Farmers' decision regarding involvement in conservation projects and communication preferences: A case study of an EU H2020 project

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Résumé

Les préoccupations environnementales sont de plus en plus au cœur de l'actualité, et l'agriculture y occupe une place centrale. Ainsi, la mise en œuvre de pratiques durables et l'implication des agriculteurs dans des projets de conservation sont des facteurs cruciaux dans la résolution de ces problèmes. Cette thèse vise à comprendre les motivations des agriculteurs à participer à des projets de conservation et à déterminer leurs préférences en matière de canaux de communication. Pour ce faire, cette étude utilise le processus de hiérarchie analytique (AHP), une méthode de prise de décision multicritères (MCDM). Cette méthode permet de hiérarchiser les critères et de trouver la meilleure solution. La méthode est appliquée dans le cadre du projet FRAMEwork (Horizon 2020), qui promeut la conservation de la biodiversité dans l'agriculture. Il se déroule dans 11 pays européens. Les résultats montrent que la volonté des agriculteurs de s'engager dans des projets de conservation repose sur différents critères. Les principaux facteurs sont leurs valeurs, la santé publique et les préoccupations environnementales, qui sont prioritaires par rapport aux avantages économiques. En ce qui concerne les canaux de communication, ils préfèrent la communication orale aux médias traditionnels et à internet. Ces résultats montrent que les motivations des agriculteurs à participer à des projets sont une combinaison de facteurs socio-économiques complexes et qu'il est essentiel de les comprendre pour modifier leur comportement. En outre, il est essentiel de communiquer pour les impliquer et instaurer un climat de confiance entre toutes les parties prenantes. Les politiques devraient donc tenir compte de ces facteurs et améliorer la communication avec les agriculteurs afin d'accroître leurs connaissances et de les rendre acteurs principaux de la conservation de l'environnement.

Abstract

Environmental concerns are rising, and agriculture is at the heart of these issues. Thus, implementing sustainable practices and involving farmers in conservation projects are crucial factors in tackling these issues. This thesis aims to comprehend farmers' motivations for participating in conservation projects and ascertain their communication channel preferences. For this purpose, this study employs the Analytic Hierarchy Process (AHP), a Multi-Criteria Decision-Making (MCDM) method. With this method, the criteria are prioritised, and the best solution is found. The method is applied in the FRAMEwork project (Horizon 2020), which promotes agricultural biodiversity conservation. It takes place in 11 European countries. The results show that farmers' willingness to engage in conservation projects is based on different criteria. The primary factors include their values, public health, and environmental concerns, prioritised over economic benefits. Regarding communication channels, they preferred oral communication before traditional media and the Internet. These findings demonstrate that farmers' motivations to get involved in projects are a combination of complex socio-economic factors and that understanding them to change their behaviour is crucial. Moreover, communicating to get them involved is essential, and building trust between all the stakeholders is vital. Thus, policies should consider these factors and improve communication with farmers to increase their knowledge and make them owners of environmental conservation.

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Acronyms

AES: Agri-Environmental Scheme

AHP: Analytic Hierarchy Process

CAP: Common Agricultural Policy

CBD: Convention on Biological Diversity

ECC: European Economic Community

EU: European Union

MCDM: Multi-Criteria Decision-Making

MEA: Millennium Ecosystem Assessment

Introduction

Agriculture feeds almost 8 billion people but it is also a main driver of environmental deterioration and biodiversity loss (Clark et al., 2017). The impact of agricultural activities on the environment is crucial, as 40% of terrestrial lands are dedicated to it (FAO, 2022). Agriculture threatens the environment by transforming lands and homogenising habitats, but also through chemical use, carbon emission and water pollution. However, recognising its indispensability in nourishing societies and driving economic progress pursuing a sustainable and resilient agricultural paradigm emerges as a vital imperative (Williams et al., 2020).

To tackle these issues, the European Union (EU) developed different solutions, such as paying for sustainable practices implemented on field or developing conservation projects (Emmerson et al., 2016). This first option is the main one chosen by the EU, with the Agri-Environmental Scheme (AES), yet its efficacy in halting biodiversity decline often falls short of expectations (Pe'er et al., 2022). Despite this, these schemes can shift farmers' motivations from financial gain to embracing broader environmental and societal considerations (Cullen et al., 2020; Barghusen et al., 2021).

Therefore, behaviour changes are necessary among farmers and the community. Communication is essential to catalyse these changes (Hooykaas et al., 2020; Whitmarsh et al., 2021). While the components of communication strategies may vary, understanding the specific target audience and selecting appropriate communication channels are foundational steps (Hooykaas et al., 2020).

Researchers have explored farmers' involvement in AES. However, the literature on their involvement in European conservation projects is relatively poor. It is also true regarding their preferences in conservation practices in the EU. Thus, this thesis tries to fill these gaps.

The general objective of the thesis is to understand farmers' decisions regarding involvement in conservation projects and communication preferences. To do so, three specific objectives have been defined:

1. To identify the main motivations of farmers to be involved in environmental conservation projects.
2. To explore farmers' preferences regarding communication channels in environmental conservation projects.
3. To formulate recommendations about the communication strategy of environmental conservation projects.

This thesis takes place in the FRAMEwork Horizon 2020 project, which aims to promote biodiversity in farmland. This project aim is to implement farmers' clusters – collaborative groups guided by facilitators – inspired by a British model. The project evaluates the feasibility of implementing such clusters in the EU.

Farmers from the project have been asked to answer a questionnaire to reach the objectives. The Analytic Hierarchy Process (AHP) has been employed. It is a multi-criteria decision-making method, aiming to find the best alternatives based on different criteria and sub-criteria by structuring problems into hierarchies and calculating priorities vectors.

Literature review

Biodiversity

Origin and definition of the concept

The concept of biodiversity is increasingly being promoted as a part of sustainable development (Hooykaas et al., 2020). This term is relatively recent, and its first apparition in the literature is dated from the 1980s. Researchers had different perspective about the use of this term for the first time. Sarkar (2021) stated that the dates of use this term back to an article by Laura Tangley (1985) that attempted to propose an approach for conserving the biological diversity in developing countries. However, the word was not introduced consciously by Laura Tangley (1985). The term "biodiversity" was first introduced as a contraction of "biological diversity" by Dr. Walter G. Rosen during the National Forum on Biodiversity in September 1986 (Wilson et al., 1988; Sarkar, 2021).

The term biodiversity comes from the Greek *bios*, referring to life and the Latin word *diversitas* referring to variety or difference. Thus, biodiversity refers to the varieties in life (DeLong, 1996; ibn, March-9-2023). Genetic diversity, species diversity, and ecosystem diversity are the three main levels at which biodiversity is often explored (Purvis et al., 2000; Meinard et al., 2014). In 1992, the United Nations Conference on Environment and Development was held in Rio de Janeiro, Brazil. During this summit, the Convention on Biological Diversity (CBD) was signed by more than 150 countries. By signing it, the different governments recognised the importance of protecting diversity and have committed to developing strategies to protect it (Markussen, 2005; Neumann, 2009; Frison, 2021). According to the CBD the definition of biological diversity is "*the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species, and of ecosystems*" (CBD, 1992). DeLong (1996), in *Defining biodiversity*, explored different definitions, ranging from species-level to ecosystem-level. He introduced is own definition: "*Biodiversity is an attribute of a site or area that consists of the variety within and among biotic communities, whether influenced by humans or not, at any spatial scale from microsites and habitat patches to the entire biosphere*" (DeLong, 1996). Moreover, he mentions that a clear definition is essential to communicate and hope to protect this biological diversity (DeLong, 1996).

To summarise, biodiversity is a complex concept representing the diversity of life from genes to species to ecosystems. It is related to conservation biology and several other fields, such as ecosystem ecology, biogeography, and phylogeny, where it plays a central role (Meinard et al., 2014). Furthermore, biodiversity has become essential in areas other than biology, such as economics, with the valuation of ecosystems; philosophy, with the values of biodiversity and animal welfare; or

anthropological studies, to find the place of Humankind in the ecosystems (Wilson et al., 1988; Meinard et al., 2014). Finally, this concept is also gaining importance among citizens and governments, as the European Union (EU) Biodiversity strategy for 2030 proves it. This plan aims "*to protect nature and reverse the degradation of ecosystems*", thus putting the EU on the path of recovering biodiversity by 2030 (European Commission, 2020).

Biodiversity and agriculture

Agricultural lands accounts for large part of terrestrial land. In fact, agroecosystems represent between 36.5% and 38% of terrestrial land on Earth in 2020, accounting for 4.7 billion ha (FAO, 2020; The World Bank, 2020a; FAO, 2022). Worldwide, agricultural lands are composed of croplands (arable lands and lands under permanent crops), which represents 12% of the total land area (1.6 billion ha), and lands under permanent meadows and pastures (cultivating and natural growing), which represent 24% of the terrestrial lands (3.2 billion ha) (FAO, 2022). In 2020, these percentages were slightly superior inside the EU, between 41% and 46.4% of terrestrial lands, representing about 160 million ha (The World Bank, 2020b; Eurostat, 2022). In France, Spain, Germany, and Poland almost half of the EU agricultural lands are found (Eurostat, 2022). By covering a large area, agroecosystems are of great importance in the global ecosystem. However, they are among the primary causes of biodiversity loss, as identified by the Millennium Ecosystem Assessment (MEA) (MEA, 2005).

Agriculture and biodiversity are strongly linked together. Although both are interconnected, agriculture is one of the primary causes of biodiversity loss despite the fact that it could benefit from the ecosystem services provided by biodiversity (Tilman et al., 2001; Foley et al., 2005). Ecosystem services are defined by Daily et al. (1997) as the "*benefits supplied to human societies by natural ecosystems"* and have gained attention in the scientific and policy-makers communities since the MEA. Biodiversity can be considered an ecosystem service, even if it is difficult to measure precisely, but it provides resources to the agroecosystems (Dudley et al., 2017; Bengtsson et al., 2019; Ortiz et al., 2021). Furthermore, it can also be considered a part of several other ecosystem services, such as pollination, agricultural resilience, soil fertility, nutrient cycles, or carbon sequestration (Eigenbrod et al., 2010; Mace et al., 2012). Nevertheless, biodiversity is threatened by agriculture, which is the main driver of its decline (Dudley et al., 2017).

The main causes of biodiversity loss, according to Dudley et al. (2017), are the conversion of natural lands to agricultural lands, the intensification of cultural landscapes, the release of pollutants (such as greenhouse gases), and the impact of the associated chain value (energy, transport, and waste).

Agricultural lands and biodiversity

Worldwide agricultural lands have reached a plateau since the beginning of this century, but lands under permanent meadows are declining, while the ones under permanent irrigated crops are increasing (The World Bank, 2020a; FAO, 2021). Moreover, natural habitats conversion is still an issue in many countries, especially tropical ones (Dudley et al., 2017). Indeed, South and Southeast Asia, Central and South America, and Africa are seeing their forest areas reduced. The annual rate of forest loss between 2010 and 2015 is 3.3 million $ha.y^{-1}$, and the yearly rate of tropical forest loss in the same period is 5.5 million $ha.y^{-1}$. Most of these natural habitats are converted into agricultural lands, which include an important biodiversity loss (Keenan et al., 2015; Azadi et al., 2021). In contrast, forests are expanding in Europe (Russian Federation including), and croplands are decreasing (UNEP, 2019).

This conversion generates a loss and a fragmentation of habitats having a negative impact on biodiversity (Fletcher et al., 2018). Nevertheless, in Europe this conversion is not observed in the last decades, but another one happened, with the shift from traditional agriculture to an intensive one, which supports a lower level of biodiversity (Dudley et al., 2017).

Intensive agriculture and biodiversity

Agricultural intensification is linked with the population increase, the global food demand, and the development of new technologies since the Green Revolution (Ickowitz et al., 2019). It aims to increase yields on the same land area, which could decrease agricultural area protecting natural habitats (Warf, 2010). However, this intensification resulted from the use of inorganic fertilisers, chemicals, pesticides, machinery, irrigation, and the development of high-yielding seeds and new breeds (Pretty et al., 2014). The negative environmental effects include increased erosion, lower soil fertility, water pollution, rivers and lakes eutrophication, impact on the atmosphere composition and the climate, and a loss in biodiversity (Rasmussen et al., 2018).

This intensification has significant impact in biodiversity, primarily through using chemical products. First of all, it affects soil ecosystems that are known to provide a wide range of ecosystem services, such as water retention, soil fertility, carbon retention, and many of these services are mediated by the diversity among the soil communities (Bach et al., 2020). Soil organisms are diverse, from macro arthropods, to earthworms, mites, protozoa, nematodes, bacteria, fungi, or collembolans. They are affected by the non-selectivity of chemical, but also by the decline in soil quality and plastic (Tibbett et al., 2020). They have a crucial role in ecosystem services that soil provides in agricultural land; for example, earthworms are essential in the decomposition and mineralisation of organic matter and, thus, soil fertility. These organisms also have a crucial role in the different soil cycles, such as nitrogen. Tsiafouli et al. (2015) demonstrated that intensive farming contributed to a decline in the diversity of

soil faunal taxonomic groups in four different European countries (the United Kingdom, Sweden, the Czech Republic, and Greece). In consequence, some ecosystem services are modified or lost. The capacity of the agroecosystems to self-regulate is compromised, and thus a higher level of external input is used, but all these services cannot be replaced by them (Kopittke et al., 2019). Soil management, such as the intensive use of tillage, also impacts soil populations, especially fungi (Tibbett et al., 2020).

Pesticides are used to protect crops against pests, including weeds, invertebrates, and fungi. They can be selective or generalist and have a wide range of targets. For example, insecticides are developed to fight harmful species to crops but will not be the only ones targeted by the product. For instance, predators and parasitoids are also impacted by neonicotinoids, a pesticide group acting on the nervous system. Thus, the biological control they could have on crop pests is reduced (Chagnon et al., 2015; Harmon et al., 2023).

Pollination plays a significant role as a supporting ecosystem service in agroecosystems as much as in natural ecosystems by allowing the reproduction of many plant species via the transfer of pollen. According to Ollerton et al. (2011), 85 % of plant species are pollinated by animals, such as insects, birds, or mammals. Thus, it is crucial for crops like fruits, nuts, cotton, and wild species (Chagnon et al., 2015). Brittain et al. (2010) highlighted the link between using insecticides and the risk these represent for the wild bee's species richness, essential for pollination.

Weeds are a significant concern for farmers, and many herbicides have been developed to tackle this issue. However, they also have an impact on biodiversity. First, they will affect the weeds inside the fields but select the most resistant ones, leading to the use of more pesticides (Brühl et al., 2021). Moreover, Andreasen et al. (2018) conducted a 50 years study on the long-term impact of agriculture on the seed bank in Danish arable bank, and they showed that between 1964 and 2014, the species richness of the seed bank was reduced by about 50 %. However, they also emphasise that between 1964 and 1989, the number of seeds in the soil decreased by about 50 %, but in 2014 this number was back to where it was in 1964. They think it is due to policies aiming to reduce pesticide and fertiliser use. Seed banks represent the diversity of plant that can be found in an area and this study show the agricultural impact on biodiversity over time. Weeds that grow in agricultural fields represent a link in the food web, so by reducing it, we also reduce the food quantity for organisms from insects to vertebrates (Brühl et al., 2021). The species that are specialised in crop areas are the most at risk, and according to Storkey et al. (2012), their population is declining or, like some species are already extinct in Europe, such as *Bromus bromoideus* (Lej.) Crépin. that is considered extinct in Europe (Storkey et al., 2012; Koch et al., 2016).

