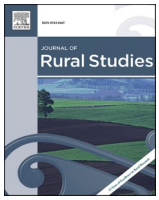
Journal of Rural Studies 119 (2025) 103707

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud



Why do we keep killing crows? Farmers' attachment to a controversial method in an attempt to protect their crops

Juliette Craplet [a], Amal Chantoufi [a,b,*], Eve-Anne Laurent [a], Claude Compagnone [c], Alice Baux [a]

[a] Agroscope, Plant-Production Systems, Nyon, Switzerland
[b] Centre d'Ecologie et des Sciences de la Conservation (CESCO), Muséum National d'Histoire Naturelle, CNRS, Sorbonne Université, Paris, France
[c] Institut Agro Dijon, Dijon, France

ARTICLE INFO

Keywords:
Human-wildlife conflict
Corvids
Crop-protection
Control methods
Social representations
Cognitive gamble

ABSTRACT

Corvids are responsible for important damage to spring crops across western Switzerland and have become a significant concern for the farming community. Various prevention methods have been tested to reduce agricultural losses, but no suitable solution has been found. In an attempt to solve this problem, the Swiss farming community is asking the authorities, despite its relative unpopularity, to liberalize control shooting. However, the effectiveness of this control method has never been scientifically proven, and the few studies in ecology or conservation biology that question its efficiency are not considered by the farming community. This raises the question of why the attachment to an uncertain and controversial method is so strong. By bringing out the farming community's dominant representation of the problem of corvid damage and analyzing the stakeholder network dynamics, this article aims to highlight the social logics and multifactorial dimension of choosing a control method. We found that the fight against corvid damage is part of a more general conflict that pits the farming community against the rest of society on issues of ecology and production. Various social, cultural and cognitive logics lead the farming community to remain attached to control shooting, making a cognitive gamble that has no solid scientific basis. To succeed in getting farmers to abandon control shooting, three conditions must be met: the emergence of a replacement innovation, awareness of the negative practical, economic and ethical aspects of control shooting, and improved access to scientific knowledge on the subject in the farming world.

1. Introduction

Urbanization and agricultural intensification have brought humans closer to natural habitats, heightening competition for resources with wildlife (Mekonen, 2020). This encroachment disrupts ecological balance by limiting available space and food, thereby exacerbating conflicts, including between birds and farmers (Araneda et al., 2022; Htay et al., 2022).

As natural habitats and grasslands decline, birds may increasingly exploit cultivated crops as alternative food sources (Buitendijk et al., 2022; Nilsson et al., 2019). In these agricultural systems, crops originally intended for human or livestock consumption can become important resources for wildlife. As a result, generalist and abundant species that thrive in these modified environments often contribute to crop damage and are frequently classified as pests (Araneda et al., 2022; Jiguet, 2020; Klug et al., 2023). Meanwhile, farmland specialists are particularly vulnerable to the effects of agricultural intensification (Chiron et al., 2014; Donald et al., 2001; Dross et al., 2018), which often leads to a shift in bird communities toward more adaptable generalist species such as Corvidae.

As these opportunistic species become more prevalent, their impact on agriculture is becoming an increasing concern for growers in certain European countries such as France, Switzerland and Italy (Furlan et al., 2021; Sausse et al., 2021). Spring crops like maize and sunflower, are especially exposed to corvid depredation (Esther et al., 2013; Robin and Ballanger, 2011). Birds can attack the sown seeds or pull seedlings at emergence, causing important economic losses. These include, for example, costs related to reduced yields and resowing (Sausse and Lévy, 2021). When combined with the time and effort required to deter corvid attacks, these financial aspects contribute to increasingly intense

* Corresponding author. Agroscope, Plant-Production Systems, Route de Duillier 60, Nyon, CH-1260, Switzerland.
E-mail address: amal.chantoufi@agroscope.admin.ch (A. Chantoufi).

https://doi.org/10.1016/j.jrurstud.2025.103707
Received 11 February 2025; Received in revised form 22 April 2025; Accepted 17 May 2025
Available online 31 May 2025

conflicts between corvids and humans, posing a real challenge for agriculture worldwide. For instance, in Switzerland, the canton of Vaud[1] estimated these damages at 800,000 CHF per year.[2] In addition, 300,000 CHF were allocated to prevention measures (Wahlen, 2022). The declarative survey on damage on spring crops conducted by Agroscope in 2021 (Bird damage survey results, Agroscope, 2021; unpublished data) shows that sunflower and maize are the most targeted crops. While the carrion crow (*Corvus corone*) is the main species declared, followed by rooks (*Corvus frugilegus*), *Columbidae* such as wood pigeons (*Columba palumbus*) and rock doves (*Columba livia*) are only occasionally mentioned.

Given the significant concern about bird damage to crops, various prevention methods have been tested to reduce agricultural losses (Klug et al., 2023). Among these methods, numerous non-lethal techniques have been developed to mitigate the damage. Acoustic or visual scaring techniques, like gas cannons, rockets, bioacoustics scarers, kites, mirrors, dead crow effigies, etc., have been proven ineffective in the medium term (Sausse and Lévy, 2021) due to the bird's rapid habituation (Esther et al., 2013; Klug et al., 2023; Linz et al., 2011). Given these limitations, seed-coating repellents have been explored as an alternative to prevent crows from eating seeds. These rely on knowledge about the pest species' biology and behavior, which means their effectiveness may be limited or restricted to certain contexts (Day et al., 2012). Historically, in Europe, bird repellents included active substances such as the fungicide Thiram (Kennedy and Connery, 2008) and the molluscicide Methiocarb (EFSA, 2018). However, due to environmental and safety concerns, both substances were withdrawn from the market and are no longer authorized for use in seed treatments, as outlined in Commissions Implementing Regulation (EU) No 2018/1500 and 2019/1606 respectively. Following these withdrawals, the Ziram-based product Korit 420 FS has become one of the few remaining seed treatments for maize in Switzerland (Swiss Federal Office for Agriculture [FOAG], 2024). According to its safety data sheet (Kwizda Agro GmbH), this fungicide is classified as highly toxic, raising significant concerns for non-target species, particularly granivorous birds and aquatic organisms exposed through seed ingestion or environmental contamination. Consequently, it cannot be considered as a sustainable solution and might soon be withdrawn because of its toxicity (Wahlen, 2022).

To mitigate wildlife-related damage to human activities, culling, excluding certain protected species, has long been practiced worldwide as a form of population control and environmental management (Betz Heinemann et al., 2020; Dickman, 2010). Regarding specifically corvid damage and considering the lack of effectiveness of current non-lethal methods, suppression methods, such as shooting, nest destruction and the use of avicides[3], have been the main operations employed to control bird populations (Betz Heinemann et al., 2020; Klug et al., 2023; Linz et al., 2011).

Each year in Europe, millions of corvids are culled, with estimates exceeding 4 million individuals. This includes around 1,150,000 carrion and hooded crows (*Corvus corone/cornix*), 1,145,000 Eurasian jays (*Garrulus glandarius*), 980,000 Eurasian magpies (*Pica pica*), 600,000 rooks (*Corvus frugilegus*), and 250,000 jackdaws (*Corvus monedula*) (Hirschfeld and Heyd, 2005). France accounts for a substantial share of this total, with average annual figures of 380,000 crows and 230,000 rooks (Albaret et al., 2014; Aubry et al., 2016). In Germany, an estimated 238.350 crows and 144.100 magpies are culled each year, while in Belgium, annual tallies exceed 114.000 crows and 78.000 magpies (Hirschfeld and Heyd, 2005). Given this very large number of corvids killed annually, along with the significant time and financial costs associated with large-scale culling, some researchers in ecology and conservation biology have raised concerns about the ecological, economic, and ethical implications of this practice (Warburton and Anderson, 2018). Jiguet (2020) emphasizes that any control strategy involving the killing of millions of animals must be supported by scientific evidence demonstrating its effectiveness. Yet, to the best of our knowledge, no study has directly examined the impact of crow culling on crop damage. Zemman et al. (2023) show that in 70 % of scientific studies evaluating the costs and benefits of vertebrate pest control, eliminating these populations does not significantly reduce predation pressure. Moreover, most of these studies focus on the impact of such pests on wildlife rather than on crop damage. Furthermore, studies assessing corvid culling generally fail to demonstrate its effectiveness, with most showing no population decline following culling (Bolton et al., 2007; Beja et al., 2009). For example, Betz Heinemann et al. (2020) have explored the effectiveness of corvid culling over three seasons in the Turkish Republic of Northern Cyprus, demonstrating that the social structure of corvids can undermine the efficacy of such population control efforts. They further demonstrated that corvid culling in the study area was ineffective, as it disproportionately targeted males and disrupted corvid social structure, triggering compensatory reproductive strategies which help sustain population densities.

