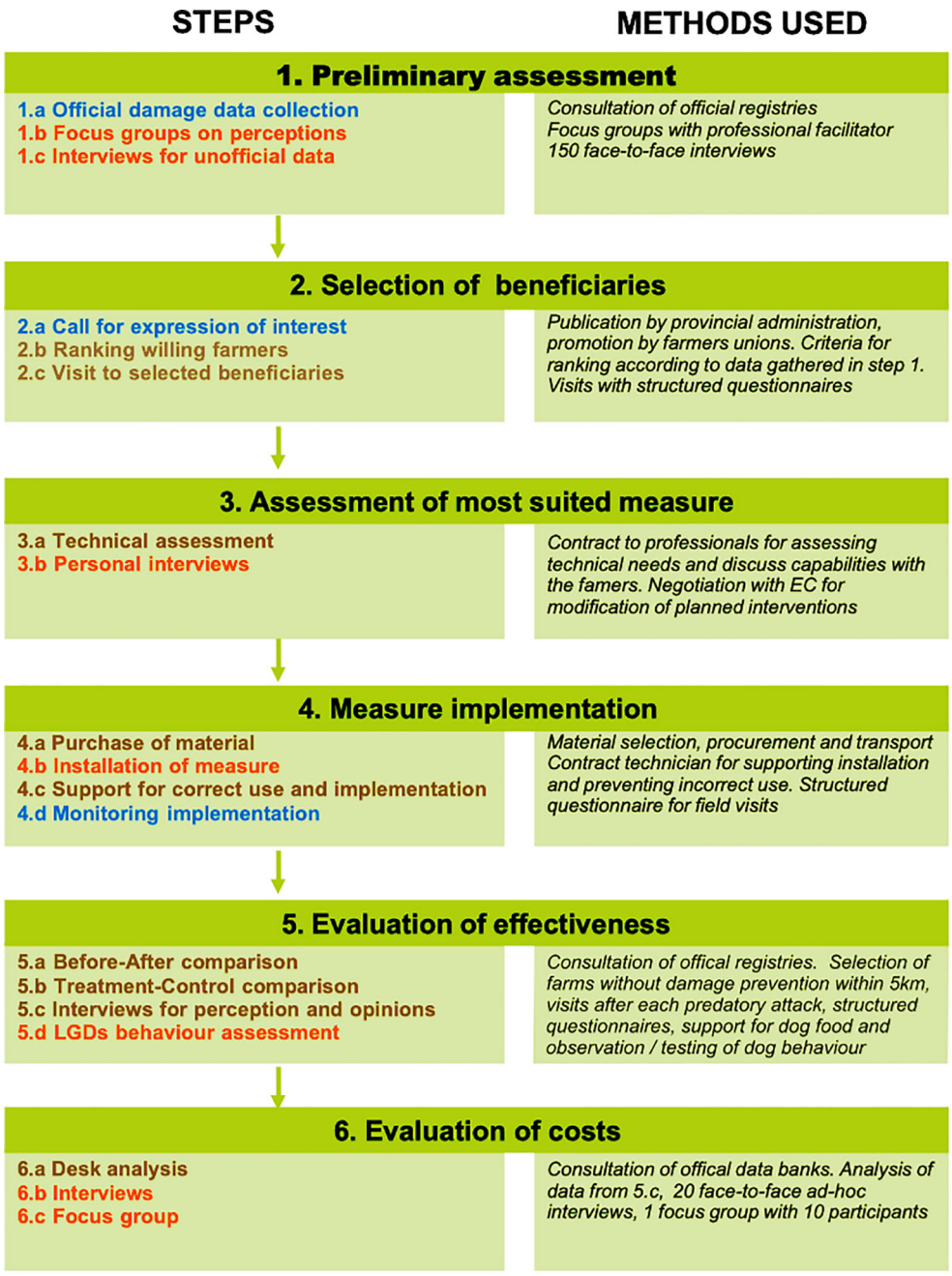

FIGURE 1
Shared responsibility, methods and contributions of different actors in each step of the LIFE MedWolf project implementation process in the province of Grosseto. Key to color text: Orange = Mainly Stakeholder contribution; Blue = Mainly Authorities contribution; Brown = Mainly project staff contribution.