The changes in agricultural management also impact bird population. Indeed, over the last decades a decline of 50% of farmland bird has been observed (Ali et al., 2021). Benton et al. (2002) linked the abundance of bird populations with the insect population in Scotland, declining when insects population was reduced by the use of pesticides. Boatman et al. (2004) also highlighted the fact that spraying pesticides during the breeding season impacts the breeding performances of corn bunting (*Miliaria calandra* L.) and yellowhammer (*Emberiza citronella* L.). Landscape modification plays a role in declining bird populations due to its homogenisation. Indeed, the removal of hedgerows and the drop in uncropped land areas impact many species' nesting, foraging, and roosting (McHugh et al., 2017).

As mentioned, chemical pesticides, machinery replacing animal labour, and inorganic fertilisers modified agriculture practices and landscapes. It has reduced the need for crop rotations leading to monoculture to increase farmer outcomes. Furthermore, it is a vicious circle in which the decrease in biodiversity will deplete the agroecosystem and decrease its capacity for self-regulation, leading to more pesticides and fertilisers (Robinson et al., 2002). This intensification led to larger and specialised farms, modifying the whole landscapes, and the fragmentation of the remaining lands led to the extinction of small, fragmented, and isolated populations (Tscharntke et al., 2005; Batáry et al., 2020).

Differences across Europe

After World War II, the Berlin Wall divided Europe between the East and the West. The land management and the intensification were different between the two blocs. In 1957 the European Economic Community (EEC) was created and included Germany, Italy, France, and the Benelux countries. The EEC represent the foundation of the European Union (EU). The Common Agricultural Policy (CAP) has been a unified policy on agriculture for the EU countries since 1962 (European Council, 2023). This last one drove the intensification of agriculture from the traditional extensive agriculture present in Europe through a complex landscapes mosaic that sustained high levels of biodiversity (Emmerson et al., 2016). The CAP protected producers by guaranteeing fixed prices; and by implanting levies on cheaper imports and export “refunds” to allow the producers to be competitive in the world market (Donald et al., 2002). Thus, the Western part of Europe decided to open this agriculture to the worldwide markets through the EEC first and the EU after. Moreover, the CAP helps farmers by providing subsidies to production, driving agricultural intensification and mechanisation (Donald et al., 2002). Before being part of the EU (1995), countries like Austria, Finland and Sweden supported their agricultural sector by helping farmers financially and politically (Donald et al., 2002).

Eastern and Central European countries, influenced by the Soviet Union, underwent large-scale collectivisation programs, consolidating individual farms into state-owned or collective farms (Maticic,

1993). Agriculture was less intensive than the one in Western Europe, with lower inputs and mechanisation, resulting in lower yields. Moreover, state support was lower than in the West (Donald et al., 2002). For several of these countries, this resulted in the late 1980s to problems in food and agriculture economies due to unsuitable policies creating a price structure ill-adapted to the domestic and international market (Maticic, 1993). Since the fall of the Soviet Union, former communist countries have been reforming their agriculture and land policies allowing more support and encouraging privatisation to align them with the CAP before joining the EU (Donald et al., 2002).

Does agriculture necessarily lead to biodiversity loss?

The increase in Earth's population is at the origin of agricultural intensification, and this population is still increasing (Kopittke et al., 2019). The demand for more food and diversity, like environmental concerns, is in the public debate. Thus, the need to intensify crop production to match this demand remain, but it should not be at the expanse of destroying natural habitats and decreasing biodiversity (Kyalo Willy et al., 2019).

The EU policy tackled the environmental issue of agriculture for the first time in 1985 in the Green Paper published by the European Commission, allowing member states to provide financial aid to protect sensitive areas. In 1992, all member states had to implement agri-environmental measures (Kleijn et al., 2003). The Agri-Environmental Schemes (AESs) provide payments to compensate the cost of practices that voluntary farmers are implemented to protect the environment. AESs represent the primary instrument to reach agricultural and environmental goals (Emmerson et al., 2016). Batáry et al. (2015) stated that AESs can effectively conserve farmland biodiversity. Still, they are expensive and should be precisely designed and targeted, while the objectives are unclear nowadays. However, Kleijn et al. (2011) examined several European studies. They found that the effects of AESs can be positive or not on biodiversity and that it is a function of the region.

However, several studies (e.g., Carvalheiro et al., 2013; Batáry et al., 2015; Albrecht et al. 2020) have shown that these measures can effectively restore biodiversity and slow the decline in some populations. For instance, 6 m grass strips at the edges of arable fields positively impact bees, orthoptera species and flora for 42 lots in the UK (Marshall et al., 2006). Moreover, as mentioned before, planting flower strips will enhance biodiversity and so the pests predators. Albrecht et al. (2020) indicated that pest control services increased by 16 % with flower strips near the fields. Pest control by predators and parasitoids can have an essential impact on pests and thus in the reduction of the use of pesticides (Alarcón-Segura et al., 2022). Flower strips and nesting sites also increase pollinators' population and diversity, increasing yields, quality, profits and stability (Tschumi et al., 2016; Albrecht et al., 2020).

This biodiversity richness makes the ecosystem more stable and resilient. Nevertheless, these measures must be designed at the farm and landscape levels to be effective (Bommarco et al., 2013).

Farmland's biodiversity could benefit the whole ecosystem as well as farmers and citizens through the development of aesthetic landscapes. This concept is complex, and several projects in Europe and worldwide are trying to implement different techniques to tackle the loss of biodiversity and the degradation of the environment more generally. Farmers must be involved as agriculture is one of the main drivers of this loss. Thus, the communication about biodiversity and biodiversity in agricultural land needs to be effective and adapted so that as many people as possible can understand it. To address this issue, all the actors must connect (Levé et al., 2019).

Biodiversity communication

Why communicate about biodiversity?

Biodiversity communication aims to transform complex scientific knowledge into a message that as many people as possible will understand and raise awareness among them to develop action that will help conserve biodiversity (Doley et al., 2023).

According to Meinard et al. (2014), there is a gap between scientists and the general population about biodiversity, with scientists taking for granted that laypeople understand the definition. Even if the global definition can be understood, the ins and outs are not understood in the same way by scientists and laypeople (Hooykaas et al., 2019; Levé et al., 2019). According to a survey conducted by the European Commission in all the member states, only 41 % of the interviewees have heard of the term and say that they are aware of its meaning, while 30 % have heard of it but are not aware of its meaning. However, 29 % of the respondents have never heard about biodiversity (European Commission. Directorate General for the Environment. et al., 2019). These results show that the knowledge about biodiversity is weak while the Earth is experiencing its sixth mass extinction (Barnosky et al., 2011). It is in line with Soga et al. (2016) findings for whom the population is increasingly disconnected from nature, leading to inaction. Thus, biodiversity communication is crucial to promote public participation in conservation actions and bridge the knowledge gap among the general public (Doley et al., 2023).

How to communicate effectively about biodiversity?

Approaches and theories

To communicate about biodiversity, specialists usually use the knowledge-deficit model, assuming that lack of knowledge is the cause of inaction (Moss et al., 2017). While knowledge is vital to take action, this model is often ineffective because behaviour is the result of numerous factors, such as personal values, attitudes, social and cultural norms, identity, and socioeconomic factors (Ajzen,

1991; Stern, 2005; Kidd, Garrard, et al., 2019). Thus, strategies to change behaviours must be designed taking all these parameters in consideration (Moss et al., 2017; Kidd, Garrard, et al., 2019).

Kidd, Garrard et al. (2019) states that most biodiversity communication is based on framing theory and social marketing approaches. Marketing is a range of techniques to search for what the consumers want and provide it to them. Social marketing is "*the systematic application of marketing along with other concepts and techniques to achieve specific behavioural goals for a social good*" (French et al., 2006; Kidd, Garrard, et al., 2019). Thus, the aim is to influence the behaviour of a specific audience and be the basis for taking decisions (Hine et al., 2014). "*Framing refers to how an issue is described and how the problem is conceived, articulated, and approached*" (Kusmanoff et al., 2020). It is also a strategic use of images, words, and concepts to raise the salience of a problem and shape people's thoughts about it (Markowitz et al., 2018). Framing refers to the frames, which in sociology fields refers to an unconscious structure that defines our thinking (Lakoff, 2010).

According to Kidd, Garrard et al. (2019), few studies use critical decision-making theories to guide their research, while their objectives are to change behaviour. One of the most famous is the theory of planned behaviour, explaining that human behaviour should be designed to be effective. The three key concepts of this theory are "*nominative beliefs and subjective norms*", "*control beliefs and perceived behavioural control*", and "*behavioural intention and behaviour*". Thus, multiple psychological factors will shape human actions (Ajzen, 1991).

The theory of diffusion of innovations (Rogers, 2010) refers to adopting a new idea, technology, product, philosophy, or practice. In the beginning, few people adopt the new idea, but through communication, it will spread among the population (June Kaminski, 2011). The theory predicts that the rate of behaviour change will be higher if people are engaged in communication and observe the idea's performance by other people of the same social group (Green et al., 2019).

Step to implement a communication strategy

While designing a communication strategy, the first step is determining the scope and the overall goal. In this part, communication strategy's objectives should be defined, precise and measurable (The Biodiversity Project, 1999; Carwardine et al., 2019; De Lange et al., 2022).

The second step is to choose the target audience for the strategy. Indeed, it is impossible to address everyone with one strategy, and the more precise the audience is, the more accurate the communication will be (De Lange et al., 2022). For The Biodiversity Project (1999), which wrote a manual about biodiversity communication, it is crucial to learn about the targeted person before crafting the strategy and choosing the topics to communicate. It could be done through informal conversations

with members of the project, through focus groups, or a literature review if the literature is available. Nevertheless, the aim is to identify the audience's core values, which are the foundations of people's behaviour, which is necessary to implement strategies (The Biodiversity Project, 1999). It is essential to know the audience and thus define the best way to address them. Identifying sub-groups with the same core values and motives is important. That approach is called "audience segmentation" (Markowitz et al., 2018). This method will allow the development of tailor-made and more precise strategies. Moreover, the comportment of the communities will be described more precisely, and by dividing a global problem, it could be simpler to tackle it. This method comes from marketing strategies and is still in its infancy but shows excellent promise (Hine et al., 2014; Martel-Morin et al., 2022).

According to De Lange et al. (2022), the third step should be to define the desired objectives and outcomes, which means to think about what a successful communication should look like and what the targeted audience should think, feel, and do. The objectives represent the strategy's goal and vision, while the outcomes include the necessary evidence to evaluate the communication. Particular attention should be paid to the choice of indicators, which should be precise and measurable. With an accurate audience, objectives, and outcomes, the means of communication can be chosen to be relevant to the audience (Ruiz-Mallén, 2016). Thus, the message must be designed with the objectives in mind (Jacobson et al., 2014).

The next part of the communication strategy is to draft the communication (The Biodiversity Project, 1999; De Lange et al., 2022). The design of the message that the strategy wants to give is the core of it, and several tools can be used to reach the main overall goal and objectives.

First, special attention should be paid to how the message is delivered. The message should be framed in a simple way to be understood and to be sure that the audience's response is in the desired direction. (Kusmanoff et al., 2020). For instance, metaphors can simplify scientific concepts for the general people and policymakers (Szabó et al., 2020). Reaching emotions is another valuable tool in biodiversity communication, and that could even be more effective than cognitive appeals (Shiv et al., 1999). These can help build a narrative based on people's emotions and experiences instead of a narrative based on statistics and complex scientific concepts. Kusmanoff et al. (2020) indicated that narratives use negative emotions more often than positive. However, Kidd, Bekessy et al. (2019) suggested that having an optimistic speech could be more effective. According to De Lange et al. (2022), positive communication could prove more effective in motivating behaviour than a threat alone. Thus, messages that inspire fear or shock can help capture public attention but can also lead people to be overwhelmed. In contrast, positive messages can support maintaining concentration and empower the audience to take action (De Lange et al., 2022).

De Lange et al. (2022) proposed five important tips to develop a compelling message which include a) It is important to think about what people already know and how they can perceive a word; b) It is essential to clarify the situation and the actors so the audience can imagine how it could evolve; c) It is necessary to have some positive responses to the highlighted threads; d) Avoiding typecasting; e) It is essential to share learning from failure.

To connect with people's emotions, it is also possible to use anecdotes, images, and success stories (The Biodiversity Project, 1999). Images can be more effective at conveying a message than text (Powell et al., 2012). According to Salazar et al. (2022) , showing visitors of the Florida Museum of Natural History images that depict plastic pollution in the ocean increases engagement and commitments but fails to generate donations to fight this problem. It is in line with the findings of Echeverri et al. (2017), who researched the protection of sea otters. Therefore, images or texts can convey the message. Most importantly, they should be used together to increase their impact (Seppänen et al., 2003).

Meinard et al. (2014) proposed using surrogates to bridge the gap between society and science, which are linguistics and conceptual tools used to discuss biodiversity. These should be transdisciplinary, not measurable, not enter into the debate biodiversity measures that, according to them, is a vague concept; accessible, translatable; the surrogate should include most of the arguments of the biodiversity importance; and understandably include biodiversity concepts. Their study proposed experiential learning as an alternative to science-society communication on biodiversity. Furthermore, this emphasizes the importance of linking people with their emotions and utilizing images to communicate about biodiversity.

Nevertheless, the message should be clear, truthful, equitable, and accurate. It is important to present facts, not fiction, to incite people to change their behaviours (MacFarlane et al., 2020; Gregg et al., 2022). The messenger's choice is also important so that the target audience can identify to it and that his word cannot be questioned (The Biodiversity Project, 1999). The Biodiversity Project (1999) also highlights that communicators should know their opposition and anticipate their "attacks". Thus, they can respond to it or raise the issue first.

Message transmission is also an important decision to reach the audience. Bickford et al. (2012) stated that including the local community in conservation efforts, such as bird monitoring, is a great way to involve the general public. With these actions, conservation scientists will collect data, while local people will learn and connect to the conservation problem. It should be a two-way communication where the scientist increases people's knowledge through action, and the people should express their

needs. Another means of communication is media which generally bridges the gap between scientific facts and the people. However, with the tendency to generate spectacular news, the trust in general media can be low (Ladle et al., 2005). Hence, scientists should strengthen their capacity to communicate and vulgarise scientific documents that laypeople are unable to understand. Since scientists are not always the best communicators, they should collaborate with experts from different disciplines and use blogs, magazines, newspapers, and social media regularly (Bickford et al., 2012). Governments and industry are among the most important audiences because a change in their habits can have large scale implications. They should be involved in research, and this one be relevant to policy, developing decision support tools (Bickford et al., 2012). Finally, communication should also occur in education. Indeed, students are tomorrow's citizens and policymakers, and education is undoubtedly one of the levers to make changes happen. Once the communication has reached its target, it should be evaluated. However, Kidd, Garrard, et al. (2019) find that one-third of the research in biodiversity communication does not contain any evaluation. Thus, it is reasonable to suppose that outside the research field, this percentage might be higher.

Biodiversity Communication and Farmers

Farmers as a targeted audience

Agriculture is one of the main drivers of biodiversity loss. Thus, farmers are key element to address this issue and having an effective communication with them is crucial.

AESs, which provide subsidies to farmers, are the primary tool of the EU to encourage farmers to protect biodiversity. However, the research conducted to evaluate schemes' effectiveness in changing behaviours shows that, on the one hand, the understanding of the biodiversity concept and attitudes towards it are not increasing and that the economic factor mainly drives the adoption of AESs. On the other hand some studies show that once involved in AESs, farmers can switch from the primary financial motivation to one based on the appreciation of environmental improvements (Burton et al., 2008; Cullen et al., 2020). Furthermore, Herzon et al. (2007), who compared Finnish and Estonian farmers involved in AESs, and found that in both countries, they would be ready to take biodiversity into account in their practices even if some basic knowledge were to improve. However, for De Snoo et al. (2013), these financial bits of help are a tool to encourage rapid changes, but more is needed to change behaviour in the long term and could lead to a switch in motivations, as mentioned before.