Despite serious doubts about the effectiveness of corvid culling for crop protection and clear evidence that it fails to reduce their populations, the Swiss farming community continues to implement and advocate lethal methods, in particular shooting, to control populations. Indeed, since the amendment of the Ordinance on Hunting and the Protection of Wild Mammals and Birds (OChP) in 2012, farmers in Switzerland, unlike those in neighboring countries (France, Italy, Germany, etc.), have very limited shooting opportunities to control corvid populations and must rely on gamekeepers or licensed hunters for both regulation and scare shots (Bollman, 1998). The farming community is not satisfied with this situation, and several of its representatives are mobilizing to lobby political leaders. In the canton of Vaud, for instance, a farmer launched a petition in autumn 2022 calling for the liberalization of shooting, seeking permission for farmers to cull corvids themselves and for increased action from cantonal authorities (Article RTS, Anonyme, 2022).

Against this backdrop, our research aims to address the following questions: why does the agricultural world continue to implement a method that has been ethically challenged by public opinion, now increasingly sensitive to ecological issues, and that scientific studies have shown to be ineffective in controlling populations? Why such an attachment to an uncertain method? What role, then, does scientific knowledge play for farmers in choosing a control method? What are the different dynamics and factors that can influence farmers in their choice?

To answer these questions and understand why the farming community still endorse shooting to control corvid population, we need to look beyond the technical and practical aspects of the problem. Significant human-wildlife conflicts often remain even after damage has been reduced (Dickman, 2010). This suggests that conflicts are more complex than they seem and that understanding them requires a broader approach, not only technical and quantitative, but also comprehensive. In this sense, conservation biology research is increasingly using the study of perceptions of stakeholders to better understand human-wildlife conflicts, and improve conservation policies (Bennett, 2016; Hill, 2002). This trend can be explained by the growing recognition that human-wildlife conflicts often involve a social dimension and are frequently characterized by underlying human-human conflicts (Jacobsen et al., 2016; Madden, 2004; Madden and McQuinn, 2014). In this respect, the contribution of sociology seems essential, in a multidisciplinary approach, to reveal the place of social dynamics and processes in these conflicts.

To carry out our analysis, we will first present the points of view of

[1] Located in western, French-speaking Switzerland, the canton of Vaud is the third most populous of the country's 26 cantons, with 830,431 inhabitants, and the fourth largest by area, covering 3,212.03 km^2.

[2] 1 Swiss Franc (CHF) is worth about 1 Euro (EUR).

[3] An avicide is an active substance intended to control bird populations by killing, repelling, or sedating targeted species.

agricultural stakeholders (farmers, advisors and gamekeepers) on the various methods of control, and particularly on control shooting, as well as the reasons they put forward to justify their positions. Next, we will see how the scientific context influences the choice of a control method. Then, we will bring out the farming community's dominant representation of the problem of corvid damage, and its management by the public authorities, to show its role in the attachment to control shooting. Finally, we take a broader look at the various factors and barriers that lead to attachment to control shooting.

2. Theoretical framework & methods

2.1. Conceptual framework

To understand why the agricultural world is attached to control shooting, different conceptual frameworks can be called upon. Firstly, we will use the concepts of attachment and detachment (here, to a method of struggle) from the sociology of innovation to analyze the way in which agricultural actors maintain the network of links between them (Akrich, Callon and Latour, 2002). Since this network gives legitimacy to the use of shooting, the latter resists detachment and thus hinders a problematization of the practice that could lead to its abandonment. As our subject concerns the abandonment of a control method rather than the introduction of a new practice, we will draw more specifically on the sociology of innovation through *detachment* (Goulet and Vinck, 2012). In view of the new environmental and ethical issues of the contemporary period, and the changing objectives of agricultural and technical innovation including soil and wildlife conservation (Lémery, 2003), "many innovations today have the dominant feature of being structured around the removal of artifacts, their suppression or their more moderate use" (Goulet and Vinck, 2012, p. 197), which is the case, for example, of no-till techniques or the withdrawal of plant protection products and, specifically in this context, of lethal methods of regulation. To use the vocabulary of the sociology of innovation, if the control shooting is, for agricultural actors, the *obligatory passage point*, (OPP) (Callon, 1986) it is, for researchers in ecology and conservation biology, the *passage point to avoid* (PPA) (Goulet and Vinck, 2012).

On the other hand, the manner in which agricultural actors uphold certain conceptions while remaining unreceptive to others highlights two key dimensions: the strategic dimension of mobilizing and maintaining an actor-network, and the epistemic dimension of constructing, validating and circulating knowledge for action. Indeed, if agricultural actors consider control shooting to be effective against corvids, it is not only due to their direct and tangible experiences, but above all because this perception is collectively reinforced through shared discussions with other farmers, particularly in comparison to alternative control methods. The question, then, is how collectives of agricultural actors maintain and validate beliefs about the effectiveness of shooting and ignore the information that would widen the scope of the problem (Barthe et al., 2001). In this approach, we refer to the work of Darré (1999) and Compagnone (2022), on how actors build common knowledge for action within professional dialogue networks. This will enable us to better understand the modalities, means and barriers to the dissemination of various scientific works to the farming community.

2.2. Study area

This study focuses on Western Switzerland, where farmers have reported increasing corvid damage to crops. This growing issue has raised significant concern within the agricultural sector, prompting farmers to mobilize politically, advocating not only for greater financial and legal support from public authorities but also for the funding of research projects aiming to develop practical and effective strategies to address this challenge.

Carrion crows (*Corvus corone*) and rooks (*Corvus frugilegus*), the main depredating bird species, are classified as 'Least Concern' globally by the IUCN Red List of Threatened Species (), and as 'Secure' at the European level according to the European Red List. In Switzerland, crows can be hunted year-round (art. 5 LChP), a protection period from February 16 to July 31 applies to rooks and nesting carrion crows (art. 3bis OChP). Gamekeepers are authorized to shoot corvids during the hunting season (September 1st to February 15th) and locally around freshly sown spring crops (April to June). Additionally, cantonal authorities can issue special trapping authorizations for crop protection. These include the Service de la faune, de la pêche et de la nature (SFPN) in Vaud, the Service des forêts et de la faune (SFN) in Fribourg, and the Office cantonal de l'agriculture et de la nature (OCAN) in Geneva.

The question of the best control method to implement across the country is therefore currently at the heart of discussions and negotiations between the farming community and elected representatives. This context of political tension is conducive to an analysis of the social logics that can impact the process of choosing a control method.

2.3. Method and data collection

A qualitative method and an interpretative approach were used to carry out the study, based on twenty-one individual semi-directive interviews.

We conducted the interviews in four cantons of Western Switzerland (Fribourg, Geneva, Valais and Vaud) with a sample of agricultural stakeholders, all concerned by corvid damage (Table 1). Our respondents were divided into three categories: farmers (10), farm advisory actors (6) and gamekeepers (5). Although the latter do not belong directly to the agricultural world, we have included them in what we call here the "farming community », as they play an active role in shooting corvids to answer farmers' requests, maintaining a close relationship with them on this issue. The interviews with the farmers took place in spring 2023. All farmers interviewed had previously responded to an online declarative survey conducted in 2021. The purpose of this survey was to gather information on bird damage to crops at sowing, in relation to crop species, agricultural practices, farm location and crop protection systems used by farmers. We selected farmers who reported moderate to high levels of damage, included sunflowers in their rotation, and had already tried various control methods. Therefore, our surveyed group consisted of four organic farmers and six conventional farmers; one from Fribourg, two from Geneva, one from Valais and six from Vaud; all men, aged 35 to 64.

We then interviewed, in autumn 2023, six members of the agricultural council (also referred to as farm advisors) and five gamekeepers, selected for their involvement in finding solutions to bird damage. Among the farm council members, we interviewed six men aged 28 to 53, three from Fribourg, two from Vaud and one from Geneva; and among the gamekeepers, five men aged 39 to 57, three from Fribourg, one from Vaud and one from Geneva (Table 1). All interviewees signed a consent form prior to the interview.