3.3 Evaluation of effectiveness

We assessed the effectiveness of DPM using two complementary approaches: a before–after–control–impact (BACI) comparison with the same farms that received DPM, and a treatment–control comparison between farms that received the fences and nearby farms that didn't. For the BACI comparison, we collected data through interviews and official statistics of damage suffered at farms that received DPM from the project only (step 5a), considering the "Before" period from January 2014, when the farms officially entered the project, and the "After" period from the date of fence completion or of LGD full functionality to the end of the project (i.e., 30/9/2017, see Supplementary Material for details). We compared the number of attacks and the number of livestock lost in each farm during these two periods.

We performed the treatment–control analysis on the farms that installed fences (treatment farms) and on farms that did not adopt DPM but were located within ca. 5 km of treatment farms (control farms; step 5b; see Supplementary Material for details). Farmers took part in the experimental design on a voluntary basis. They informed the

project staff after each depredation event so that both treatment and control farms could be visited to collect data on the circumstances of each attack, in the form of a structured questionnaire.

Some of the farmers who had received DPM within the project (n = 62) or had implemented them through other means (N = 101) also took part in interviews to describe their experiences and offer their opinions (step 5c). Finally, 11 farmers from the treatment group and 6 farmers who had not taken part in the project participated in more in-depth interviews. Dog behavior was assessed through evaluation of distance to the flock in 11 farms (step 5d, see Zingaro et al., 2017 for a detailed description).

3.4 Evaluation of costs

To understand the impact that DPM have on the everyday lives of farmers we undertook a significant effort to quantify the economic costs sustained by farmers who had newly implemented them (step 6a). We also designed an *ad-hoc* questionnaire with a sample of 20 farmers selected taking into consideration a set of variables (location, flock size, membership of union organization) as well as farmers' willingness to participate in the survey (step 6b). Given the high variability obtained through the various interviews, we convened a focus group with 5 farmers, 3 representatives of the farmers unions and 2 representatives of the main milk transformation cooperatives. The discussion was aimed at developing estimates of DPM costs in a typical farm in Grosseto (step 6c). Depreciation costs of the tools installed was calculated using reference values from the National Farming Data Network (FADN) managed by CREA.

4 Results

4.1 Selection of farmers, choice of damage prevention measures, and their implementation

Our preliminary assessment showed that most livestock holdings were managed in a semi-extensive manner, often on rough terrain. Farmers reported that the landscape and terrain in Grosseto usually allowed grazing areas to be close enough to the main holdings for flocks to be returned to farms at night. However, most farms used regular fences to confine livestock at night rather than enclosures suited to preventing wolf attacks. Ninety-seven percent of interviewees reported having 1m high fences, and experiencing high levels of stress and anxiety along with difficulty in resting properly at night due to their fear of suffering wolf depredations. Seventy-four percent of the farmers reported having suffered attacks at night, often not far from their holdings. Most (68%) said they were interested in receiving damage prevention measures.

A total of 201 farmers responded to the public call for expression of interest. We made visits to the 70 highest ranked farms. When funds allowed it we visited lower ranking farms too. During these visits, most farmers had deemed mobile electric fences unsuitable to their farm management systems and the project underwent significant restructuring to be able to offer tools that were easier to implement, such as fixed metal fences and fixed electric or mixed fences to be used as night shelters. We thus modified the planned activities, and engaged in a collaborative relationship with 86 farms. The project also planned to deliver at least 20 LGDs in the area. Initially only six farmers agreed to have them, but as word of mouth spread among farmers, we received more requests. By the end of the project a total of 79 fences and 54 LGDs had been adopted by local farmers (Table 1).

4.2 Evaluation of effectiveness

Eighty-one percent of interviewed farmers (n = 163) evaluated fences as a valid tool to reduce depredation risk, and 74% evaluated LGDs positively. Sixty-nine percent of the interviewees who had installed fences (N = 108) reported a decrease in the occurrence of damages; even though 59% claimed they added a significant amount of labor to regular livestock management workloads. Of the 11 farmers who participated in the project and offered in-depth interviews regarding their experience, all of them reported that the technical interventions had improved their situation, stating firmly that "*with the dogs our life has changed completely … we feel much safer, the female dog is a phenomenon*"; and that "[fences] *have allowed many people to sleep soundly*". Farmers also highlighted the importance of highly specialized technical assistance and continued support *"We need competence. We need highly competent staff visiting the farms" … "the technical assistance represents a good 80% of the prevention strategy"*.