Since farmers are among those who maintain biodiversity, it is vital to make them "owners" of the conservation issue in order to change their behaviours in the interests of sustainability. According to De Snoo et al. (2013), farmers are a "*judgmental peer group who constantly compare themselves against each other's performances*". Therefore, benchmarking tools that help farmers understand how

they are performing in terms of biodiversity and enable them to discuss and compare these results with other farmers could be crucial. Moreover, providing feedback about their environmental impact and practices is also essential, and both of these concepts could lead to nominative pressure and thus enhance behaviour changes (De Snoo et al., 2013; Malawska et al., 2014; Mills et al., 2017).

Social theory can be beneficial to understand farmer behaviours and how innovations could be spread amongst them. Lokhorst et al. (2011) found that farmers' behaviour engaged in conservation practices without subsidies is strongly influenced by self-identity and the norms of that social group. Maleksaeidi et al. (2019) showed that the main drivers of intention to protect biodiversity in farmland are attitude and perceived threats of integrated agriculture, knowledge, and moral norm. Thus, biodiversity knowledge is essential and needs to be spread more among farmers, and the comparison with their pairs is also of great importance. Lokhorst et al. (2011) encouraged policymakers to "*find ways to address farmers' self-identity as conservationists and their moral concerns, and thus improve nature conservation*". The theory of diffusion of innovation can also be used to understand how innovation can be spread among farmers and which factors can represent barriers (Anibaldi et al., 2021). However, this theory is often used to evaluate one practice, such as using nets reducing pesticides use (Vidogbéna et al., 2016). Nevertheless, Mirela et al. (2014) found that this theory could be applied to more significant concepts such as organic farming.

Based on these findings, communicators should develop strategies to improve farmers' knowledge and enhance behaviour change. The steps are the same as in biodiversity communication. Social interaction and face-to-face meetings are crucial for farmers (BenYishay et al., 2013; Ćurčin et al., 2018).

Communication example of a European project

Showcase is a European project that aims to "*Showcase synergies between agriculture, biodiversity, and ecosystem services to help farmers capitalize on native biodiversity*" (Kleijn et al., 2022). It also outlines an extensive communication strategy to involve farmers and persuade them to adopt more sustainable practices (Kleijn et al., 2022).

They first identified different gaps between narratives in biodiversity conservation and farming to build an "*inspirational internal narrative to reconcile biodiversity with productive agriculture*" (Velado-Alonso et al., 2023). The narrative is the centrepiece of their communication strategy. It is based on engaging several stakeholders in the project, such as farmers, policymakers, NGOs, companies, and society. Moreover, their communication is based on three main points; firstly, "*why we care about biodiversity*" (Velado-Alonso et al., 2023); secondly, "*clearly defining what we can do*"

(Velado-Alonso et al., 2023); and finally, "*tips on how to improve biodiversity opportunities in farming*" (Velado-Alonso et al., 2023). The narrative and the communication tools are adapted according to the audience.

The narrative's message should be precise and concise but comprehensive. Velado-Alonso et al. (2023) proposed four steps similar to the ones described in other studies (The Biodiversity Project, 1999; De Lange et al., 2022). The first step is to engage the audience, know about them, meet them, and learn about their perceptions. The second step is to explain why the project is essential. In this step, it is important to be clear on the definitions, and metaphors can be helpful such as "*Biodiversity is like a tractor. You would never use a tractor with missing gears. It needs its proper gears to fully work*" (Velado-Alonso et al., 2023). The third one is to explain the main objectives of the project. Slogans like "*Life fits everywhere: we want to help to farm with biodiversity (not against)*" could be useful in achieving goals (Velado-Alonso et al., 2023). Furthermore, the fourth step is to exemplify how these goals will be achieved. They emphasise that it is a complex problem without a simple solution, requiring all the stakeholders. They found that the best way to realise this step is by using success stories, especially the local ones, which corroborate the previous findings (The Biodiversity Project, 1999; Lokhorst et al., 2011).

Communication channels are essential to communicate the message. They decide to communicate through their website, which serves as the main platform; in-person communication, as previously mentioned with the holding of workshops; social networks of which YouTube, Facebook, and Twitter have been identified as the most popular among farmers, and finally, through events and conferences organized by the project, which is an appropriate way to connect its participants (Sapundzhieva et al., 2022; Velado-Alonso et al., 2023).

Thus, communication with farmers is similar to other biodiversity communications, but the message should be adapted to the audience. This message should be positive in order to be attractive for farmers. The emphasis should be on solutions, practical, intelligible concepts, and visible concepts in the context of complex scientific ones, clear, with the use of direct-to-the-point communication, and it should emphasize cooperation among all project stakeholders (Velado-Alonso et al., 2023).

Case study: The Horizon 2020 FRAMEwork project

Presentation

Biodiversity is vital for the resilience and sustainability of agroecosystems. Moreover, incentives to encourage biodiversity in farmland are only sometimes efficient and implemented at an

individual level rather than the landscape level. Generally, they are imposed by the EU or national governments with inefficient monitoring (Simmons et al., 2021).

The project has been designed to tackle these issues in 2020 and develops an alternative called the FRAMEwork System for Biodiversity Sensitive Farming. The aim is to facilitate the EU farming system transition towards systems conserving biodiversity and enhancing its ecosystem services while managing economic and agronomic risks. This system is based on four pillars (Simmons et al., 2021):

1. **Farmer clusters** are regrouping farmers locally, working as a group to manage their landscapes. The facilitator supports them, thanks to an expertise in environment and agriculture. This one is linked to a stakeholder group, such as universities, foundations, or private institutes, that promote policy and practice linked to regional, national, and international networks.
2. **Technical resources** are composed of technical specialists linked to different networks. They provide technical support to manage the agroecosystem, monitor management, and inform about policy.
3. **Scientific innovation**, with scientists providing knowledge on biodiversity, sociology, and economics of sustainable farmland.
4. **Citizen Observatory and Information Hub** are online platforms to share data information and resources between all project stakeholders.

The project is a prototype of the FRAMEwork System for Biodiversity Sensitive Farming, financed by the European Union's Horizon 2020 research and innovation program (€8 million) (Framework, March-15-2023a). It works with three essential concepts: "*promoting collective landscape management; applying the approach across a diversity of European farming systems; and understanding and supporting the social and ecological change associated with a transition to biodiversity-sensitive farming*" (Simmons et al., 2021).

Thus, the project aims to value farmland biodiversity benefits. These include food security, mitigating global heating, securing sustainable businesses, providing countryside recreation, and protecting wildlife.

This project comprises 11 clusters in 10 countries (Austria, Czech Republic, England, Estonia, France, Italy, Luxembourg, Netherlands, Scotland, and Spain) (Figure 1). In addition, 18 partners are involved, including university, media and communication advisers, research institutes, research non-

profit organisations, foundations, and charitable organisations (Game and wildlife trust conservation) helping in the creation of a farming game[1] (Framework, March-15-2023b, March-16-2023d).

Figure 1 - Localisation of the 11 clusters (map from GoogleMaps).

The land use in these clusters and farming activities are different, from hunting in Spain to orchards in France and Luxembourg, to olive groves in Italy, through arable crops, grassland and livestock in Austria, Czech Republic, England, Estonia, Netherlands, and Scotland[2] (Framework, March-16-2023d).

[1] The description of all the partners can be found on the following link: https://www.framework-biodiversity.eu/partners

[2] The description of all the clusters can be find on the next link: https://www.framework-biodiversity.eu/clusters/all

The project is structured around seven work packages (WP) WP1: coordination and communication; WP2: advanced farmer cluster; WP3: citizen observatory and information hub; WP4: agro-ecological understanding; WP5: biodiversity management and monitoring; WP6: farmer behaviour and incentives; WP7: system analysis and synthesis (Framework, March-15-2023c).

The project helps farmers to implement action to protect biodiversity. For instance, in France, the goal is to reduce pesticide use by installing bat roosts and tit nesting boxes to increase pest regulation by natural predators (Framework, March-16-2023d). In Scotland, the farms involved in the cluster have planted wildflower strips to enhance the pollinator and bird populations, and some farmers are using direct drilling, under-sowing, and the installation of cover crops to increase soil health (Framework, March-16-2023e). A final example will be the one in the Czech Republic, near Brno, where the goals are to increase bird populations, promote soil fertility and earthworms, prevent soil erosion and increase water retention (Framework, March-16-2023f).

Project's communication

Communication between all the stakeholders and farmers goes only through clusters' facilitators. Workshops and meetings with the different stakeholders are organised. In addition, a yearly project meeting is organised to bring together all involved in the project.

Different communication tools have been implemented. First, the website aims to present the project and make all the resources, data, activities and results available. Moreover, it will link the Citizen Observatory, Information Hub, and social media (X, ex-Twitter, and Facebook) (Simmons et al., 2020)

The Citizen Observatory is an iNaturalist community aiming to monitor biodiversity in the different clusters. It can be used by every citizen wanting to help the project. Only five clusters are active in the community (Italy, Luxembourg, Scotland, Austria, and Estonia) (iNaturalist, August-2-2023). The Information Hub will be a web platform available in September 2023 (Framework, August-2-2023g). Finally, there is a Facebook page, a Twitter account for the project, and a Twitter account for the English cluster.

Material and methods

Analytic hierarchy process (AHP)

Introduction

AHP is a multicriteria decision-making (MCDM) method developed by T. L. Saaty between 1971 and 1975 (Saaty, 1987). AHP is used to analyse and organize complex decisions. It is a non-statistical method, based on mathematic and psychology, that decomposes complex problems into smaller ones structured in a hierarchy (Apostolopoulos et al., 2016; Jegerson et al., 2022). It will ensure that, while facing a decision or a problem, the most important aspects are considered allowing the decision-makers and researchers to make the best decision. It can use qualitative and quantitative factors (Wedley, 1990).

Decision-makers and researchers have used this method in a wide range of fields. For instance, the AHP has been used in social research, healthcare research, or construction research, but also by industries, governments, schools and universities, and more generally, managers (Vaidya et al., 2006; Khaira et al., 2018; Darko et al., 2019). Moreover, this method has been used in various environmental research and agronomics (Ramanathan, 2001; Vaidya et al., 2006; Nnadi et al., 2021; Kumar et al., 2022).

Regarding the agronomic field, AHP has been used in different ways. For example, Sabir et al. (2022) used it to determine the best alternative between organic and conventional farming in the Pakistani context; Dragincic et al. (2015) applied it to choose the best grape variety for organic viticulture in Serbia; Schiavon et al. (2023) employed it to select which variety of sugar cane should be used by producers; Orduño Torres et al. (2020) used it to understand farmers preferences regarding several mitigation and adaptions actions in the context of climate change; Paakala et al. (2020) used it to investigate the preferences of Finnish farmers regarding the traits when selecting bulls for artificial insemination. This sample of articles shows that AHP is used in various ways in agriculture, from deciding to understanding preferences.

Description of the AHP method

The AHP method is used to choose the best alternative to a problem based on different criteria and sub-criteria, and derived priority vectors. The method is composed of several steps (Figure 2): a) defining the goal of the AHP; b) identifying the experts: c) structuring the problem by creating a hierarchy; d) building pairwise comparison matrices; e) performing the judgments; f) calculating the weight of each element; g) checking consistency; h) developing overall priority ranking. These steps will be described in the next sections.

Figure 2 - Steps of the analytic hierarchy process (adapted from Vaidya et al. (2006) and Velmurugan et al. (2011)).

Define the goal of the AHP

The objectives of the thesis have been mentioned before. The AHP method is applied to the first and second objectives. These objectives have been transformed to reflect a decision-making process.

Thus, the first goal is to decide based on their experience in FRAMEwork, if farmers will choose to be involved in conservation projects in the future. The second goal is to choose the best communication channel for this project. To meet these two objectives, two AHP have been developed, one regarding farmers' motivations and the other one regarding communications preferences.

Identification of the experts

In this thesis, the experts are the farmers involved in the different clusters of the Framework. The word expert does not refer to a level of education but to knowledge in a specific field. In several studies, researchers ask other academics or agronomic engineers to realise the judgments on farmers' decisions, and not necessarily to farmers. Nevertheless, it seems essential to have farmers' vision of their experience in Framework. Moreover, they are experts in running their businesses and making choices for their farms.

The project is organised in 11 clusters in 10 countries. For this research, the people of interest are the farmers involved in the project. Thus 10 clusters were approached, via clusters' facilitators, that received the questionnaire and sent it to the farmers. Table 1 indicates the main information about each cluster.

Table 1- Cluster information (source: Framework, March-16-2023d)

Cluster	Localisation	Number of farms	Total size of the cluster (ha)	Average farm size (ha)	Landscape type
Austria	Eisenstadt	11	2870	260	Arable land and Grassland
Austria	Mostviertler	12	61	5	Grassland
Czech Republic	Velké Hostěrádky	9	2822	313	Arable land
England	Cranborne Chase, Salisbury	19	8440	444	Arable land and livestock, Grasslands
Estonia	Southern	10	3170	317	Arable, Grasslands
France	Sénas	10	1762	176	Orchards
Italy	Calci	18	54	3	Olive groves
Luxembourg	Born	6	480	80	Orchards
Netherlands	Flevoland	8	550	69	Arable, Lowlands
Scotland	Stuartfield, Peterhead	4	3700	300	Arable and livestock
Spain	Aguilar de la Frontera, Córdoba	10	400	40	Hunting

Identification of the criteria

As mentioned before, this method relies on the structuration of a complex problem in a hierarchy, represented by a hierarchical tree. The different elements in the hierarchy will be compared two by two in a pairwise comparison matrix with the judgments of experts, enabling decision-makers to arrive at the optimal choice (Saaty, 2008). Figure 3 and 4 represents the two hierarchical trees, for the first and the second objectives, respectively. At the top you find the goal of the hierarchy and the alternatives at the bottom. Between these extremes, the criteria and sub-criteria structure the hierarchy.

Criteria can be identified via different methods, such as focus groups, interviews with experts, literature research or opinions of the authors (Russo et al., 2015). In this master thesis, the criteria were identified in the literature and discussed with academics involved in the project.

The explanation of each criterion can be found in Tables 2 and 3 for the AHP regarding farmers' motivations and communication channels, respectively.

For the first objective, four main criteria were selected: environmental concerns, economic benefits, people's health, and personal values. For each criterion, different sub-criteria were established:

1. **Environmental concerns**:
    1. Benefits from biodiversity to farmers (ecosystem services) such as pollination, soil fertility or pest control.
    2. The protection of animals and plants for their existing value.
    3. To increase water quality.
2. **Economic benefits**:
    1. Subsidies for implementing conservation practices.
    2. Market advantages to sell products from conservation agriculture.
    3. Reliable and stable incomes.
3. **People's health**:
    1. To decrease pesticide exposure
    2. Food safety.
4. **Personal values**:
    1. To increased job satisfaction.
    2. To better fit with their own values

Regarding the second objective, the channel of communication has been separated into three: face-to-face; traditional media; and internet.

1. **Face-to-face** refers to three channels: project meetings, workshop with scientists, and workshops with framers.
2. **Traditional media** refers to phones, radio, television, scientific magazines, and specialized magazines.
3. **Internet media** refers to the project website, specialized websites, and social media. In order to identify the best one to communicate at another level in the hierarchy, social media were divided in Facebook, YouTube, Instagram, and Twitter.