The survey aimed to collect information on respondents' characteristics, experiences, attitudes, and opinions about corvid damage and how they can, try or would like to deal with it. The semi-structured interviews were shaped around four main themes (Table 2): (I) Perception of the problem: experiences, analysis and feelings, (II) Perception of the effectiveness of different control and prevention methods, (III) Relationship with science and public authorities, (IV) Attitudes towards changing practices.

In addition, we complemented our analysis of respondents' discourse by reviewing publicly available popularized scientific information regarding corvid damage. We drew on content provided by cantonal administrations, the Swiss Ornithological Institute and agricultural consultants, including advertisements, technical and commercial documents, and online resources. To document the political mobilization of various stakeholders on this issue, we referred to the regional press and the minutes of meetings from the Grand Conseil of the canton of Vaud.

Table 1
List of interviews.

Farmers	Gender	Age	Farm type	Farming background	Education Level[a]	Canton
1	Male	61	Conventional farming	Yes	6	Vaud
2	Male	50	Conventional farming	Yes	4	Genève
3	Male	36	Organic farming	Yes	6	Vaud
4	Male	42	Conventional and Organic farming	Yes	4	Vaud
5	Male	54	Conventional farming	Yes	4	Vaud
6	Male	64	Organic farming	Yes	6	Valais
7	Male	46	Conventional farming	Yes	4	Genève
8	Male	35	Conventional farming	Yes	4	Vaud
9	Male	42	Organic farming	Yes	4	Vaud
10	Male	56	Conventional and Organic farming	Yes	6	Fribourg
Farm advisors	**Gender**	**Age**	**Precise occupation**	**Farming background**	**Education Level[a]**	**Canton**
11	Male	29	Farm advisor in crop production	Yes	7	Vaud
12	Male	53	Farm advisor, plant Station Coordinator	Yes	6	Vaud
13	Male	53	Head of the Plant Production Sector, Head of the Cantonal Plant Protection Service	Yes	8	Fribourg
14	Male	28	Farm advisor for field crops	Yes	7	Genève
15	Male	32	Farm advisor for field crops, Scientific collaborator, site trial coordinator	Yes	6	Fribourg
16	Male	30	Scientific collaborator, responsible for plant production trials, training manager	Yes	7	Vaud
Game- keepers	**Gender**	**Age**	**Precise occupation**	**Farming background**	**Education Level[a]**	**Canton**
17	Male	57	Scientific collaborator, head of gamekeepers of the canton	No	8	Fribourg
18	Male	50	gamekeeper	No	6	Fribourg
19	Male	51	gamekeeper	Yes	6	Vaud
20	Male	47	gamekeeper	No	4	Fribourg
21	Male	39	gamekeeper	No	6	Genève

[a] According to the International Standard Classification of Education (ISCED) 2011: 0: Early childhood education, 1: Primary education, 2: Lower secondary education, 3: Upper secondary education, 4: Post-secondary non-tertiary education, 5: Short-cycle tertiary education, 6: Bachelor's or equivalent level, 7: Master's or equivalent level, 8: Doctoral or equivalent level.

3. Results

3.1. A widespread attachment to control shooting

3.1.1. Positions on control shooting by social groups

Most of the interviewees showed strong attachment to control shooting. More broadly, the representation of the problem of corvid damage was relatively homogeneous between the three surveyed professional groups. Despite various opinions emerging from the subgroups, there was a real unity of the social group around this issue: 17 out of 21 interviewed defended control shooting, believing it to be a control method that should be used more extensively (Fig. 1). Only four of them declared that it was not effective enough to reduce corvid populations and therefore could not be considered as a good option. Farmers took the most radical stance. While almost all the agricultural council members (5/6) thought that shooting was a partial solution (Fig. 1), three quarters of the farmers (7/10) regarded it as a viable solution. Similarly, farmers were the most represented (4/7) among those who believe that shooting would be the best method of controlling corvid damage (Fig. 2): "*My only solution is to regulate by shooting*" (Farmer 10). Gamekeepers were the most skeptical about the effectiveness of control shooting, making up the largest proportion (2/4) of those who believed it was not a viable solution (Fig. 1). According to them, it is impossible to shoot enough individuals to significantly impact the population:

> "*Removing a few of them doesn't change the pressure on crops at all. […] If hunting carrion crows is allowed, so few are shot that it has absolutely no impact on population size » (*Gamekeeper 2*).*

Like agricultural consultants, they tended to advocate for other lethal methods (egg freezing, nest destruction), but they also had higher hopes in finding alternative crop protection solutions like seed-coating repellents or effective scaring devices to reduce damage (Fig. 2). Overall, the majority of the farming world supports control shooting, whether they see it as a partial or complete solution.

3.1.2. Arguments put forward by the farming community

The farmers base their arguments on social and practical rationality (Lazega, 2011; Compagnone, 2022). They may be articulated, but not necessarily. When they are, for example, reference is made to the effectiveness of shooting, linking it both to a tried-and-tested "old

Table 2
Main Themes and key questions of semi-structured interviews (Face-to-face), conducted from February to December 2023.

Key themes	Key question categories
Socio-economic characteristics	- Age, gender, education level, farm type, family agricultural background - Difficulties experienced in their profession
Perception of corvid damage	*For farmers*: Perception of damage (estimated loss, concrete consequences, bird species involved) *For farm advisors and gamekeepers:* Frequency of farmers' solicitations and damage perception For both: - How they perceive the global evolution of the problem in their field: eventual sense of increase, local and global explanatory factors, knowledge concerning corvids (ecology and behavior) - Prevailing feeling about the problem
Perception of the effectiveness of control methods	*For farmers*: Control methods used or known and their effectiveness *For farm advisors and gamekeepers:* Known and recommended control methods and their effectiveness *For both:* - Role of different stakeholders in the global control management - Expected attitudes of public authorities and politicians
Relation to science	- Do they know/hear about current scientific work on corvids - Do they trust science in general - Informal exchanges with peers and participation in extension networks
Attitude towards changing practice	- Significant changes in practice in the past - Closed peers' opinion about the supposed solution to the problem of bird damage

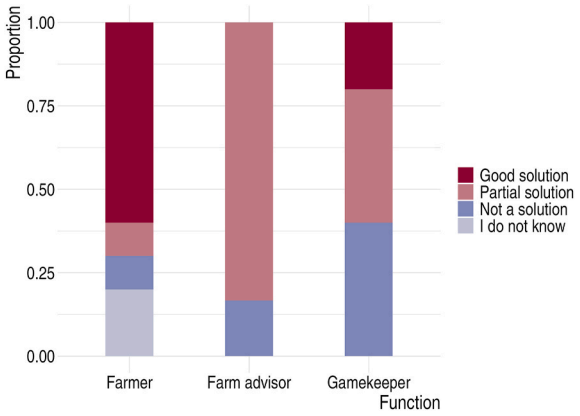


Fig. 1. Perception of control shooting as a control method in the Swiss farming community by stakeholder groups.

farmers'" method and to a method on which there is epistemic agreement among the professional group of today's farmers.

One of the main arguments is that control shooting is the "old-fashioned method" that worked before politics got involved. For some of those interviewed, this is the reason why corvid numbers have remained under control for so long. Thus, for Farmer 4, who initiated a petition for the liberalization of shooting, crow populations have increased precisely because farmers are no longer allowed to shoot them:

> "*Back then, every farmer had a Flobert and the right to shoot them. […] There were fewer crows, they [the elders] could shoot them!*". (Farmer 4)

In addition, a farm advisor even mentioned the obligation to shoot that may have existed in the past:

> "*(when) my dad […] took out his hunting license in 85 […], every hunter had to provide five pairs of crow's feet to show to the prefecture […] to be allowed to take out the hunting license the following year. Well, I'm convinced it's a good thing*". (Farm advisor 15)

A causal link is therefore established between previous shooting authorizations and the low level of corvid damage suffered by former farmers.

Another argument to legitimize this position was to highlight the convergence of views within the farming community on the need to liberalize control shooting. As one farmer put it:

> "*We are all pretty much on the same page"* (Farmer 2).

> "*Honestly, we're all thinking pretty much the same thing*" (Farmer 8).