Overall DPM were viewed as a "necessary evil" which required significant adjustment and labor but allowed farmers to take issues into their own hands: "*I can't sell the flock, thus I must adapt.*" … "*I was somehow forced to get the dogs … after having suffered the attacks I had to do something … I need to ensure income continuity, protect my capital, then I hope the institutions will do something* (alluding to the possibility of passing regulations to carry out wolf population control), *but I see a long and challenging process ahead*". Nonetheless, in many statements, they transmitted a sense of ownership of the process for adopting prevention measures: *"I decided I no longer want to suffer damages. Now when I let the sheep out, they stay with the dogs, otherwise I keep them in"* and *"The difficulty lies in the fact that traditional practices are no longer viable, the world progresses, we cannot remain 30–40 years behind … one needs to adapt to the changing situations…"*.

TABLE 1 Damage prevention measures implemented at 86 farms in the province of Grosseto through the LIFE MedWolf project..

Type of measure	No. of farms	No. of interventions
Fences*	59	69
LGDs	19	39
Fences and LGDs	8	10 fences, 15 LGDs
Total	86	133 (79 fences + 54 LGDs)

*After the evaluation only two farms opted for mobile electrified fences, while the others were fixed fences.

Many farmers expressed satisfaction towards the collaborative process facilitated by the project and its diverse partnership, stating that "*The whole approach was fundamental, I had the feeling of not being alone and forgotten in my troubles.* [It contributed to mitigate the conflict] *because it put the two parties, farmers and conservationists, together,*" … "*I met people who provided support and ideas*". Others instead expressed skepticism towards the project-driven initiatives, which were known to be supported by EU funds "*On the one hand it will be a shame when the project will come to an end as nobody will visit us, but on the other hand it'll be good because there was too much money*" and in some cases were perceived to be limited in scope "*The interventions were useful, but they can only help up to a certain point*". The interviewed farmers who were not involved in the project claimed to have little knowledge about it, but expressed some skepticism and distrust "*I know very little about Medwolf … I am generally skeptical. There may be some* [financial] *speculation*"… "*while allocating funds within the project, the least amount was for us who are the offended party…*". Among the most skeptical farmers were those who felt that focusing on damage prevention was harmful because it diverted attention from more immediate solutions such as changing the law to allow for wolves to be culled "[the project] *further destroyed the local economy because it didn't provide a solution to the root causes, it circled around them instead*"… "[damage prevention] *decreases our freedom in an already challenging job, because it requires a constant physical presence … It is a lie that prevention solves the problem, it is not true, it forces livestock to live an unnatural life … no other adequate means exist but removing the predator*". Some farmers, though, had positive views of the project even though they had chosen not to be involved in it: "*I don't know it very well but when there is the opportunity to discuss it is always positive. Maybe such initiatives are more suited for young people*".

4.3 Evaluation of costs

Many farmers reported that LGDs require a significant time investment to train properly, are expensive to maintain, and that their expenses, along with the costs of other types of DPM, should be covered by public institutions: "*I like the wolf but we should all pay for its presence … we need funds for the fences, dog food and vet care. I like having the dogs, but they are a considerable expenditure*". A few also suggested that farms that were successful in reducing depredations should be supported as much as others: "*there should be an incentive per head: if you see in my farm there are no losses anymore, but they produce less*". Despite the diversity of systems highlighted by the farmers, those who participated in the focus group with the aim of producing monetary estimates of the overall costs of DPM, first set out to characterize what a "typical sheep farm in Grosseto" might look like, i.e., is family-run, with an average of 1–2 full time equivalent working individuals; relies primarily on privately owned land and secondarily on rented land as well as communal grazing areas; specializes in dairy sheep breeding, with 300–400 sheep heads and sells milk to a dairy processing cooperative; uses part of its livestock and dairy products for stock replenishment and personal consumption; engages in other productive activities (e.g. cereals, wine, olives) and produces most of its fodder, but rarely engages in extra-agricultural activities; relies on subsidies from the 1st pillar of the Common Agricultural Policy (formerly known as direct payments) but rarely taps into funding available by Rural Development Programs. Considering the impact that fencing had on sheep (i.e., higher risk of diseases and higher need of fodder) and the costs associated with raising good quality dogs, on average, they estimated that the costs for adopting and maintaining the necessary DPM ranges from 43 to 54 euros per sheep head, per year. Fifty-two percent of this estimate was attributed to labor costs, due to the additional workload that DPM represent for small family-run farms (Figure 2).