Figures 3 and 4 represent the hierarchical for tree farmers' motivations and the choice of communication channels, respectively.

Pairwise comparison matrices

The AHP method uses pairwise comparison matrices to derive accurate ratio scale priorities for each element (Velmurugan et al., 2011). For each level of the hierarchy, a matrix of size n x n is created to compare the criteria and sub-criteria between them. The sub-criteria are compared regarding the level immediately above them. Equation 1 represents the matrix A, an example of a pairwise comparison matrix where the elements are compared by pair. The position a_{ij} of the matrix refers to the comparison between the element i and j.

Equation 1 - Example of a comparison matrix. The matrix A, of size n x n, is composed of elements aij, with i indicating the position on the rows and j the position on the columns.

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & \cdots & \cdots & a_{1n} \\ a_{21} & a_{22} & & & & a_{21} \\ \vdots & & \ddots & & & \\ \vdots & & & \ddots & & \\ \vdots & & & & \ddots & \vdots \\ a_{n1} & a_{n2} & & \cdots & \cdots & a_{nn} \end{bmatrix}$$

Perform judgments

The matrix will be filled in by experts' judgments thanks to the fundamental scale of values from 1 to 9 (Table 4) (Saaty, 1990). Each element of a matrix is compared to each other. In a n x n matrix, n x (n-1) judgments will take place. In the matrix, reciprocal value is assigned to each pairwise comparison. For example, if the element i is compared with the element j, and a value of 5 (strong importance) is assigned to the element i over j, $aij = 5$ and $aji = \frac{1}{5}, \forall i, j$. In the AHP, these qualitative estimations will be converted into quantitative estimates (Podvezko, 2009).

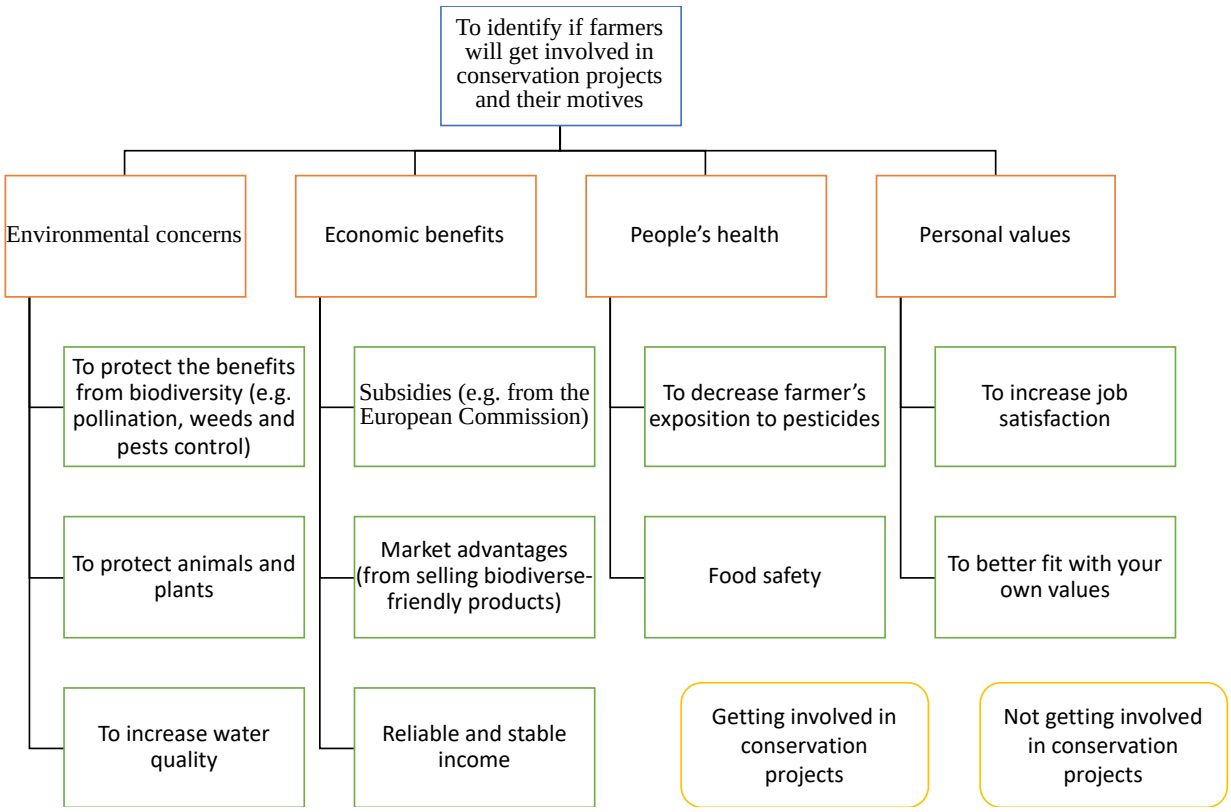


Figure 3 - Hierarchical tree for the AHP regarding farmers' motivations.

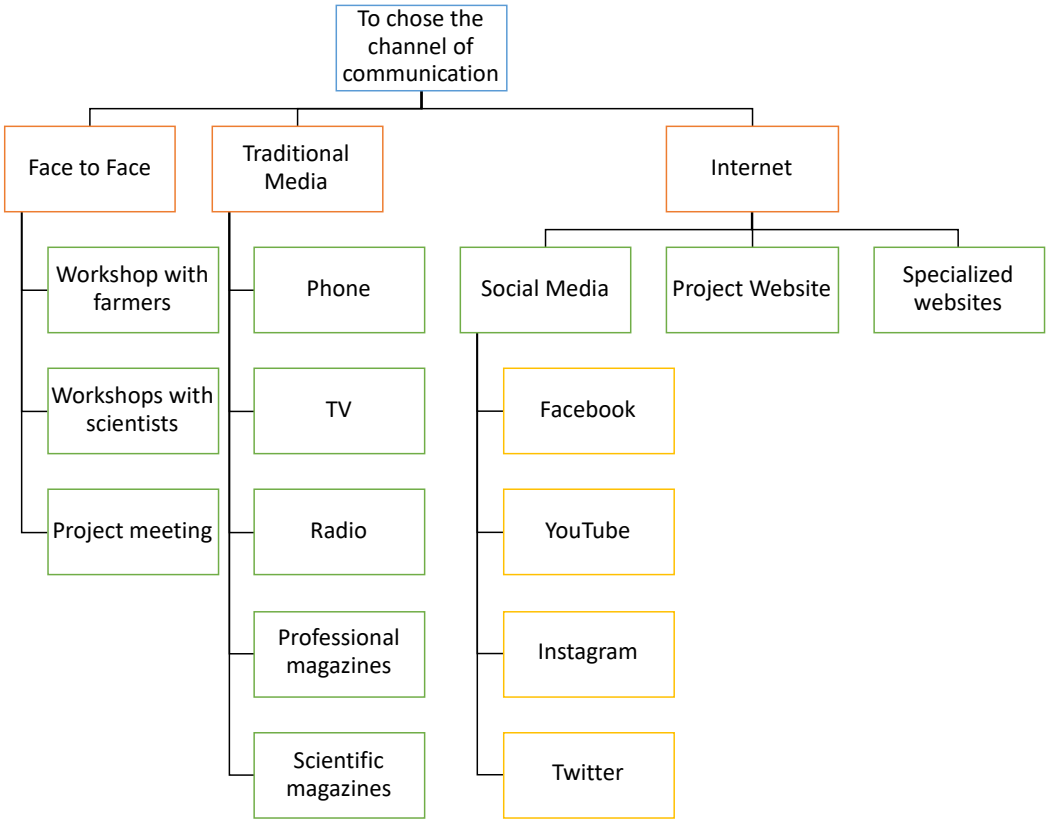


Figure 4 - Hierarchical tree for the AHP regarding communication channels.

Table 2 - Criteria and sub criteria for the AHP regarding the motivations of farmers. (I), (II), (III), and (IV) represent the criteria to which the sub criteria refer.

Criteria	Explanation	References
Environmental concerns (I)	To tackle environmental issues / To protect the environment	(Cranfield et al., 2010; Kelemen et al., 2013; Mills et al., 2018)
Economic benefits (II)	To expect some economic advantages from the practices implemented	(Karali et al., 2013; Barghusen et al., 2021)
People's health (III)	To protect the health of farmers and their family and consumers'	(Herzon et al., 2007; Cranfield et al., 2010)
Personal values (IV)	Personal norms, reasons, beliefs, choices	(Cranfield et al., 2010; Karali et al., 2013; Mills et al., 2017, 2018; Dessart et al., 2019; Barghusen et al., 2021)
Sub-criteria		
(I) To protect the benefits from biodiversity (e.g., pollination, weeds and pests' control, soil fertility)	To protect the agronomic benefits (ecosystem services) that biodiversity can procure to farmers	(Kelemen et al., 2013; Barghusen et al., 2021; Maseyk et al., 2021; Moroder et al., 2022)
(I) To protect animals and plants	To protect them because they have an existence value	(Kelemen et al., 2013)
(I) To increase water quality	Seen by some farmers as a benefit from biodiversity conservation; one of the targets of the CAP	(Michel-Guillou et al., 2006; Cranfield et al., 2010; Power et al., 2013; Dudley et al., 2017; Maas et al., 2021)
(II) Subsidies (e.g., from the European Commission	Financial helps for implementing conservation practices, such as AES; premiums	(Karali et al., 2013; Barghusen et al., 2021)
(II) Market advantages (from selling biodiverse-friendly products)	Through labelling; to target consumers interested in organic produce; through improved prices	(Cranfield et al., 2010; Kelemen et al., 2013; Barghusen et al., 2021)
(II) Reliable and stable income	Product diversity; input cost decrease; better fertility;	(Kertész et al., 2014; Harkness et al., 2021)
(III) Decreasing farmer's exposition to pesticides	By adopting conservation practices to reduce diseases occurrence	(Herzon et al., 2007; Cranfield et al., 2010)
(III) Food safety	To produce a high-quality and safe food	(Cranfield et al., 2010)
(IV) To increase job satisfaction	Through collaboration with other farmers; increase social status and recognition; learning new techniques	(Cranfield et al., 2010; Karali et al., 2013; Mzoughi, 2014; Dessart et al., 2019; Barghusen et al., 2021)
(IV) To better fit with your own values	Personal awareness of biodiversity importance; perceived responsibility (towards the environment or future generation); openness to new experiences	(Cranfield et al., 2010; Kelemen et al., 2013; Mills et al., 2017, 2018; Dessart et al., 2019; Barghusen et al., 2021)

Table 3 -Criteria and sub criteria for the AHP regarding communication channels.

Criteria	Explanation	References
(I) Face-to-face	/	(BenYishay et al., 2013; Ćurčin et al., 2018)
(II) Traditional media	Non internet media and mass media	(Ćurčin et al., 2018)
(III) Internet	/	(Ćirić et al., 2018; Sapundzhieva et al., 2022)
Sub-criteria		
(I) Workshop with farmers	Presentation and training with experienced farmers on biodiversity subjects	
(I) Workshop with scientists	Presentation and training with scientific on farming aspects	
(I) Project meeting	Meeting with all stakeholders of the project and possibly some other stakeholders or citizens	
(II) Phone	Phone call	(Ćurčin et al., 2018)
(II) Radio	Preference for radio to communicate information	(Ćurčin et al., 2018)
(II) TV	Preference for television to communicate information	(Ćurčin et al., 2018)
(II) Specialized magazines	Magazines specialized in agriculture	(Ćurčin et al., 2018)
(II) Scientific magazines	Magazines with scientific articles	(Ćurčin et al., 2018)
(III) Social media	"Sites and technological applications that allow its users to share content and/or to participate in social networking." (Leyrer-Jackson et al., 2018)	(Ćirić et al., 2018; Sapundzhieva et al., 2022)
(III) Project website	Website with all the information about the project	(Sapundzhieva et al., 2022; Framework, March-15-2023a)
(III) Specialized websites	Agricultural websites; forums	(Ćirić et al., 2018)
Sub criteria for social media		
Twitter®	/	(Ćirić et al., 2018; Sapundzhieva et al., 2022)
Facebook®	/	(Ćirić et al., 2018; Sapundzhieva et al., 2022)
Instagram®	/	(Ćirić et al., 2018; Sapundzhieva et al., 2022)
YouTube®	/	(Ćirić et al., 2018; Sapundzhieva et al., 2022)

Table 4 - The 9-point scale for pairwise comparison.

Importance	Definition	Explanation
1	Equal importance	The two elements are equally important
3	Moderate importance	One of the elements is slightly more important than the other one
5	Strong importance	One of the elements is strongly more important than the other one
7	Very strong importance	One of the elements is very strongly more important than the other one
9	Extreme importance	One of the elements has an absolute dominance on the other one
2, 4, 6, 8	Intermediate values	Intermediated values if the distinction between the other levels needs to be more nuanced

Synthetising pairwise comparison

To calculate the vector of priorities or eigenvector of the matrix *A* (*W*i) the matrix is normalized. Then, the sum of every column is calculated; the elements in the matrix are divided by the sum of its column, and the average of the rows represents the relative weights. Equation 2 represents the mathematical form of this calculation.

Equation 2 - Calculation of the vector of priorities.

$$W_i = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{ij}}{\sum_i^n a_{ij}}, i, j = 1, 2, \dots, n$$

W_i is the vector of priorities; a_{ij} is the comparison on the row i and the column j; n is the size of the matrix.

Checking consistency

Ensuring the consistency of judgments is crucial in the AHP method due to the subjective nature of judgments. The AHP method measures this inconsistency to validate and improve the result (Saaty, 2008).

A matrix is considered consistent when $a_{ij}a_{jk} = a_{ik}, \forall i, j, k$. The consistency of a matrix is determined by the consistency ratio (CR): ratio between the consistency index (CI) and the random index (RI) (Table 5) (Saaty, 1987; Velmurugan et al., 2011). Different steps are necessary to obtain this ratio.

Firstly, the maximum eigenvalue λ_{max} is calculated. This maximum eigenvalue is obtained by multiplying the comparison matrix (unnormalized) by the vector of priorities to have a new vector. For each row, we will obtain a component of the vector. The elements of this new vector will be divided by their respective elements in the vector of priorities. For a matrix of size n, n values are obtained. Finally, the average of these values is calculated, and the result is λ_{max}. Secondly, Equation 3 is used to calculate the CI.

Equation 3 - Consistency index.

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Finally, the CR is calculated as the ratio between the CI and RI (equation 4). The RI is chosen in Table 5 depending on the size (n) of the matrix. According to Saaty (1987) inconsistency should not exceed 10% by much. Thus, exceeding a CR of 0.1 (10%) indicates a need for reviewing and refining judgments (Saaty, 1987; Velmurugan et al., 2011).

Equation 4 - Consistency ratio.

$$CR = \frac{CI}{RI}$$

Table 5 - Random index

Matrix size (n)	1	2	3	4	5	6	7	8	9	10
Random index (RI)	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Perform step 4 to 6 for every level in the hierarchy

These steps should be done for the first level (criteria), then for the second level (sub-criteria) and the third level (alternatives in the first hierarchy and second level of sub-criteria in the second hierarchy). Comparisons are made regarding the level below, meaning the matrix is constructed following the branches of the hierarchical tree. The sub-criteria of a criterion are compared together but not with the sub-criteria of another criterion. The alternatives are compared for all the sub-criteria.

Develop overall priority ranking

The final step is to develop a general priority for each sub-criteria and alternative, which results in calculating a general priority vector. In other words, if a criterion is more important than another, with the same judgments, its sub-criteria will be more important than the other criteria. The priority vector of alternatives should be multiplied by the priority vector of sub-criteria, and then this new vector

should be multiplied by the priority vector of criteria. In other words, the priority vector of a level should be multiplied by the priority vectors of the level above.