They therefore claim an epistemic cohesion, i.e., a shared knowledge

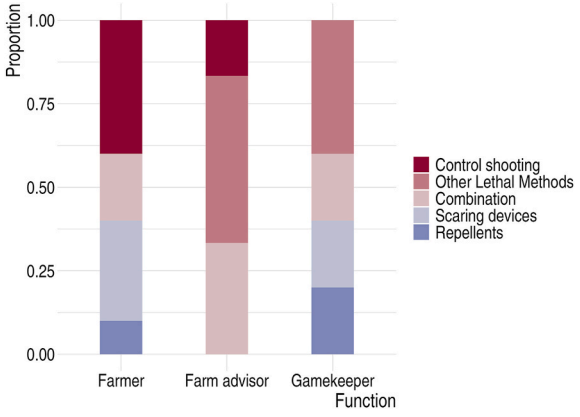


Fig. 2. Ideal control method for managing corvid damage on crops across different stakeholder groups.

of things, that seemingly guarantees the legitimacy of defending shooting as a method for controlling corvid populations. The interviews reveal that this agreement stems not from exchanges between farmers to appreciate the different methods and their relevance, but from a relationship of deference to epistemic authorities (Bourdieu, 1977; Lazega, 2011). For farmers, it consists in relying on one or more reference groups to guide their practices, and in being loyal to them. They recognize the authority of these groups in terms of technical and best practices knowledge and will follow the rule or norm that prevails in these groups (Lazega, 2011). Several farmers interviewed for this study thus refer to the agricultural council or to farmers involved with public authorities (and who thus benefit from a certain social position and the authority that derives from it among their peers) to legitimize their views on control shooting. During the interviews, several farmers referred to the same farmer (Farmer 4), very active in negotiations with public authorities, claiming that he could explain it better than they could. The consequence of these logics of deference is the homogeneity of points of view on the method that should be implemented to solve the problem of corvid damage.

The third argument put forward by the farming community is arithmetic evidence. On the question of scientific proof of culling's efficacy, respondents contrasted their understanding of the problem, based on individual experience and the epistemic authority of the group, with the scientific perspective, which they felt lacked the necessary elements to provide a definitive answer. For them, the effectiveness, if not scientifically proven, does indeed seem evident. They refer to common sense and logic. The more you shoot, the fewer there are - it's arithmetic.

> "*There's one thing that always makes me smile: people say that shooting won't work. Shooting won't work because we don't shoot enough birds!"*. *He adds: "If we eliminate them […], there will be fewer of them. That's for sure*". (Farm advisor 11)

According to them, if there is no scientific proof, it's only because the legal context doesn't allow shooting to be carried out under the right conditions, and therefore in sufficient numbers. For Farmer 2, if the effectiveness has not yet been proven, it is because "*Firstly, we're not allowed to shoot them, and secondly [because the gamekeeper doesn't come]*. All farmers are convinced that if they could practice shooting freely, we'd see that it's effective.

> *"If we were left to our own devices, it would have been regulated*" (Farmer 2).

When it comes to the absence of proof during the interview, they maintain their point of view, saying that in any case, even if shooting doesn't control populations effectively, it creates a climate of insecurity that makes corvids flee, which is acceptable regardless of the outcome. Shooting thus becomes a scare tactic, and takes on a hybrid status in the argument, blending with other alternative techniques.

Although shooting has not been freely practiced by farmers in Switzerland since 2012, it appears to be a practice deeply rooted in the traditional professional standards of farmers and in the recommendations of prescribing bodies such as the agricultural council.

3.2. An unfavorable technical, epistemic and scientific context to detachment

The control of bird damage takes place in a technical and scientific context that is particularly unfavorable to the detachment of control shooting.

3.2.1. « there is no solution! »

First and foremost, no known and applicable alternative method is currently proven to be effective (Esther et al., 2013; Klug et al., 2023; Linz et al., 2011). According to respondents, some may work (using a falconer, a continuous human presence, changing the scaring method on a regular basis), but they are not viable, either because they are too

time-consuming or too expensive. The farming community feels helpless in addressing the issue. All respondents insist that there are no effective solutions: « *There's no solution!*» (Farmer 7). As no technical solution currently available has proven its effectiveness in the medium or long term, shooting remains the primary hope for achieving results. It appears to be the only solution left to invest in.

« *I don't see any other solution* » (Farmer 10).

From the perspective of Goulet and Vinck (2012), the network thus lacks sufficiently appealing alternative technical entities to which the farming community could redirect its attachments.

3.2.2. An uncertain scientific and epistemic context

In addition, on the question of the effectiveness of control shooting, the scientific and epistemic context is characterized by uncertainty. To date, no scientific studies have been carried out specifically on the impact of corvid regulation on agricultural damage and studies on the effectiveness of shooting on corvid population numbers are rare (Zemman et al., 2023). As a result, the abandonment of shooting is seen as an unappealing point of passage to avoid (PPA), lacking the robust scientific evidence needed to persuade the farming community of the need for detachment.

Although these studies could offer valuable insights for managing corvid damage to crops, they remain largely unknown within the farming community. Indeed, only 1 out of 21 interviewees was aware of this scientific literature. Given that this work was carried out by researchers in ecology and conservation biology, this raises the question of the visibility and accessibility, in the farming community, of scientific work from other disciplinary fields.

3.2.3. Invisibility of certain scientific works

As far as farmers are concerned, keeping abreast of scientific research, regardless of the discipline, requires social resources that they generally don't have (Bourdieu, 1977; Lazega and Lebeaux, 1995) and it's not part of their job requirements. For this reason, agricultural extension services, run by the farm advisory, exist to make scientific work accessible to farmers and provide them with research-based technical advice. Farmers are therefore largely dependent on the farm advisory to be informed about the scientific work that would be useful to them. To try and choose their control method, they submit to the authority of agricultural advisors, who are supposed to possess an updated technical-scientific knowledge and the legitimate know-how (Darré, 1999). However, farmers interviewed in our study say that scientific work in ecology and conservation biology about corvids is absent from extension meetings they regularly attend.

Interviews with farm advisory members reveal that they are no more familiar than farmers with scientific work in ecology and conservation biology about corvid regulation. It makes sense that it's not presented at extension meetings. When asked if they keep abreast of current scientific research about corvids, without specifying which discipline, they spontaneously refer to *agronomic* research (effectiveness of scaring techniques or repellents, for example), and acknowledge that this is the only field where they are aware of recent work. Their relationship with science is thus characterized by a form of *agro-centrism*. While this agro-centrism is fully justified in the usual context of their work, since it corresponds to their field of activity, it is less self-evident in the case of corvid damage since it is an entity outside the agricultural world. So, aside from professional habits (agricultural advisors don't necessarily read scientific work from other disciplines), it raises the question of this invisibility of relevant literature in ornithology, ecology or conservation biology in the case of corvid damage.

Some declare they have a certain mistrust of ecology or conservation biology research, believing that its authors do not share the same perspective on corvids and do not pursue the same objectives as agronomists. A farm advisor says for instance he is "*skeptical*" because, from his point of view:

> « *There's a bias. By definition, the environment you come from … Well, you take a biologist, he's going to want to defend … Well, be against the farmer, against phytosanitary products, to preserve earthworms. You take a soil scientist against machinery to preserve the soil. Once again, it all depends on who's behind the study, and that changes the whole result.* »[4] (Farm advisor 5)

These comments illustrate the skepticism of the Swiss farming community that may exist towards work from other disciplines as ecology. Science is not an absolute, homogeneous authority for them, and research is not received in the same way, depending on its disciplinary field and the underlying interests and values. The members of the agricultural council are therefore selective. They choose the studies that are most useful for their professional interests and most consistent with their ethical approach to problems. Another farm advisor mentions a "*buffet effect*" to explain this tendency to select and the invisibility of work in ecology and conservation biology: science is like a large interdisciplinary buffet, offering all kinds of studies, and "*you're going to choose what you like the most first*", he says (Farm advisor 6).

A selection criterion that agricultural consultants like to emphasize is the contribution to *concrete solutions*. They expect science to be applied. This is consistent with the fact that, in interviews, farmers often express the need to act when facing a problem such as bird damage. However, ecological studies do not provide concrete solutions. On the contrary, they advocate for restraint, which contradicts the stakeholders' desire to take action. Partly for this reason, they are set aside.

The study reveals there is a differentiated reception of scientific work according to their origin, and particularly a mistrust toward ecology and biological conservation research. The result is a blockage in the circulation of knowledge from these fields and a persistent attachment to a method that this research calls into question.