5 Discussion

In this paper we present a method through which sheep farmers, trade union technicians, local administration representatives and conservationists were drawn into a collaborative relationship, co-

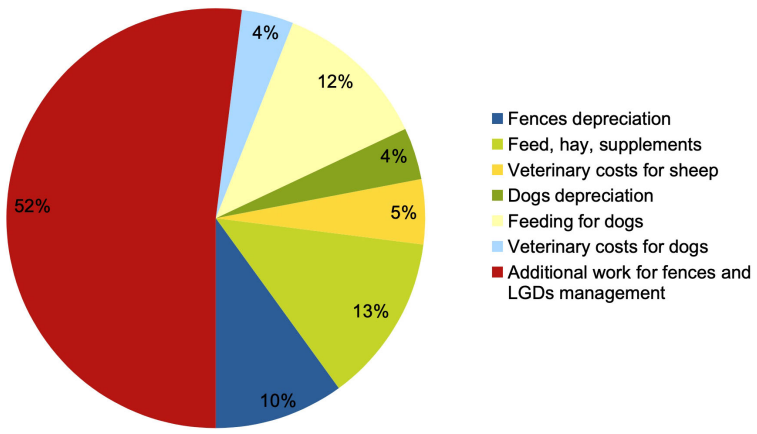

FIGURE 2
Cost estimation for adoption and maintenance of damage prevention measures (three fences and 7–8 livestock guarding dogs for ca. 400 sheep heads) at a typical farm in Grosseto.

producing, implementing and jointly monitoring the effectiveness of measures to reduce wolf depredations on livestock, in a selected group of 86 farms. Expertise from conservation technicians provided scientifically tested measures and tools, known to successfully mitigate depredations across a variety of herding contexts (Espuno et al., 2010; Reinhardt et al., 2012; Bruns et al., 2020). Farm visits and wider efforts made by trade union technicians and local administration representatives served as important forms of outreach through which local institutions showed concern, presence and support for farmers faced with the challenge and burdens of coexisting with wolves. Technicians and administrative representatives were offered the opportunities to live day-to-day farming management systems and challenges and learn about the impact of wolves on farming livelihoods. Farmers themselves are the primary holders of knowledge and expertise regarding these dynamics and therefore are best positioned to lead efforts aimed at identifying solutions suited to their specific needs (Horowitz, 2015), and their farm-specific expertise played a central role in the selection, implementation and assessment of damage prevention effectiveness and costs. More than anyone else, they have a detailed understanding of the diverse ecological, labor and organizational conditions of their farms, and intimate knowledge of their livestock's needs and behavioral habits.

The results we present therefore draw from a combination of local and scientific knowledge, brought together iteratively. This enabled a flexible adaptive management approach, whereby interventions and their objectives were repetitively revised and reframed with each new piece of acquired knowledge (Stringer et al., 2006; Armitage et al., 2007). Our methodology includes a diverse set of social science methods ranging from questionnaires, semi-structured and in-depth interviews, focus groups as well as forms of joint labor and socialization that enabled knowledge transfer and social learning to emerge over time. Interviews and focus groups particularly served to center the experiences and knowledge of farmers, allowing them to drive efforts to select, implement and monitor the efficacy and costs of DPM. Social science methods were complemented with ecological analyses of depredation registries, as well as before-and-after and treatment-and-control analyses of damages, to systematically evaluate the effectiveness of the implemented measures.