Analysis

AHP can be performed in different ways, by hand calculation, on Excel, or using specific software. Expert Choice V11 software was used for this research. It aggregated judgments, calculated the priorities and CR, and provide a sensitivity analysis.

Choice of the analytic hierarchy process (AHP)

The decision regarding the choice of the method was based on two criteria. First, the objectives are to understand the farmers' decision to get involved in conservation projects, and to understand their choice in their communication channel preferences. Therefore, AHP is a suitable method as the objectives are based on farmers decision. Secondly, AHP required a small number of participants. Indeed, AHP is based on expert subjective judgments on a specific topic and only requires a small sample. Studies use from one to several hundred participants. However, most used between 2 and 30 (Rezaei-Moghaddam et al., 2008; Darko et al., 2019).

Sampling

As mentioned, the AHP is a non-probability method. Thus, the sampling is not based on random selection and does not require the justification of the probability theory. Purposive sampling was used in this research. It is a sampling method for non-probability sampling. The expert selection is based on their knowledge regarding the problem that needs to be solved (Apostolopoulos et al., 2016).

Experts were approached during a project meeting in England, by one of the supervisors, for some and directly by e-mails for the others.

Questionnaire design

The questionnaires were designed to last less than 15 minutes to avoid the loss of interest by the participants and to increase the response rate[3] (Deutskens et al., 2004; Marcus et al., 2007). The ideal length of a questionnaire is between 10 and 15 minutes (Revilla et al., 2020). It was tested by people exterior to the research.

At the beginning of the questionnaire, an example was used to explain the AHP method to the farmers, comparing vanilla and chocolate (Figure 5).

[3] It was very important in the project as facilitators explained that farmers were very busy and not necessarily willing to respond to questionnaires.

Here is an example based on food. If the question is: what do you prefer, chocolate or vanilla?

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Chocolate									X									Vanilla

The one indicates that you like both equally.

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Chocolate											X							Vanilla

Here it means that the importance of vanilla for you is moderately more important compared to chocolate.

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Chocolate	X																	Vanilla

Here, for you there is only chocolate.

Figure 5 - Example to explain the AHP method in the questionnaire.

The questionnaires were sent to the facilitators, who agreed to respond via email. They were translated into each language via Deepl®[4] and sent with the English version. The questionnaire can be found in Annexe 1.

Communication workshop

For this thesis, an online workshop called "Communicating the value of biodiversity" and developed by the United Nations Development Program, the CBD, Rare, and the NBSAP forum. The objectives of the course are to frame the issues to be understandable by the audience, engage with the stakeholder using the right channel; promote the behaviour change by engaging the stakeholder effectively; identify the collaborators and create a network; to draw an effective biodiversity communication plan; and to understand power dynamics involved in biodiversity conservation (UNDP, July-24-2023). This workshop was a complement to the literature to understand communication strategies and how to enhance participation in conservation practices. The certificate of completion for this course can be found in Annexe 2.

[4] https://www.deepl.com/translator

Results

Answers from 18 farmers were obtained from Austria, the Czech Republic, Italy, and Scotland. In Austria, they come from two different clusters. Thus, five clusters on the ten selected answered.

Characteristics of respondents and farms information

Table 6 summarizes the characteristics of respondents and farms information regarding the sample. Most of the respondents were from Italy (55.6%) and Austria (33.3%) and were primarily men (61.1%). The respondent's age is principally above 45 years (52.9%), with 23.9% over 55. However, 29.4% are under 35 years old. Most farmers surveyed have been to university (66.7%). The clusters are mainly composed of farmers that started their activity in the last 20 years (64.7%), with 35.3% that started in the last five years. Only 5.9% have been active for 40 – 45 years.

The Italian cluster focus is on olive groves. Thus 55.6% of the farmers are growing olives. Moreover, 55.6% of all the respondents also raise livestock (cattle, sheep, donkey, horse, hen). Most farmers have multiple activities (72.2%) and only do organic agriculture (88.9%). One conventional farmer is currently converting to organic. The farm size is mainly inferior to 10 ha (44.4%) but can be superior to 100 ha for 16.7% of the respondents, and one farmer has 370 ha.

The farmers indicate implementing sustainable practices in their farm such as windbreaks trees, diversifying the culture, conversion arable land into grassland, late mowing, extensive husbandry, preservation of forage plant for butterfly, creation of flower strip, implantation of bird boxes, composting, reduced tillage, no used of artificial fertilizer, or leaving deadwood in orchards. In Italy, they mentioned stopping the use of synthetic chemical, weeding respecting the blossoms, planting medicinal plant (such as Aloe vera (L.) Burm.f., 1768), using copper to increase the strength and the resistance of olive trees to disease, using natural insecticides, and DSS (decision support system) to manage the olive fruit fly (Bactrocera oleae (Rossi) 1768). One farmer mentioned that he is implementing “environmental schemes from the Scottish government to preserve plants, birds and other wildlife”.

Table 6 - Farmers' and farms' information.

		Percentage (%)			Percentage (%)
Country			**Farming size**		
	Austria	33.3		< 10 ha	44.4
	Czech Republic	5.6		10 - 30 ha	27.8
	Italy	55.6		30 - 100 ha	11.1
	Scotland	5.6		100 ha+	16.7
Gender			**Farming type**		
	Female	38.9		Conventional	11.1
	Male	61.1		Organic	88.9
Age			**Main activities**		
	18-25	0		Arable crop	38.9
	25-35	29.4		Vegetables	27.8
	35-45	17.6		Fruits (trees)	16.7
	45-55	29.4		Livestock	55.6
	55+	23.5		Olive groves	55.6
Educational level				Grassland	22.2
	Secondary	5.6		Other	27.8
	High School	27.8			
	University	66.7		One activity	27.8
Years of farming				Several activities	72.2
	0 to 5	35.3			
	5 to 10	17.6			
	10 to 15	11.8			
	15 to 20	0.0			
	20 to 25	11.8			
	25 to 30	11.8			
	30 to 35	5.9			
	35 to 40	0.0			
	40 to 45	5.9			
	45 +	0.0			

Farmers' motivations

Alternatives

The results of AHP indicate that FRAMEwork's farmers will be involved in conservation projects in the future. The overall weight of the alternatives "getting involved" is 0.832, while the weight of the alternative "not getting involved" is 0.168. Table 7 represents the weight of the alternatives regarding each criterion and sub-criterion. The weight indicates that for all criteria and sub-criteria, farmers decided that being involved in a conservation project is more suitable than not being. The criteria and sub-criteria related to economic factors obtained the lowest priority, although they are still high.

Table 7 - Alternatives' priorities for each criterion and sub-criterion.

Criteria	Getting involved	Not Getting involved
Environmental concerns	**0.845**	**0.155**
To protect the benefits from biodiversity	0.864	0.136
To increase water quality	0.806	0.184
To protect animals and plants	0.844	0.156
Economic benefits	**0.776**	**0.224**
Subsidies	0.689	0.311
Market advanatges	0.800	0.200
Reliable and stable income	0.792	0.208
People's health	**0.845**	**0.155**
To decrease farmer's exposition to pesticides	0.833	0.167
Food safety	0.856	0.144
Personal values	**0.827**	**0.173**
To increase job staisfaction	0.805	0.195
To better fit with your own value	0.842	0.158
General priority	**0.831**	**0.169**

Criteria and sub-criteria

Environmental concerns

Table 8 shows the normalized comparison matrix obtained for the "Environmental concerns" criteria. According to the respondents, the most important sub-criteria is "To protect the benefits of biodiversity". Figure 6 represents the local priorities.

Table 8 - Synthetised matrix for the criteria "Environmental concerns". This matrix is normalized. BB: To protect the benefits from biodiversity; AP: To protect animals and plants; WQ: To increase water quality.

	MA	WQ	AP	Total row	Priority Vector
MA	0.461	0.457	0.464	1.382	0.461
WQ	0.208	0.206	0.203	0.617	0.206
AP	0.330	0.337	0.333	1.001	0.334
					1.000

The CR equals 0.0001 < 0.1. Thus, the matrix and the judgments are consistent.

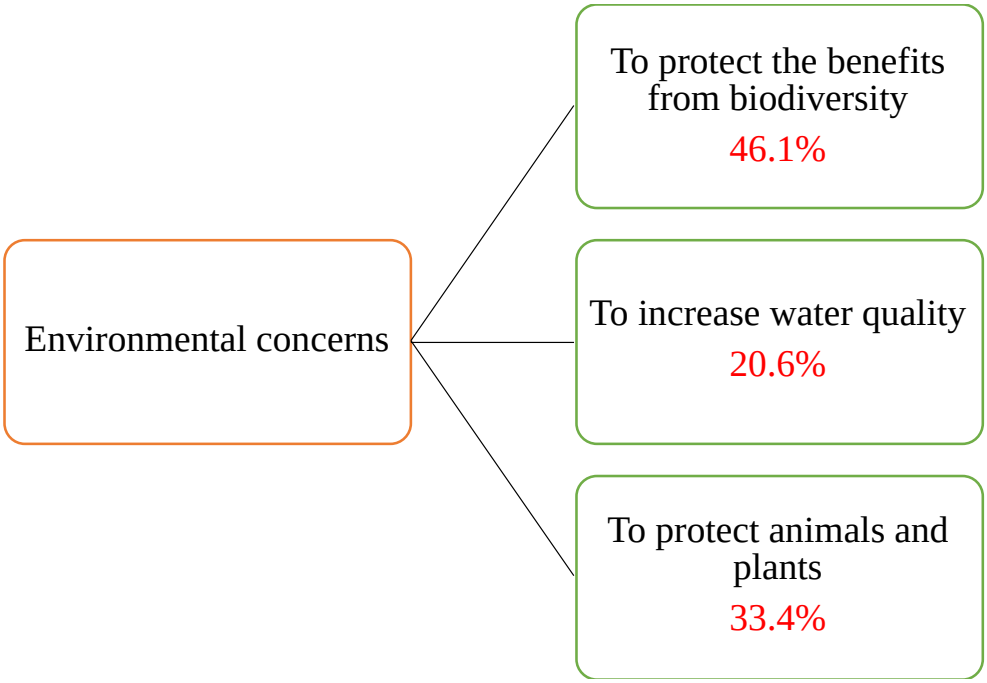


Figure 6 - Local priorities, expressed in percent, for the criteria "Environmental concerns".

Economic benefits

Table 9 shows the normalized comparison matrix for the “Economic benefit” criteria. The results indicate that “Market advantages” and “Reliable and stable incomes” are considered the most important sub-criteria in this category by respondents. Figure 7 represents the local priorities.

Table 9 - Synthetised matrix for the criteria “Economic benefits”. This matrix is normalized. S: Subsidies; MA: Market advantages; RS: Reliable and stable incomes.

	S	MA	RS	Row sum	Priority Vector
S	0.184	0.192	0.177	0.553	0.184
MA	0.389	0.406	0.414	1.209	0.403
RS	0.426	0.402	0.409	1.237	0.413
					1.000

The CR equals 0.0011 < 0.1. Thus, this matrix and the judgments are consistent.

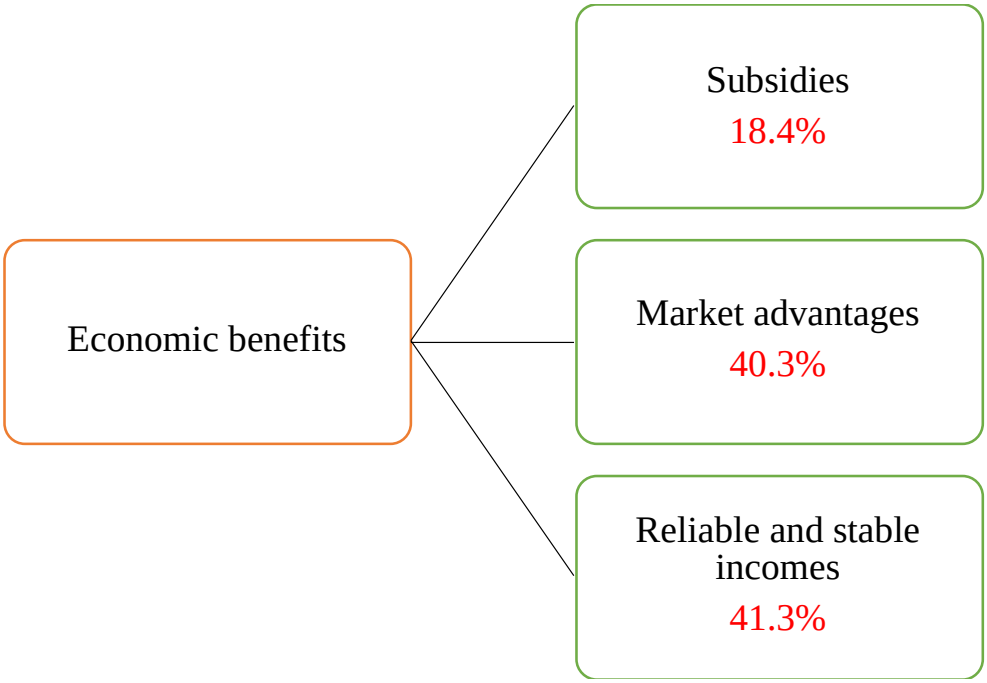


Figure 7 - Local priorities, expressed in percent, for the criteria "Economic benefits".

People's health

Table 10 shows the normalized comparison matrix obtained for the "People's Health" criteria. The results indicate that "Food safety" is slightly more important for farmers, but the results are close. Figure 8 represents the local priorities.

Table 10 - Synthetised matrix for the criteria "People's health". This matrix is normalized. P: To decrease farmer's exposition to pesticides; FS: Food safety.

	P	FS	Row sum	Priority Vector
P	0.496	0.496	0.992	0.496
FS	0.504	0.504	1.008	0.504
				1.000

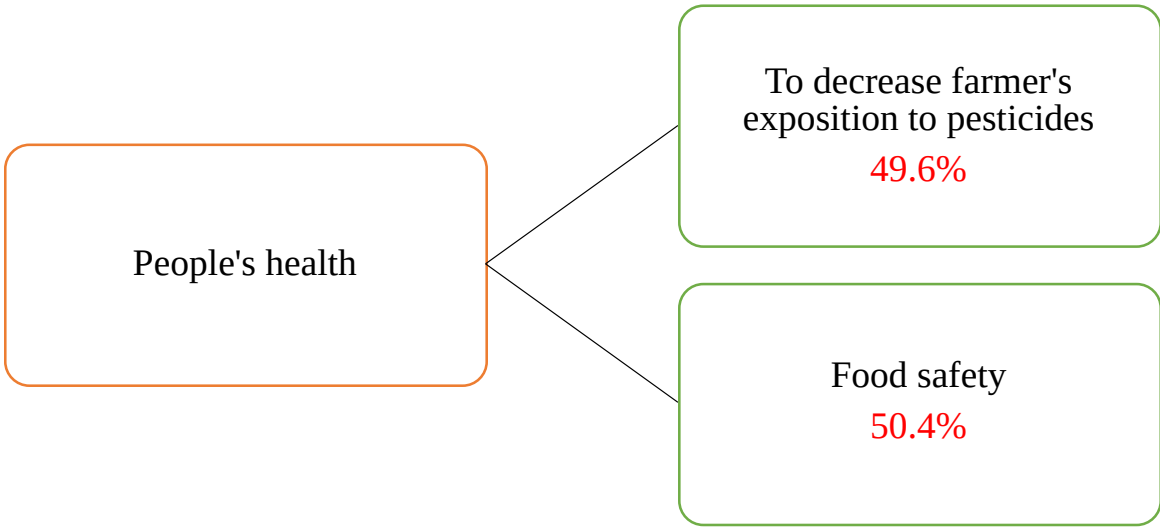


Figure 8 - Local priorities, expressed in percent, for the criteria "People's health".