3.3. Conflicting logics dominate the representation of the corvid damage problem

Drawing on their personal experience to justify their interpretation of the situation (Jodelet, 2006), members of the farming community, and farmers in particular, put forward several elements of annoyance and conflict: the stigmatization of the profession by public opinion, their concrete difficulties in fulfilling their mission due to a counter-productive political ecology, and their sense of anger and injustice towards a society that doesn't understand their issues and prevents them from protecting their crops.[5]

3.3.1. A stigmatized profession

For a significant majority of interviewees, their job is a passion. They all declare that they "*adore*" their work; for Farmer 7, "*it's the greatest job in the world*"; for Farmer 1, "*the most beautiful*"; for Farm advisor 5, "*it's more than a job, it's my passion*". However, when asked about difficulties of their profession, most participants mention three main points: administrative red tape, the incoherence of agricultural policies and conflicting relations with public opinion, or with society as a whole. All agreed that the lack of understanding of public opinion is one of the most burdensome aspects. Accused of being the biggest polluters and potential crow killers, they suffer from a sense of stigma.

> « *Farmers already get a bad rap because we're the ones polluting the whole planet, but if we're carrying a gun on top of that, it's all over*» (Farmer 7)

[4] Author's translation.

[5] It should be noted that references to "public opinion" or "society" in this study reflect only how respondents perceive and describe them in their discourse. We have not conducted any specific investigation into the actual attitudes of the public toward control shooting.

« If I go for a walk with my rifle and shoot a crow, I'm sure I'll be in the papers the next day. Because "Oh my God, the terrorist shot a crow!" » (Farmer 1)

They are particularly affected by this stigma, as they consider the ecological trend as partly unjust and counterproductive. They feel it is unfair to be blamed for polluting the planet by a society whose lifestyle is, in many respects, highly polluting. Many of them refer, for example, not without irony and anger, to the abusive use of airplanes, which shocks public opinion less than the use of pesticides:

« Everyone thinks it's normal to fly to Lisbon for 30 francs, then gets offended when you take out your sprayer to apply fertilizer! (Farmer 1)

Respondents often raise the issue of pollution on their own. By transferring representations from one situation to another (Jodelet, 2006), they spontaneously associate the use of plant protection products with shooting to control corvid populations, assuming that the two are part of the same anti-environmental attitude in the eyes of society, even though they consider them as legitimate means of crop protection. Beyond the feeling of injustice, the farming community is concerned about this moral condemnation, as it ultimately translates into restrictive legislation that prevents it from carrying out its mission.

3.3.2. Feeding the population: an impossible mission?

For the majority of farmers and farm advisors interviewed, the role of agriculture "*is above all to produce to feed a population*" (Farmer 3). However, excessive environmental constraints and the restriction on regulating pests such as corvids are, for them, obstacles to fulfilling their mission. The contradictory attitude of society, which expects to be fed while at the same time imposing a counter-productive ecology, is difficult to bear.

« For someone who's always been a farmer, for whom the goal is to produce and feed the population, it's something that's hard" (Farmer 1).

From a psycho-sociological perspective, a form of *cognitive dissonance* could explain these difficulties experienced by the farming community (Festinger, 1957). Their behavior towards the problem could appear as an attempt to escape this dissonance: disobedience on the part of some (who would shoot anyway), pressure from the agricultural council on elected representatives, petitions or legal action, or rejection of scientific recommendations. However, this sense of mission conflict is primarily attributable to the diverse social affiliations of those involved in agriculture. As individuals, they are both citizens and farmers and are caught at the crossroads of contradictory injunctions. Depending on the situation, they must choose a social group and an associated value system to refer to in order to act. Thus, the choice of a practice is not just a cognitive, individual or even collective process, but "a social process of arbitration by the farmer between collectives and the norms or rules that these collectives respectively defend" (Compagnone, 2022, p. 6). When it comes to defending their work and the meaning they give to it, as in the case of the fight against corvid damage, farmers and agricultural advisors choose the standards of the farming community over those of the rest of society.

In the context of our survey, this leads to a rather dual perception of the situation: on one hand, the farming community (here reduced to farmers and agricultural council members), facing increasing pressure from corvids on crops; on the other, society which, under pressure from public opinion and ecological arguments perceived as detached from on-the-ground realities, prevents farmers from protecting their crops by imposing an overly restrictive legislative framework. Scientific production is itself part of this social and political conflicting context. On one side, agronomic research seeks concrete solutions to support farmers; on the other, research in ecology, ornithology and conservation biology, aimed at protecting birds, is seen as partly influencing public opinion and driving policies that restrict the use of lethal methods for bird population control. In between are gamekeepers, assisting farmers within the scope of their resources (Fig. 3).

The problem of corvid damage in Switzerland is the singular expression of a more general conflict that pits the agricultural world against the rest of society around questions of ecology and production. The predominance of these social conflicting logics in the farming community's representation of the problem explains the invisibility of research in ecology and conservation biology on the effectiveness of control methods against corvid damage, and the group's persistent attachment to control shooting. This underscores the epistemic cohesion within the farming community regarding this issue, driven in particular by logics of deference and loyalty to the social group (Compagnone, 2022).

3.4. A multifactorial process leading to a cognitive gamble

If we analyze the problem from a general point of view, there are therefore a variety of social, cultural, emotional and cognitive factors or barriers, which reinforce the process of attachment to control shooting. As a result, in a context of scientific uncertainty and in the absence of a truly effective solution, agricultural stakeholders adopt a method whose efficacy remains unproven. This attachment is not based on any scientific expertise or conclusive feedback, it takes root in an assumption, a conviction, that on a large scale, control shooting would work. From the perspective of the farming community, this conviction is enough to legitimize the political mobilization in favor of liberalizing shooting, and in other countries like France, its large-scale implementation (Jiguet, 2020). This appears to be a *cognitive gamble* that the farming community is currently engaged in. It is the result of a multi-factorial process at the crossroads of different social, cultural and cognitive logics (Fig. 4).

4. Discussion

All these results highlight the multifactorial dimension of the process that leads to attachment to the control shooting as a cognitive gamble. In this discussion, we reverse the perspective - from *attachment* to *detachment* - to discuss the reasons for the failure of detachment from the perspective of actor-network theory. Then, we examine ways in which detachment can be strengthened, and whether, in this respect, thinking solely in terms of the actor-network is relevant.

4.1. The failure of detachment in the theoretical perspective of the actor-network

We conducted this study using the concepts of *attachment* and *detachment* derived from the sociology of innovation and actor-network theory (Callon, 1986; Goulet and Vinck, 2012; Latour, 1989). From this theoretical perspective, the persistent attachment to control shooting reveals the failure in the socio-technical network of innovation by detachment (Goulet and Vinck, 2012). The researchers in ecology and conservation biology who advocate the abandonment of control shooting (Beja et al. 2009; Bolton et al. 2007; Jiguet, 2020) have not yet succeeded in rallying the agricultural community around this renunciation, i.e., untying the existing associations between agricultural stakeholders and their traditional control methods.

Several factors contribute to this outcome. Firstly, as there is no alternative innovation that can effectively solve the problem of corvid damage (Esther et al., 2013; Klug et al., 2023; Linz et al., 2011), the network lacks a replacement entity, an alternative method to shooting, that could facilitate new connections. This absence seems to be a major obstacle. Secondly, and closely related, the point of passage to avoid (PPA), in this case control shooting (Goulet and Vinck, 2012), fails to generate enough attractiveness and centrifugal force, in the network of actors. This is particularly due to a lack of awareness of its ineffectiveness, and to the relative incompatibility of the values cited by different actors when discussing their method choice. In short, in order to succeed

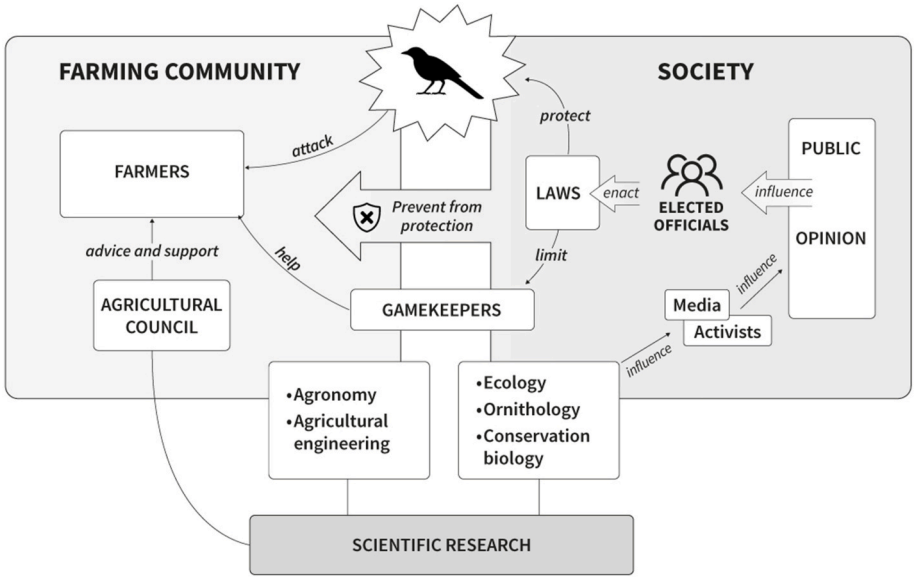


Fig. 3. Swiss farming community perception of the problem of corvid damage and the role of various stakeholders.