The experiences we report suggest the importance of moving beyond just complementing local and scientific knowledge, toward effective integration of the two (Clark and Murdoch, 1997). Farmers and conservation technicians worked side by side to choose the best suited measures and ensure they functioned correctly. Moreover, farmers contributed essential information to develop more accurate depredation statistics, and to quantify the financial burden of DPM by producing cost estimates. Meanwhile, systematic evaluations of the efficacy of DPM proved their effectiveness in reducing depredations. These, along with farmers' personal accounts, circulated through word of mouth and contributed to increase the popularity of DPM and of LGDs particularly. In this way, local knowledge and experience directly informed science-based approaches. Through their contributions, farmers developed and often expressed a sense of ownership of the process and its results (see also Young et al., 2018).

The case study we present is of limited scope and impact. Despite focusing on improving relations of trust and collaboration between different stakeholders and knowledge systems, the damage prevention interventions that were developed are still primarily "technical" in their nature (Li, 2007; Taylor, 2015). The focus has been and always was on changing localized farming practices so that they could be more successfully adapted to rural rewilding. The process was initiated through European funding directed at biodiversity conservation, and as such, never contemplated changing or debating the wider terms of wolf presence and management dictated by national laws, nor was it ever intended to address the structural changes occurring in increasingly globalized agrarian systems (Fletcher and Toncheva, 2021), which severely impact rural livelihoods and farmers' overall vulnerability to wolf depredations. This is an important factor to consider when discussing the participatory nature and limits of certain conservation interventions (Nadasdy, 2007). It explains why, in addition to receiving positive feedback from many satisfied farmers, the project also encountered widespread opposition from a portion of the local farming sector who see damage prevention measures as a distraction or an obstacle to more radical solutions involving wolf culling. The cross-sectorial collaborative approach undertaken through the partnership was founded on the idea that partners needed to agree over which activities to implement and how to tailor the planned interventions. The need for DPM was something that all partners and many farmers viewed as important and urgent. Considering the context of intense social conflict in which the project was developed, partners and farmers engaged in the project on the basis of a shared commitment toward improving the current conditions of local coexistence, even when a common ground on other issues could not be established or when the local scale and narrow focus of the project limited its capacity to impact wider regional policies (Marino et al., 2021).

Our results show that the collaborative implementation of DPM was successful in reducing depredations in the farms that actively participated in the project. Whether these results have decreased the overall wolf predatory pressure in the Province of Grosseto is yet to be determined and will also be linked to a variety of other factors. As reported in the in-depth interviews the livestock owners who took part in the process claimed to have come out of it feeling more supported and better able to face the challenges of coexisting with wolves. The "softer" results of the project related to social learning are potentially its most significant and radical results. The power dynamics at play in many conservation conflicts (Robbins, 2012; Adams, 2015), including our case study, are likely to persist despite and potentially even through some forms of participatory conservation (Cooke and Kothari, 2001; Li, 2007). However, there is value in reflecting on the opportunities provided by moments of shared labor and efforts to collaboratively define goals, as these play a role in improving relationships and bridging across differences.

Finally, the results we present highlight both the value of setting flexible funding conditions and the challenges posed by unresponsive governance institutions. The iterative method reported in this study required a high level of adaptability. With each initiative aimed at re-designing the project interventions came the process of requesting approval by the European Commission. By the end of the project the Commission had granted over 50

modifications to the budget. This included approving new lines of research such as the study of the costs incurred by farmers to adopt damage prevention measures, requested by farmers and their trade unions. Funding sources that allow for explorative, open ended and reflexive research are essential for interventions of this type, as co-production approaches inevitably require adaptable goals. On the other hand, we encountered difficulty in extending this approach to upper management levels and, since the project ended, the area has experienced a lack of continuity in the kind of management approach adopted. Whilst there is now a group of farmers in Grosseto who are leading local efforts to support the adoption of damage prevention strategies (https://difesattiva.info), they currently do so without support from the regional administration.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

VS: Conceptualization, Funding acquisition, Project administration, Writing – original draft, Writing – review & editing. AM: Data curation, Writing – original draft, Writing – review & editing. PC: Supervision, Writing – review & editing. CG: Project administration, Writing – review & editing. MM: Writing – review & editing. EP: Writing – review & editing. SR: Conceptualization, Data curation, Writing – review & editing. GR: Writing – review & editing. FR: Writing – review & editing. LT: Conceptualization, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2023.1264166/full#supplementary-material

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