Personal values

Table 11 shows the normalized comparison matrix obtained for the “Personal values” criteria. The results indicate that “To better fit with your own values” is considered more important than “Job satisfaction”. Figure 9 represents local priorities.

Table 11 - Synthetised matrix for the criteria “Personal values”. This matrix is normalized. JS: Job satisfaction; V: To better fit with your own values.

	JS	V	Row sum	Priority Vector
JS	0.408	0.408	0.816	0.408
V	0.592	0.592	1.184	0.592
				1.000

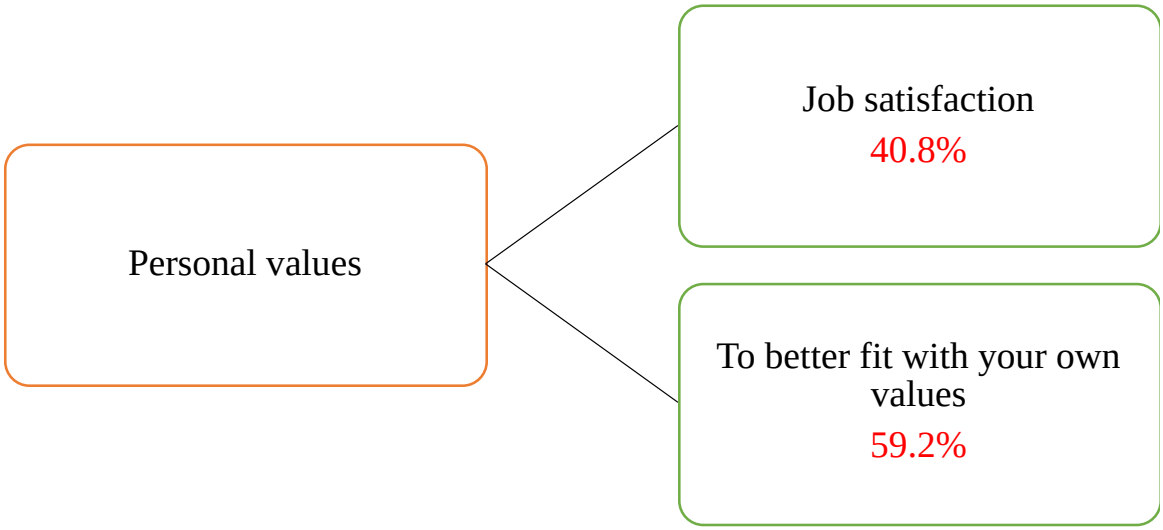


Figure 9 - Local priorities, expressed in percent, for the criteria "Personal values".

Farmers' motivations

Table 12 shows the normalized comparison matrix obtained while comparing the criteria, which means the motivations. The criteria "personal values" is the most important criterion, with a global priority of 0.301. In the second position, with a global priority of 0.287, is "people's health", followed by "environmental concerns" (0.283) and "economic benefits" (0.129). Figure 10 shows the criteria's priority.

Table 12 - Synthetised matrix for the AHP goal. EC: Environmental concerns; EB: Economic benefits; PH: People Health; PV: Personal values.

	EC	EB	PH	PV	Row sum	Priority Vector
EC	0.274	0.330	0.268	0.259	1.131	0.283
EB	0.106	0.128	0.140	0.141	0.515	0.129
PH	0.298	0.266	0.291	0.295	1.150	0.287
PV	0.322	0.276	0.301	0.305	1.204	0.301
						1.000

The CR equals 0.0049 < 0.1. Thus, this matrix, and the judgments, are consistent.

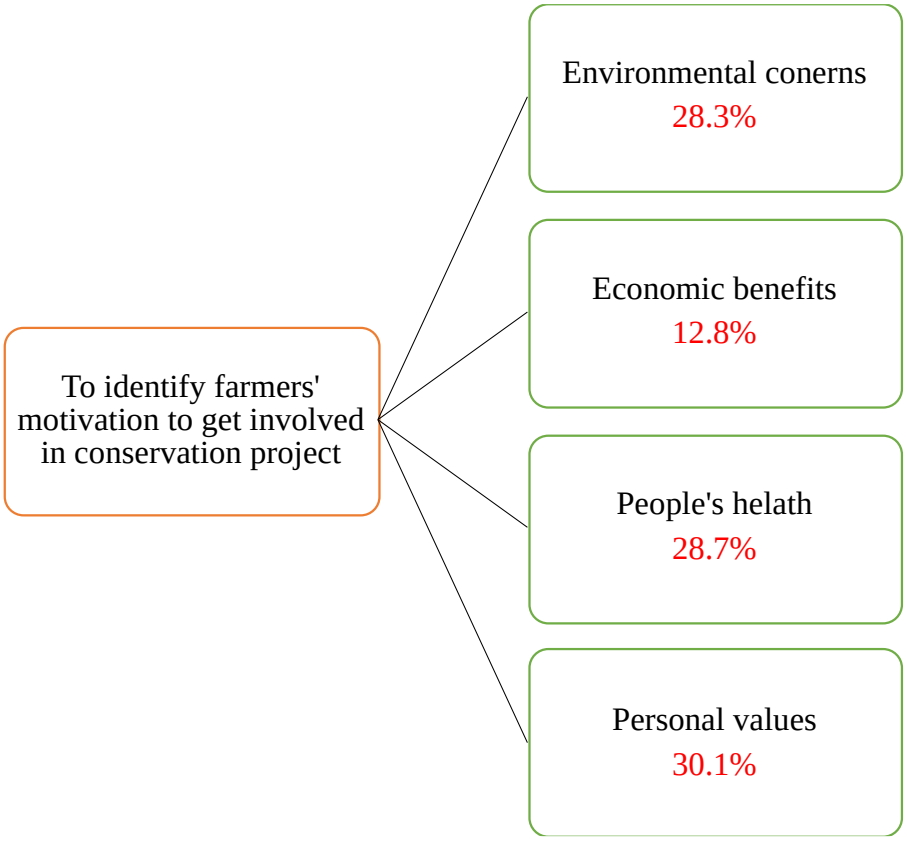


Figure 10 - Priorities, expressed in percent, for the criteria.

The global priorities are calculated with the local ones, as explained in the paragraph “Develop overall priority ranking”. Figure 11 shows global priorities. Personal values, people’s health, and environmental concerns have the most weight in the decision to be involved in a conservation project. Looking deeper in the hierarchy, “to better fit with your own¨ value” is the first sub-criteria, followed by “Food safety”, “to decrease farmer’s exposition to pesticides”, and “to protect the benefits from biodiversity”. The lower weights are attributed to the three sub-criteria of the economic factor, “reliable and stable income”, “market advantages”, and “subsidies”.

Table 13 summarizes the global and local priorities as well as the CR.

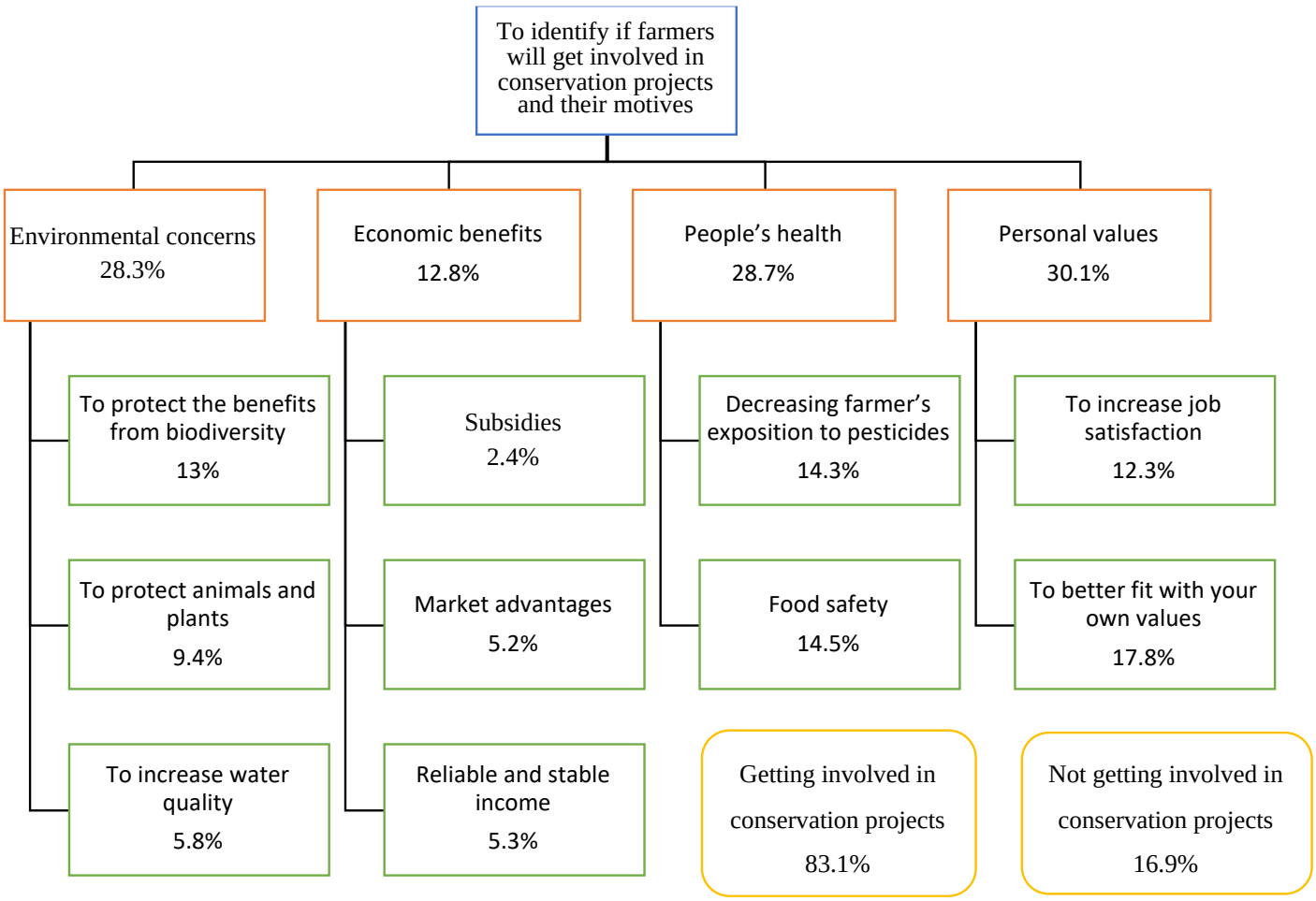


Figure 11 - Hierarchy with global priorities. In blue the goal of the AHP, in orange the criteria, in green the sub-criteria, and in yellow the alternatives.

Sensitivity analysis

The sensitivity analysis reveals that the decision of getting involved is firm. Indeed, as shown on figure 12, if the weight of the different criteria change it won't affect the final choice of getting involved. Even if the economic factor, which is the less important in the decision, would become the most important one, farmers will still stay involved in the project.

Table 13 - Local and global priorities with the rank of each sub-criterion and criterion (bold). The CR are inferior to 0.1 with an overall CR of 0.041.

Criteria	Local priority	Global priority	Rank	CR
Environmental concerns	**0.283**	**0.283**	**3**	
To protect the benefits from biodiversity	0.461	0.13	4	
To increase water quality	0.206	0.058	7	0.0001
To protect animals and plants	0.334	0.094	6	
Economic benefits	**0.128**	**0.128**	**4**	
Subsidies	0.184	0.024	10	
Market advantages	0.403	0.052	9	0.0011
Reliable and stable income	0.413	0.053	8	
People's health	**0.287**	**0.287**	**2**	
To decrease farmer's exposition to pesticides	0.496	0.143	3	
Food safety	0.504	0.145	2	
Personal values	**0.301**	**0.301**	**1**	
To increase job satisfaction	0.408	0.123	5	
To better fit with your own value	0.592	0.178	1	
				CR Goal = 0.0049

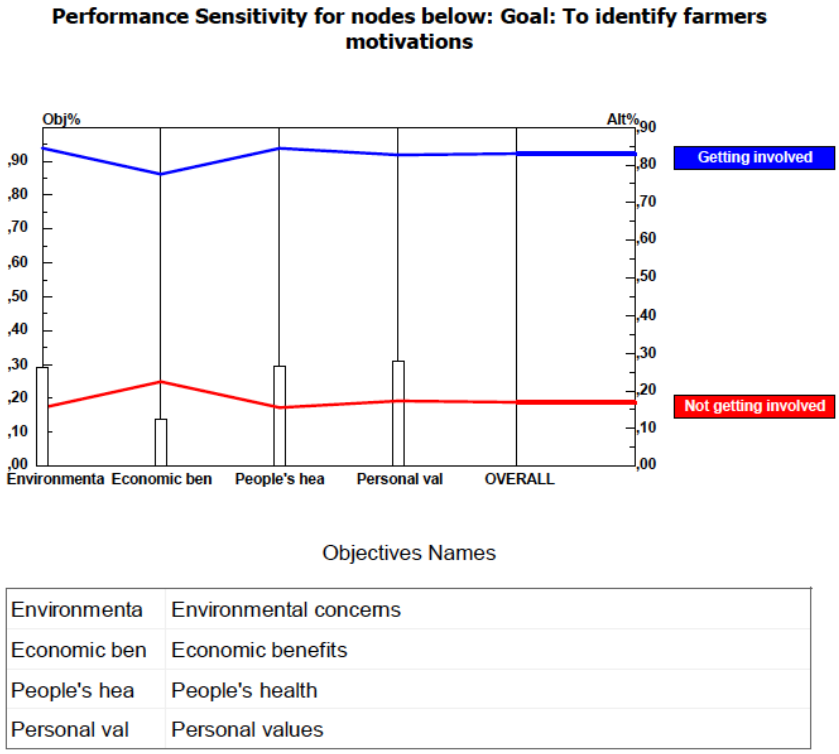


Figure 12 - Sensitivity analysis for the AHP regarding farmers' motivations.

Channel of communication

Face-to-Face

Table 14 shows the normalized comparison matrix obtained for the face-to-face channel. The results indicate that the "Workshop with farmers" is more important than the others. Figure 13 represents the local priorities.

The CR equals 0.026 < 0.1. Thus, the matrix, and the judgments, are consistent.

Table 14 - Synthetised matrix for the face-to-face communication channels. WF: Workshop with farmers; WS: Workshop with scientists; PM: Project meeting.