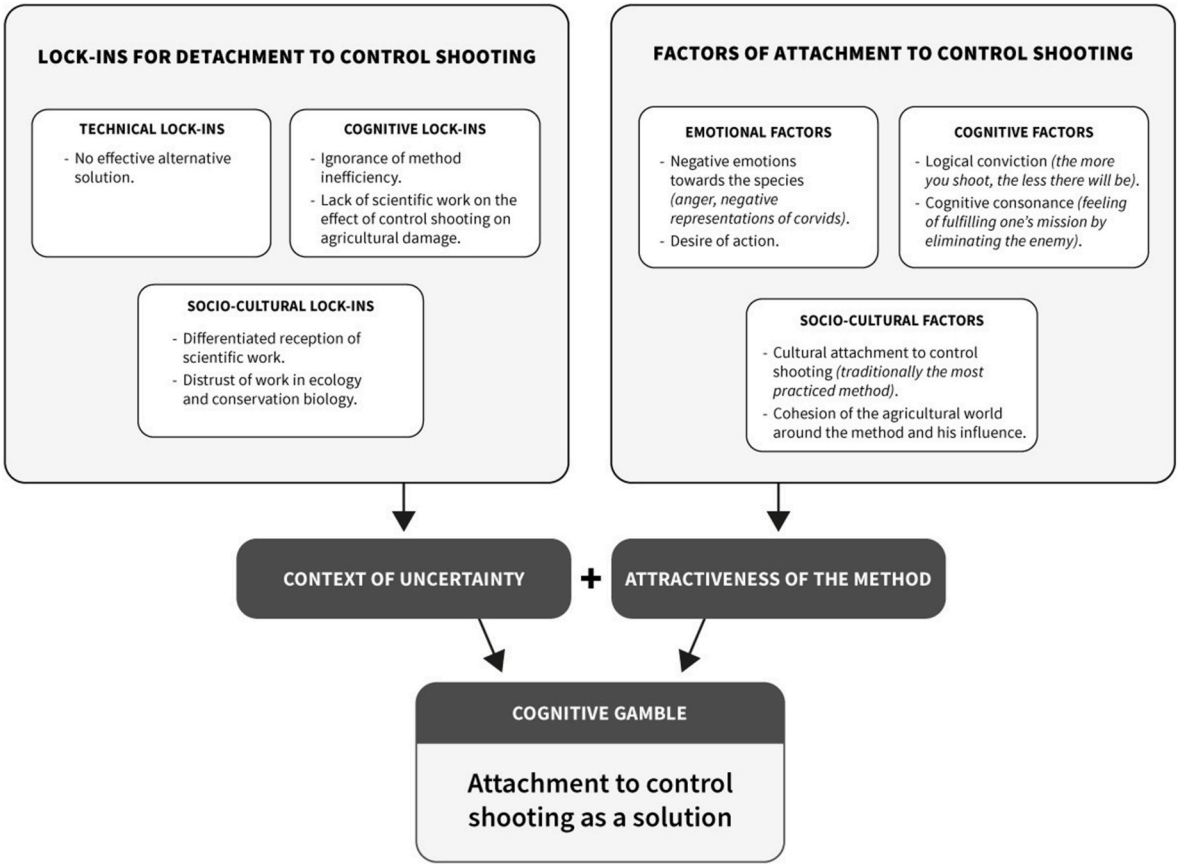


Fig. 4. Multifactorial process of attachment to control shooting.

in making control shooting undesirable for other stakeholders, researchers in ecology and conservation biology lack material (no substitute innovation), discursive (invisibility of their work), and cognitive resources (researchers refer to a different value system than agricultural actors), essential to build a robust network (Goulet and Vinck, 2012). Attachment to control shooting therefore remains strong, and the fact that it is caught up in persistent logics of conflict between social groups reinforces the phenomenon.

All this makes recruitment around the detachment of shooting particularly difficult. It prevents the creation of a solid socio-technical network, which seems to be the first condition for the successful adoption of an innovation, even if it's the abandonment of a traditional method (Callon, 1986).

4.2. How to get people to abandon control shooting?

Three conditions seem important to successfully abandon control shooting: (i) the emergence of a replacement innovation, (ii) awareness of the negative practical, economic and ethical aspects of control shooting and (iii) access to scientific knowledge from different fields on the subject in the farming community.

Agronomy research is active on the first point with the conception of bird scarers, or the research of repulsive seed coating products. However, efforts must continue, as no viable solution has been found so far, and this appears to be an essential condition for detachment from control shooting.

Efforts are still needed to raise awareness concerning the negative aspects of control shooting, not only among farmers, but also among elected representatives and the public authorities concerned. A cost analysis should first be carried out by the governing bodies, in order to measure the constraints and costs involved in a large-scale policy of pest control by shooting (Jiguet, 2020; Warburton and Anderson, 2018). In France, for example, the cost of pest control has been roughly estimated at around 45 million euros per year for 8.6 million reported cases of damage (Jiguet, 2023). Although the case of Switzerland is different, this shows the potential cost of corvid population control policies, as the implementation may easily exceed the estimated damage cost. From our perspective, this economic aspect is essential to make control shooting undesirable. There's a meeting point here with Rogers' diffusionist model of innovation, which emphasizes the importance of economic interest in rallying players to an innovation (1983). That is why it seems essential to assess the effectiveness of regulation, both for economic and ethical reasons, as millions of individuals are killed every year in Europe (Jiguet, 2020).

Finally, promoting access to scientific research in ornithology, ecology, and conservation biology for the farming community could lead them to approach the problem from a different perspective, with better knowledge of the depredating species' ecology. Both research and extension organizations should be active in the opening of disciplinary frontiers, to promote knowledge exchange across fields and reduce conflicts between social groups. This is a real challenge insofar as the incompatibility of values between the farming community and a large part of society regarding environmental and production issues hinders the dissemination of research in ornithology, ecology and conservation biology. In Rogers' model of innovation diffusion (1958; 1983), this question of compatibility between the values conveyed by an innovation and those held by its target group is also central.

4.3. Outlook

Thinking in terms of network makes it possible to identify several obstacles to detachment from control shooting and seek solutions. But this approach, given the role of values and social relations in guiding practice choices, needs to be enriched by an analysis that takes into account the social dynamics shaping the farming community itself, and above all in its dialogue networks. Focusing on these networks is crucial for understanding farmers' relationships to knowledge and shifts in practices (Compagnone, 2022). Actor-network theory would be insufficient on these points, as the elaboration of epistemic points of view is too dependent on the material and social positions of the agents involved (Darré, 1984). This is a point that calls for further investigation, as our study did not focus specifically on dialogue networks. However, we highlight the fact that farmers' ability to adhere to new practices is strongly linked to their ability to access relevant cognitive and social resources (Darré, 1996; Lazega and Lebeaux, 1995).

5. Conclusion

Our survey showed that attachment to control shooting is a multifactorial process that cannot be reduced to an individual decision based on scientific rationality. The factors influencing farmers, members of the agricultural council and gamekeepers, are at once cognitive, cultural, emotional and, above all, social. The farming community's perception of corvid damage is rooted in a wider social conflict that pits it against the public opinion, around issues of ecology and production. The dominance of these conflicting logics hinders the circulation of scientific knowledge from different fields that question shooting's effectiveness as a control method, which explains its continued endorsement by the farming community despite researchers' efforts to discourage it.

However, given the high social and economic cost of implementing a large-scale control shooting policy, and the large number of corvids killed unnecessarily in the process, this method of control does not appear to be the right solution.

To prevent the farming community from committing itself in the long term to a losing cognitive gamble, it therefore seems essential to improve the frameworks for the production and dissemination of agronomic knowledge by opening up disciplinary boundaries and working towards the integration of relevant work from other fields, such as ornithology, ecology and conservation biology. From this perspective, sociology plays a crucial role in rethinking how scientific knowledge is produced and disseminated, as well as how training, research, and collaboration are structured within the agricultural world, in order to ultimately improve the effectiveness and relevance of extension efforts.

Knowledge of sociological studies about human-wildlife conflicts, such as the one presented in this article, would indeed enable actors and decision-makers, whether from the farming community or public authorities, to adapt their bird damage management policies, by taking greater account of the social factors that influence the choice of a control method.

CRediT authorship contribution statement

Juliette Craplet: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Amal Chantoufi:** Writing – review & editing, Visualization, Methodology, Conceptualization, Writing – original draft. **Eve-Anne Laurent:** Writing – review & editing, Methodology, Conceptualization. **Claude Compagnone:** Writing – review & editing, Methodology. **Alice Baux:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Funding

This article is part of the GEODE project, funded by the Swiss Federal Office for Agriculture (FOAG).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We sincerely thank all the participants who took part in the survey. Their time and willingness to share their experiences were invaluable to this research.

Data availability

Data will be made available on request.

References

Agroscope, 2021. National survey on bird damage in crop fields. Unpublished report.

Akrich, M., Callon, M., Latour, B., 2002. The key to success in innovation part I: the art of interessement. Int. J. Innovat. Manag. 6 (2), 187–206. June 2002.
Albaret, M., Ruette, S., Guinot-Ghestem, M., 2014. Nouvelle enquête sur la destruction des espèces classées nuisibles en France – saisons 2011-2012 et 2012-2013. Faune Sauvage 305, 10–16.
Araneda, P., Ohrens, O., Ibarra, J.T., 2022. Socioeconomic development and ecological traits as predictors of human-bird conflicts. Conserv. Biol. 36 (1), e13859. https://doi.org/10.1111/cobi.13859.
Arena, M, Auteri, D, Barmaz, S, Brancato, A, Brocca, D, Bura, L, Carrasco Cabrera, L, Chiusolo, A, Civitella, C, Court Marques, D, Crivellente, F, Ctverackova, L, De Lentdecker, C, Egsmose, M, Erdos, Z, Fait, G, Ferreira, L, Greco, L, Ippolito, A, Istace, F, Jarrah, S, Kardassi, D, Leuschner, R, Lostia, A, Lythgo, C, Magrans, JO, Medina, P, Mineo, D, Miron, I, Molnar, T, Padovani, L, Parra Morte, JM, Pedersen, R, Reich, H, Sacchi, A, Santos, M, Serafimova, R, Sharp, R, Stanek, A, Streissl, F, Sturma, J, Szentes, C, Tarazona, J, Terron, A, Theobald, A, Vagenende, B, Van Dijk, J, Villamar-Bouza, L, EFSA (European Food Safety Authority), 2018. Conclusion on the peer review of the pesticide risk assessment of the active substance methiocarb. EFSA Journal 16 (10), 26. https://doi.org/10.2903/j.efsa.2018.5429, 5429.
Article RTS, Anonyme, 2022. Pétition lancée dans le canton de Vaud pour lutter contre la surpopulation des corbeaux, 2022 [Online] Available at: https://www.rts.ch/info/regions/vaud/13319930-petition-lancee-dans-le-canton-de-vaud-pour-lutter-contre-la-surpopulation-des-corbeaux.html (Accessed 21 December 2024).
Aubry, P., Anstett, L., Ferrand, Y., Reitz, F., Klein, F., Ruette, S., Sarasa, M., Arnauduc, J.-P., Migot, P., 2016. Enquête nationale sur les tableaux de chasse à tir. Saison 2013-2014 – résultats nationaux. In: Faune Sauvage 310, Supplément Central, p. 8. http://www.oncfs.gouv.fr/IMG/file/publications/revue%20faune%20sauvage/FS_310_enquete_tableau_de_chasse.pdf.
Barthe, Y., Callon, M., Lascoumes, P., 2001. Agir dans un monde incertain, essai sur la démocratie technique. La couleur des idées. https://doi.org/10.3917/ls.barth.2014.01. Seuil.
Beja, P., Gordinho, L., Reino, L., et al., 2009. Predator abundance in relation to small game management in southern Portugal: conservation implications. Eur. J. Wildl. Res. 55, 227–238. https://doi.org/10.1007/s10344-008-0236-1.
Bennett, N., 2016. Using perceptions as evidence to improve conservation and environmental management 30, 582–592. https://doi.org/10.1111/cobi.12681.
Betz Heinemann, K., Betmezoğlu, M., Ergoren, M.C., et al., 2020. A murder of crows: culling corvids in Northern Cyprus. Hum. Ecol. 48, 245–249. https://doi.org/10.1007/s10745-020-00154-4.
Bollman, K., 1998. Les corvidés et l'agriculture [Online] Available at: https://cdnfiles2.biolovision.net/www.nosoiseaux.ch/pdffiles/infos/Corvides_agriculture-4537.pdf.
Bolton, M., Tyler, G., Smith, K., , et al.Bamford, R., 2007. The impact of predator control on lapwing *vanellus Vanellus* breeding success on wet grassland nature reserves: lapwing breeding success. J. Appl. Ecol. 44, 534–544. https://doi.org/10.1111/j.1365-2664.2007.01288.x.
Bourdieu, P., 1977. Une classe objet. Actes De La Recherche En Sciences Sociales, pp. 17–18. www.persee.fr/doc/arss_0335-5322_1977_num_17_1_2572.
Buitendijk, N.H., de Jager, M., Hornman, M., Kruckenberg, H., Kölzsch, A., Moonen, S., Nolet, B.A., 2022. More grazing, more damage? Assessed yield loss on agricultural grassland relates nonlinearly to goose grazing pressure. J. Appl. Ecol. 59 (12), 2878–2889.
Callon, M., 1986. Éléments pour une sociologie de la traduction. La domestication des coquilles Saint-Jacques et des marins dans la baie de Saint-Brieuc, L'année sociologique 36, 170–208.
Chiron, F., Chargé, R., Julliard, R., Jiguet, F., Muratet, A., 2014. Pesticide doses, landscape structure and their relative effects on farmland birds. Agric. Ecosyst. Environ. 185, 153–160.
Commission Implementing Regulation (EU), 2018. In: 2018/1500 of 9 October 2018 Concerning the Non-renewal of Approval of the Active Substance Thiram, and Prohibiting the Use and Sale of Seeds Treated with Plant Protection Products Containing Thiram, in Accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council Concerning the Placing of Plant Protection Products on the Market, and Amending Commission Implementing Regulation (EU) No 540/2011 (Text with EEA Relevance.) (OJ L 254 10.10. ELI, p. 1. http://data.europa.eu/eli/reg_impl/2018/1500/oj.
Commission Implementing Regulation (EU), 2019. In: 2019/1606 of 27 September 2019 Concerning the Non-renewal of the Approval of the Active Substance Methiocarb, in Accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council Concerning the Placing of Plant Protection Products on the Market, and Amending the Annex to Commission Implementing Regulation (EU) No 540/2011. ELI, p. 53 (Text with EEA relevance.) (OJ L 250 30.09. http://data.europa.eu/eli/reg_impl/2019/1606/oj.
Compagnone, C., 2022. La dimension sociale de l'orientation des pratiques des agriculteurs: Autorités, déférences et conflits épistémiques. Agronomie, Environnement & Sociétés 12 (2), 1–11. https://institut-agro-dijon.hal.science/hal-04036947.
Darré, J.P., 1984. La production des normes au sein d'un réseau professionnel L'exemple d'un groupe d'éleveurs. Sociol. Travail 141–156.
Darré, J.-P., 1996. L'invention des pratiques dans l'agriculture. In: Vulgarisation Et Production Locale De Connaissance. Paris, Karthala, coll. Hommes et Sociétés.
Darré, J.-P., 1999. La production de connaissances pour l'action. Argument Contre Le Racisme De L'Intelligence. Édition de la MSH et INRA Editions, Paris.
Day, T.D., Clapperton, B.K., Porter, R.E., Waas, J.R., Matthews, L.R., 2012. Responses of free-ranging house sparrows to feed containing primary and secondary repellents. N. Z. J. Crop Hortic. Sci. 40 (2), 127–138.
Dickman, A.J., 2010. Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. Anim. Conserv. 13, 458–466. https://doi.org/10.1111/j.1469-1795.2010.00368.x.
Donald, P.F., Green, R.E., Heath, M.F., 2001. Agricultural intensification and the collapse of europe's farmland bird populations. Proceedings of the Royal Society of London. Series B: Biological Sciences 268 (1462), 25–29.
Dross, C., Princé, K., Jiguet, F., Tichit, M., 2018. Contrasting bird communities along production gradients of crops and livestock in French farmlands. Agric. Ecosyst. Environ. 253, 55–61.
Esther, A., Tilcher, R., Jacob, J., 2013. Assessing the effects of three potential chemical repellents to prevent bird damage to corn seeds and seedlings. Pest Manage Sci 69, 425–430.
Festinger, L., 1957. A Theory of Cognitive Dissonance. Stanford University Press, California.
Furlan, L., Contiero, B., Chiarini, F., Bottazzo, M., Milosavljević, I., 2021. Risk factors and strategies for integrated management of bird pests affecting maize establishment. Crop Prot. 148. https://doi.org/10.1016/j.cropro.2021.105744.
Goulet, F., Vinck, D., 2012. L'innovation par retrait. Contribution à une sociologie du détachement. Rev. Fr. Sociol. 53, 195–224. https://doi.org/10.3917/rfs.532.0195.
Hill, C.M., 2002. People, crops and wildlife: a conflict of interests. In: Hill, C.M., Osborn, F.V., Plumptre, A.J. (Eds.), Human-Wildlife Conflict: Identifying the Problem and Possible Solutions, 60–67. Albertine Rift Technical Reports,Vol. 1, Uganda: Wildlife Conservation Society. https://www.researchgate.net/publication/235944935_Human-Wildlife_Conflict_Identifying_the_problem_and_possible_solutions.
Hirschfeld, A., Heyd, A., 2005. Mortality of migratory birds caused by hunting in Europe: bag statistics and proposals for the conservation of birds and animal welfare. Ber. Vogelschutz 42, 47–74.
Htay, T., Ringsby, T.H., Røskaft, E., Ranke, P.S., 2022. Promoting bird conservation in wetland-associated landscapes: factors influencing Avian crop damage and farmers' attitudes. Global Ecology and Conservation 38. https://doi.org/10.1016/j.gecco.2022.e02212.
International Union for Conservation of Nature (IUCN). (n.d.). Corvus corone & Corvus frugilegus. IUCN Red List of Threatened Species. Retrieved from https://www.iucnredlist.org.
Jacobsen, Kim S., Linnell, John D.C., 2016. Perceptions of environmental justice and the conflict surrounding large carnivore management in Norway — implications for conflict management. Biol. Conserv. 203, 197–206. https://doi.org/10.1016/j.biocon.2016.08.041.
Jiguet, F., 2020. The fox and the Crow. A need to update Pest control strategies. Biol. Conserv. 248. https://doi.org/10.1016/j.biocon.2020.108693.
Jiguet, F., 2023. Interroger les pratiques de régulation pour concilier éthique et efficacité. Oral presentation presented at the Colloque "Dégâts d'oiseaux aux cultures: quelles solutions? Paris, 24 novembre 2023. Available at: https://www.youtube.com/watch?v=638kHfM_T-Y&t=7553s. (Accessed 20 December 2024).
Jodelet, D., 2006. Place de l'expérience vécue dans les processus de formation des représentations sociales. In: Haas, V. (Ed.), Les Savoirs Du Quotidien. Transmissions, Appropriations, Représentations. Rennes. PUR, pp. 235–255. https://doi.org/10.1522/030023179. http://dx.
Kennedy, T.F., Connery, J., 2008. An investigation of seed treatments for the control of Crow damage to newly-sown wheat. Ir. J. Agric. Food Res. 79–91.
Klug, P., Shiels, A., Kluever, B., Anderson, J., Hess, S., Ruell, E., Bukoski, W., Siers, S., 2023. A review of nonlethal and lethal control tools for managing the damage of invasive birds to human assets and economic activities. Management of Biological Invasions 14 (1), 1–44. https://doi.org/10.3391/mbi.2023.14.1.01.
Latour, B., 1989. La Science en action, traduit de l'anglais par Michel Biezunski ; texte révisé par l'auteur, Paris, La Découverte, «Textes à l'appui. Série Anthropologie Des Sciences Et Des Techniques.
Lazega, E., 2011. Pertinence et structure. Swiss journal of sociology 37 (1), 127–149.
Lazega, E., Lebeaux, M.-O., 1995. Capital social et contrainte latérale. Rev. Fr. Sociol. 36–4, 759–777. https://doi.org/10.2307/3322455.
Lémery, B., 2003. Les agriculteurs dans la fabrique d'une nouvelle agriculture. Sociol. Travail 45 (1), 9–25. https://doi.org/10.4000/sdt.30813.
Linz, G.M., Homan, H.J., Werner, S.J., Hagy, H.M., Bleier, W.J., 2011. Assessment of bird-management strategies to protect sunflowers. Bioscience 61 (12), 960–970. https://doi.org/10.1525/bio.2011.61.12.6.
Madden, F., 2004. Creating coexistence between humans and wildlife: global perspectives on local efforts to address human–wildlife conflict. Hum. Dimens. Wildl. 9 (4), 247–257. https://doi.org/10.1080/10871200490505675.
Madden, F., McQuinn, B., 2014. Conservation's blind spot: the case for conflict transformation in wildlife conservation. Biol. Conserv. 178, 97–106. https://doi.org/10.1016/j.biocon.2014.07.015.
Mekonen, S., 2020. Coexistence between human and wildlife: the nature, causes and mitigations of human wildlife conflict around bale Mountains national park, southeast Ethiopia. BMC Ecol. 20 (1), 51. https://doi.org/10.1186/s12898-020-00319-1.
Nilsson, L., Bunnefeld, N., Persson, J., Žydelis, R., Månsson, J., 2019. Conservation success or increased crop damage risk? The natura 2000 network for a thriving migratory and protected bird. Biol. Conserv. 236, 1–7.
Robin, N., Ballanger, Y., 2011. Colombidés: quels dégâts sur quelles cultures. Faune Sauvage. N°293 [Online] Available at: https://professionnels.ofb.fr/sites/default/files/pdf/RevueFS/FauneSauvage293_2011_Art19.pdf.
Rogers, E.M., 1958. Categorizing the adopters of agricultural practices. Rural Sociology Society 23 (4), 345–354.