	WF	WS	PM	Row sum	Priority Vector
WF	0.474	0.414	0.537	1.425	0.475
WS	0.298	0.260	0.206	0.765	0.255
PM	0.227	0.326	0.257	0.810	0.270
					1.000

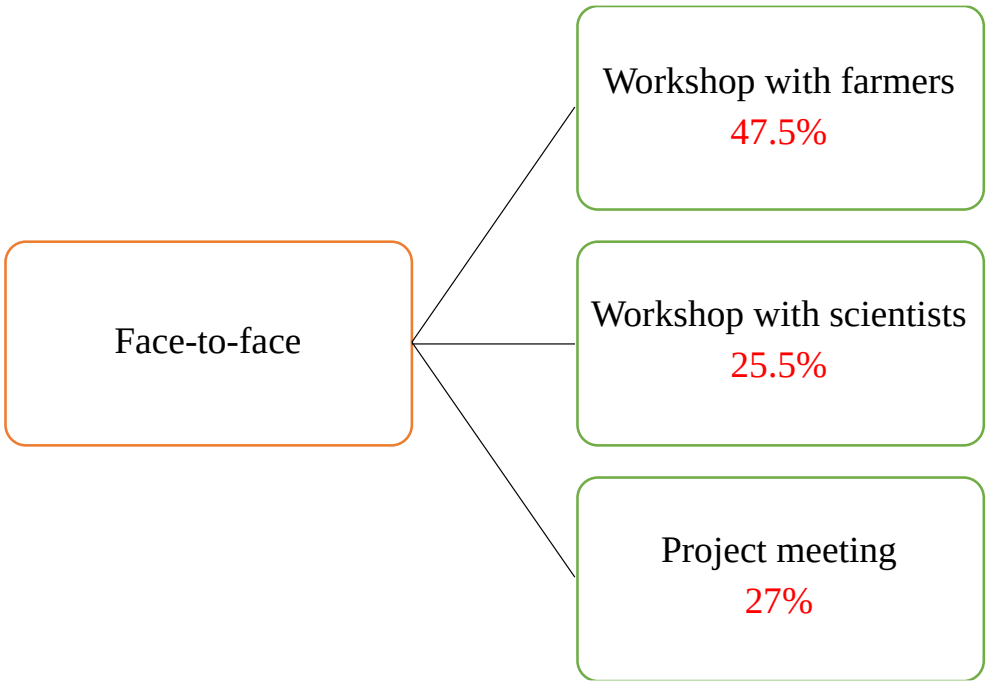


Figure 13 – Local priorities, expressed in percent, for face-to-face communication channels.

Traditional media

Table 15 shows the normalized comparison matrix obtained for the traditional media channels. The results indicate that professional magazines (0.368) are the preferred channel amongst the

traditional ones, followed by scientific magazines (0.203) and Phone (0.197). Figure 14 represents local priorities.

Table 15 - Synthetised matrix for the traditional media communication channels. TV: Television; PM: Professional magazines; SM: Scientific magazines.

	Phone	TV	Radio	PM	SM	Row sum	Priority Vector
Phone	0.187	0.216	0.177	0.159	0.247	0.985	0.197
TV	0.082	0.094	0.074	0.107	0.100	0.457	0.091
Radio	0.142	0.171	0.134	0.116	0.142	0.705	0.141
PM	0.431	0.323	0.419	0.365	0.302	1.839	0.368
SM	0.159	0.197	0.197	0.253	0.209	1.015	0.203
							1.000

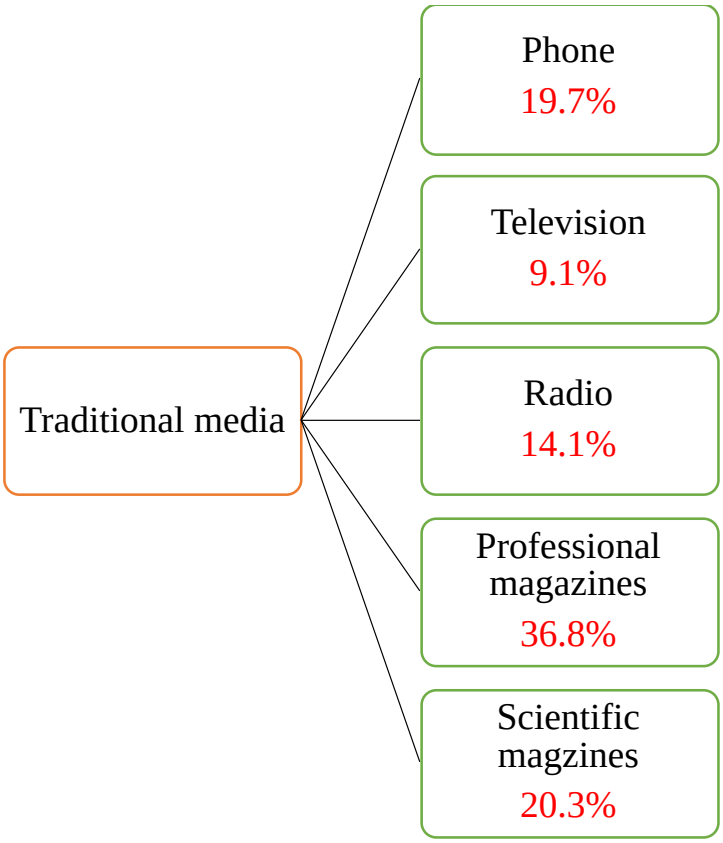


Figure 14 - Local priorities, expressed in percent, for traditional media communication channels.

The CR equals 0.0104, which indicates that the matrix and the judgments are consistent.

Internet

Table 16 shows the normalized comparison matrix obtained for the internet channels. The results indicate that the three professional channels have similar weight but still slightly prefer social media (0.362). Figure 15 represents local priorities.

Table 16 - Synthetised matrix for the internet communication channels. SM: social media: PW: Project website; SW: Specialized website.

	SM	PW	SW	Row sum	Priority Vector
SM	0.362	0.356	0.369	1.087	0.362
PW	0.327	0.321	0.314	0.962	0.321
SW	0.311	0.324	0.317	0.951	0.317
					1.000

The CR equals 0.0004 < 0.1, which indicates that the matrix and judgments are consistent.

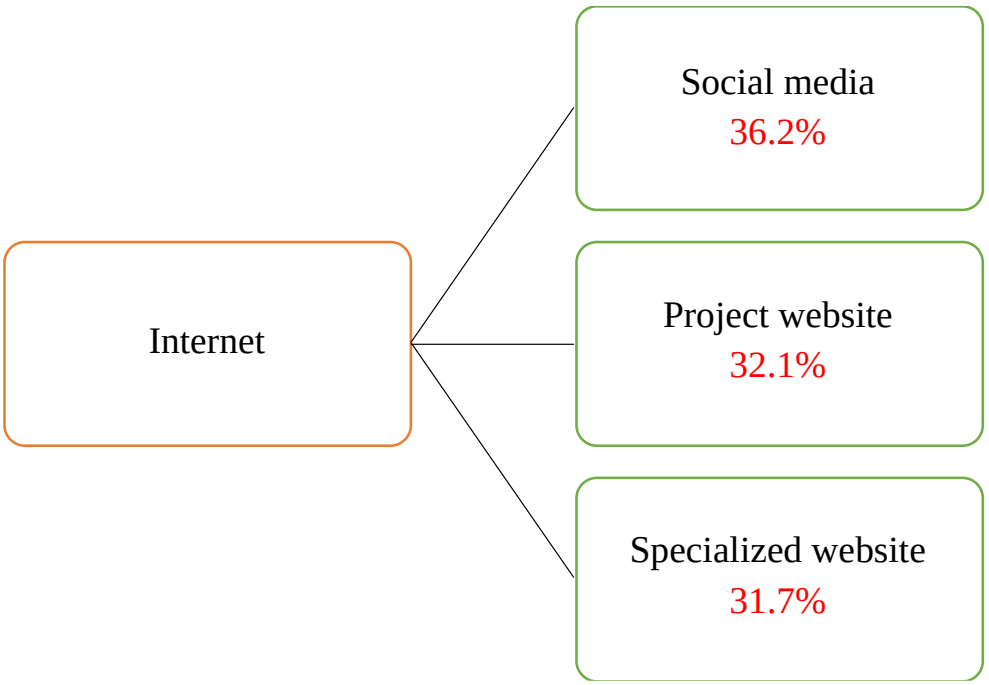


Figure 15 - Local priorities, expressed in percent, for internet communication channels.

Social media

Table 17 shows the normalized comparison matrix obtained for social media. The results indicate that YouTube (0.512) is the favourite social media compared to the others. Figure 16 represents local priorities.

Table 17 - Synthetised matrix for the social media. FB: Facebook; T: Twitter; Ig: Instagram; YT: YouTube.

	FB	T	Ig	YT	Row sum	Priority Vector
FB	0.180	0.227	0.231	0.159	0.797	0.199
T	0.096	0.121	0.114	0.135	0.466	0.117
Ig	0.137	0.186	0.176	0.190	0.689	0.172
YT	0.587	0.465	0.479	0.517	2.048	0.512
						1.000

The CR equals 0.0103, which indicates that the matrix and judgments are consistent.

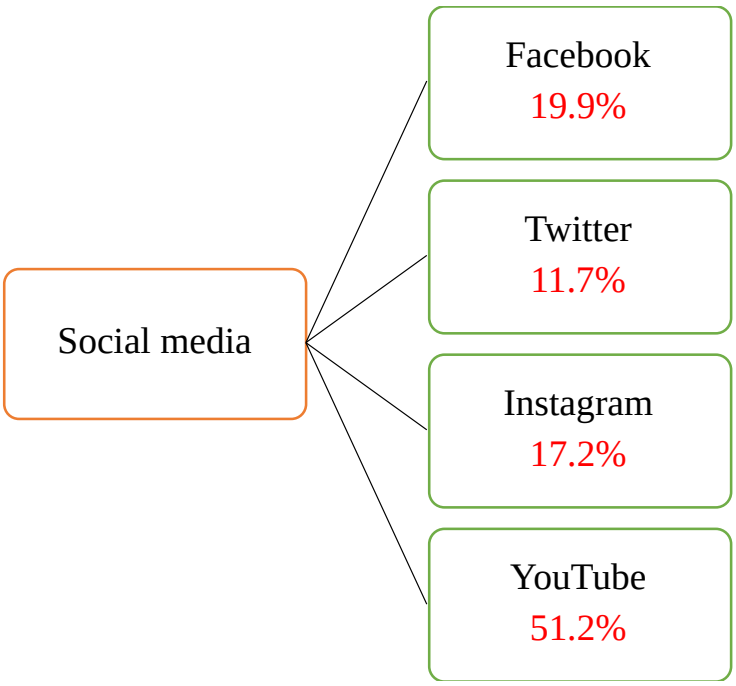


Figure 16 - Local priorities, expressed in percent, for the social medias.

Channel category

Regarding the farmers' communication channel preferences, the results of the AHP indicate that they preferred face-to-face communication with a priority of 0.636 before traditional media (0.197) and internet (0.168). Figure 17 shows the priorities of each channel from the first level of the hierarchy.

Table 18 - Synthetised matrix for the goal of the AHP to choose the preferred communication channel amongst farmers. FF: Face-to-face; Tr: Traditional media; I: Internet.

	FF	Tr	I	Row sum	Priority Vector
FF	0.635	0.633	0.638	1.907	0.636
Tr	0.198	0.197	0.194	0.590	0.197
I	0.166	0.170	0.167	0.503	0.168
					1.000

The CR is equal to 0.0001 <0.1 which indicate that the matrix and the judgments are consistent.

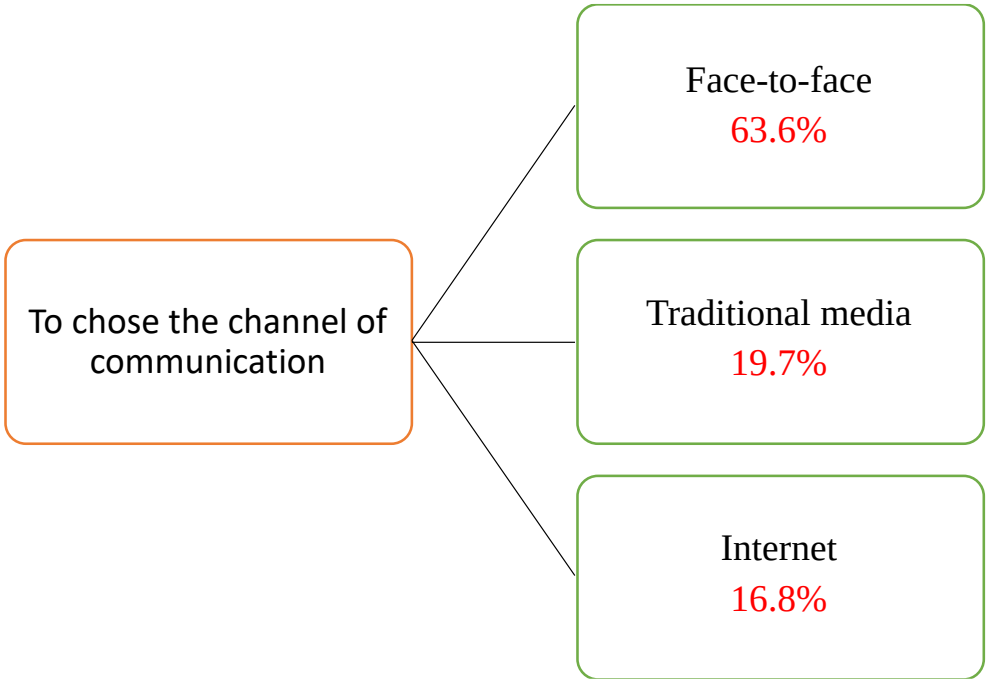


Figure 17 – Local priorities, expressed in percent, regarding the communication channel.

After calculating local priorities, the global ones are calculated to identify which communication channel farmers prefer (Figure 18). The preferred channels are workshops with farmers (0.303), project meetings (0.171), workshops with scientists (0.162), professional magazines (0.073) and social media (0.061). Regarding social media, the preferences are clearly for YouTube (0.031). The lower priorities are Twitter (0.007), Instagram (0.01), Facebook (0.012), and television (0.018). The consistency ratios are inferior to 0.1, which indicates that the matrices are consistent. In Table 19, all the priorities, ranks, and CR can be found.