Rogers, E.M., 1983. Diffusion of innovations. University of Illinois at urbana-champaign's academy for entrepreneurial leadership historical research reference in entrepreneurship. Available at: SSRN: https://ssrn.com/abstract=1496176.

Sausse, C., Lévy, M., 2021. Bird damage to sunflower: international situation and prospects. OCL - Oilseeds and Fats, Crops and Lipids 28, 34. https://doi.org/10.1051/ocl/2021020.

Sausse, C., Baux, A., Bertrand, M., Bonnaud, E., Canavelli, S., Destrez, A., Klug, P.-E., Olivera, L., Rodriguez, E., Tellechea, G., Zuil, S., 2021. Contemporary challenges and opportunities for the management of bird damage at field crop establishment. Crop Prot. 148, 1–7. https://doi.org/10.1016/j.cropro.2021.105736.

Swiss Federal Office for Agriculture (FOAG), 2024. Korit 420 FS – product information. Swiss pesticide database [Online] Available at: https://www.psm.admin.ch/fr/produkte/6679. (Accessed 15 September 2024).

Wahlen, M., 2022. Postulat Marion Wahlen et consorts—Dégâts causés par les corvidés aux cultures : Que fait l'Etat de Vaud. État de Vaud, 24 mai 2022. [Online] Available at: https://www.vd.ch/gc/seances-du-grand-conseil/point-seance/id/cbb15d2a-d626-4a5d-8cd8-95d3aa3baf28/meeting/1004436#:~:text=En%20arboriculture%20et%20en%20viticulture,d%C3%A9truire%20le%20c%C5%93ur%20des%20salades. (Accessed 15 September 2024).

Warburton, B., Anderson, D., 2018. Ecology, economics and ethics: the three Es required for the sustainable management of wild sentient species. In: Sarkar, S., Minteer, B.A. (Eds.), A Sustainable Philosophy – the Work of Bryan Norton, the International Library of Environmental, vol. 26. Agricultural and Food Ethics. https://doi.org/10.1007/978-3-319-92597-4_14.

Zemman, C., Langridge, J., Plancke, M., Garnier, M., Soubelet, H., 2023. Les prélèvements des Espèces susceptibles d'occasionner des dégâts (Esod) réduisent-ils les dégâts qui leur sont imputés. Synthèse De Connaissances. FRB, Paris, France.