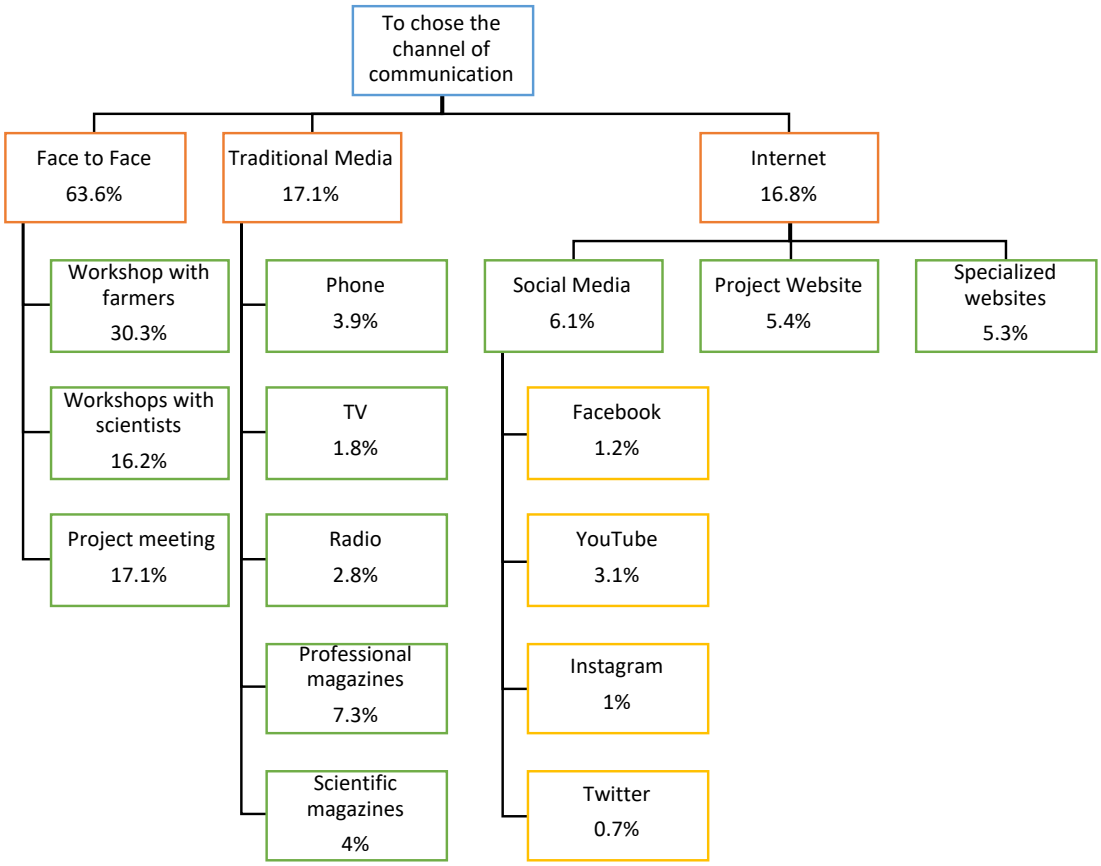
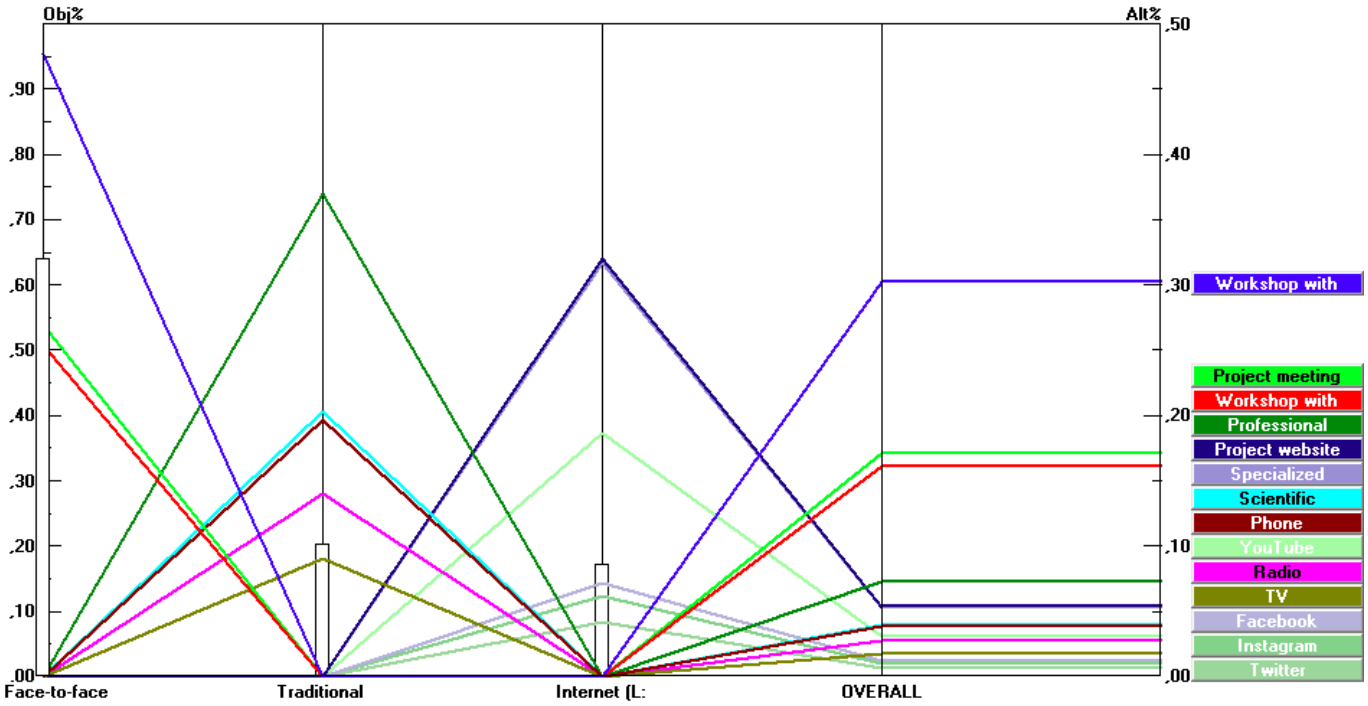


Figure 18 - Hierarchy with global priorities. In blue the goal of the AHP, in orange the main channels categories, in green the communication channels.

Table 19 - Local and global priorities with the rank of each sub-criterion and criterion (bold). The ranks for social media are in italic. The CR are inferior to 0.1 with an overall CR of 0.0095.

Criteria	Local priority	Global priority	Rank	CR
Face to face	**0.636**	**0.636**	**1**	
Workshop with farmers	0.476	0.303	1	
Workshop with scientist	0.254	0.162	3	0.0260
Project meeting	0.269	0.171	2	
Traditional media	**0.197**	**0.197**	**2**	
Phone	0.196	0.039	9	
TV	0.091	0.018	11	
Radio	0.141	0.028	10	0.0104
Professional magazines	0.37	0.073	4	
Scientific magazines	0.203	0.04	8	
Internet	**0.168**	**0.168**	**3**	
Project website	0.321	0.054	6	
Specialized websites	0.317	0.053	7	0.0004
Social media	0.362	0.061	5	
Facebook	*0.199*	*0.012*	*2*	
Twitter	*0.117*	*0.007*	*4*	*0.0103*
Instagram	*0.172*	*0.01*	*3*	
YouTube	*0.512*	*0.031*	*1*	
				CR Goal = 0.001



Sensitivity analysis

Figure 17 represents the analysis sensitivity for the communication channel. If the weights of traditional media and the Internet change, the priority rank will change. For instance, if the weight of traditional media increases professional magazines will be in the first position. It is the same for the internet with project meetings and specialized websites. It shows which channels will react strongly if the weights are modified.

Figure 19 - Sensitivity analysis regarding the communication channels. Workshop with (blue): workshop with farmers; Workshop with (red): workshop with scientists; Project meet: project meeting; Professional: professional magazines; Scientific m: scientific magazines; Project webs: project website; Specialized: specialized websites.

Discussion

Agriculture needs to reinvent itself to face the World's challenges. The European Union, through the CAP and by financing projects, is trying to tackle these issues. The Framework project financed by Horizon 2020 is one example. However, adaption to these changes can be difficult to implement by farmers. Nowadays, the European Union is counting on subsidies through the AES to encourage farmers. As mentioned, there might be better solutions for a durable change, and thinking that farmers are only motivated by money is reductive. Another point to involve farmers in these projects is to be able to communicate with them and transfer the information through the proper channels.

This master thesis tries to understand farmers' motivations to get involved in conservation projects and their preferences regarding communication channels. The respondents are from four countries and represent the variability of practices in the project, except for orchard producers from France and Luxembourg. However, the first limit is that more than half of the respondents are from Italy and are growing olives. Another limitation of this thesis is that only five clusters of the ten selected answered and the Eastern countries are under-represented. This limitations echoing other research in the project with small response rates and a higher participation in the Italian cluster (Rellensmann et al., 2022). The potential lack of comprehensive cluster representation could influence the generalisability of the study's conclusions beyond the specific regions and clusters under investigation. In addition, AHP method gives general results for all the respondents, and does not differentiate between them. Communication strategies should be done at the project level but also at a local level. To account for this, future research could consider engaging farmers in cross-country dialogue during project meetings. It is also important to notice that 70.6% of the respondents have been to university, which is a higher percentage than the average farmers inside the European Union, where in 2013, only 8.5% of the farmers' population finished an agricultural training, and 69.8% learn their activity by experiences (European Parliament, 2017). Moreover, most of the farmers are organic (88.2%), which is also superior to the average in Europe (9.9%) (Eurostat, 2023). In this way, the research conclusions do not apply to all the farmers in Europe but to the ones involved in the project or with a strong interest in preserving the environment.

Farmers' motivations

To the question "Will you be involved in conservation projects in the future?" the results are unambiguous that farmers will be. Thus, they seem to think that being a part of projects like Framework makes sense. The lowest priority for this answer is regarding subsidies (0.689), even if they will be involved regarding this criterion. It can be interpreted in different ways. First, it might be because

farmers do not think that the subsidies are enough in terms of motivation or money. Secondly, they can differentiate the money received for implementing AES from being involved in a project like Framework that does not finance them directly through subsidies but indirectly by implementing practices that are eligible for subsidies.

Looking at the global priorities (Figure 11), farmers do not consider economic benefits the most important criterion for getting involved. Indeed, it counts for 12.8% of the decision, while the interest in preserving the environment is 28.3%, the protection of people's health is 28.7%, and personal values are 30.1%. Thus, increasing their incomes is essential for farmers, but it is not the main criterion. That can be explained by the fact that choosing to be involved in a project is more investment than just implementing sustainable practices that can be remunerated, which implies a more profound willingness to change their behaviour.

Moreover, most of the farmers have a high level of education, which according to Lastra-Bravo et al. (2015), will increase farmers' willingness to implement sustainable practices. It shows that they already have a sensibility regarding the challenges that agriculture is facing and might be more inclined to play a role. Most of them are organic farmers and have several activities on their farms, showing once again that they have started to adapt and diversify their sources of income. The literature to understand farmers' motivations to implement AES is rich. However, it is not the case when it comes to being involved in conservation projects. Thus, these results do not contradict the literature that shows that many criteria influence farmers' behaviour, and not only economic ones (Lastra-Bravo et al., 2015; Brown et al., 2021). According to Cranfield et al. (2010), health, safety, and environmental motivations are more important in implementing sustainable practices than profitability and economic factors. Thus, this study provides a first approach to understanding farmers' motivations in conservation projects.

Personal values

The results show that "personal values" is the first criterion to be involved, slightly behind people's health and environmental concerns. In this category, two sub-criteria were compared, and the most important one for farmers was to better fit with their values (59.2%) over increasing job satisfaction (40.8%).

This criterion emerged as the most important factor, suggesting that farmers' intrinsic beliefs and ethical considerations greatly influence their willingness to engage in conservation initiatives. The values that can drive farmers to be involved in such projects can be different, and understanding these could be a key to increase involvement in conservation efforts. Thus, further research could be conducted in this field.

Nevertheless, farmers can be aware of the problem that agriculture and society face, and they might want to adapt their activity (Cranfield et al., 2010). Moreover, they can feel responsible toward society and the next generation (Dessart et al., 2019). They could also prefer to work as a group to share information with other farmers and stakeholders, which is the purpose of joining European projects. It might help their business, and they could search for group efficacy and feel more robust with more power in decision-making.

In the global priorities, job satisfaction arrives at fifth place with a weight of 0.123. It is still a predominant factor, but farmers are putting it after health and the protection of the benefits that they could obtain from biodiversity. Thus, being part of a conservation project increases job satisfaction but is not the most important factor for farmers. On one hand, protecting the environment, being part of a group working together, and reconnecting people in a local community could make farmers happier (Dessart et al., 2019). On the other hand, a greater volume of work, a decrease in yields, and so on the incomes could lead to decrease job satisfaction. Nevertheless, being part of the project increases job satisfaction and it is a crucial factor to involve more farmers. Mzoughi (2014) showed that organic farmers get more satisfaction from their job than conventional ones in relation with environmental awareness but also good health, social recognition, financial compensation.

People's health

"People's health" is the second most important criterion for farmers (0.287). Cranfield et al. (2010) explain that health and security are one of the main concerns for organic farmers. Dessart et al. (2019) indicate that organic farmers are more aware of the health risk and thus more apt to adopt sustainable practices, which aligns with the AHP results.

The weights of the two criteria are closed, indicating that farmers are putting their own health at the same level as the consumers. Intensive use of chemicals is known to be an essential factor in skin disease, haematological disorders, respiratory issues, endocrine dysfunction, infertility, neurotoxicity, and in increasing the risk of cancer (de-Assis et al., 2020). Thus, project's farmers recognized the risk that pesticides represent. Reducing their exposure to it is crucial in entering conservation projects and implementing sustainable practices. This perception might be due to their educational level or the fact that the European Union communicates about it. However, it could also be based on their experiences with chemical-related diseases (Toma et al., 2007). However, in our society, some voices are rising to stop pesticides without any products to replace them, which will be a problem for farmers and their production. This study shows that farmers interested in conservation agriculture perceived this risk. However, alternatives must be made available for farmers to tackle pest and diseases problem. Farmers

from the different clusters indicate some practices that they implement that could be effective in managing these issues, such as introducing different varieties, late mowing, using copper, Spinosad, rock dust or essential oil, monitoring olive's fly and using repellent and pheromones trap to catch it. Nevertheless, some of these methods are expensive and cannot be applied to all European fields. Thus, a balance should be found between the different types of agriculture, and sustainable practices that are easily implemented should be encouraged.

Moreover, they consider that they have a role to play regarding consumers in producing safe and high-quality food. Indeed, farmers are producing food for the rest of the population, and the results shows that the quality of their products and consumers' security are important factors. As mentioned by Howlett et al. (2002) and Cranfield et al. (2010), producing healthier and safer food is a concern of organic farmers. Organic food is produced with fewer pesticides than conventional, and the residue levels are lower, especially in fruits and vegetables, which are the primary source of consumer exposure. Moreover, the use of antibiotics is less intensive in organic animal production, diminishing the risk of antibiotic resistance in society (Mie et al., 2017).

Environmental concerns

"Environmental concerns" is the third factor in the AHP. However, his weight (0.283) is close to "people's health" (0.287) and "personal values" (0.301). Therefore, it is also an essential factor in the decision to be involved in conservation projects.

The most important sub-criterion is about the benefits that biodiversity could procure to farmers (0.461) before the protection of plants and animals (0.334) and to increase water quality (0.206). Thus, farmers put as a first factor what they could obtain from the environment for their activity. In other words, the protection of ecosystem services. During a project meeting in the Czech cluster, farmers explained that the presence of predatory birds reduced the vole's population and that it was not an issue anymore (except along a highway). It shows that practices implemented by farmers are working at a certain level. A significant number of services can be provided by the environment, as mentioned in the introduction.

Regarding the practices implemented by farmers in the project, it can be said that services such as increasing soil fertility (composting, leaving straw on the soil, intercropping), and pollination (wildflower strips, cutting grass by respecting the blossoms, beehives) are of importance for farmers. Another benefit that is certainly important for farmers might be pest and disease control. For the olive groves, all farmers mentioned using natural pesticides to fight the olive's fly (Spinosad, rock dust, copper, pheromone traps), and some mentioned monitoring the fly and using a DSS to increase the

precision of their treatments. Findings from a Dutch cluster deliverable shows that implementing wildflowers strips and delaying their mowing will increase hoverflies population and reduce the aphids one (Mansier et al., 2023). This result shows farmers have a utilitarian vision of biodiversity and the environment. They will protect what could benefit them. Kelemen et al. (2013) find similar results where farmers value biodiversity for its economic aspects (ecosystem services). However, in their study, biodiversity was valued in this way mainly by conventional farmers, while organic farmers valued it for its social, ethical, and ecological aspects first. The result of this study is different, but not in total contradiction, as the protection of plants and animals has a local weight of 0.334 in environmental concerns. In addition, Moroder et al. (2022) found that farmers have a perception of biodiversity for its effects on agriculture but a narrowest perception regarding its effects on the whole ecosystem. However, regarding global priorities, it is only 0.094, while protecting the benefits from biodiversity is 0.130.

Thus, protecting plants and animals is considered essential rather than one of the first factors in engaging in conversation projects. This result indicates that there is still some work to do to improve the knowledge about biodiversity's importance. However, the conception of biodiversity can be different depending on the farming activity, the country, and the philosophical ideas of each farmer. Moreover, this result can also be explained by the fact that farmers can perceive biodiversity as necessary ecologically and ethically, but at a cost to them (Kelemen et al., 2013; Maseyk et al., 2021). In other words, protecting species on-farm, such as weeds, can lead to a lower yield and then lower incomes. Moroder et al. (2022) explain that biodiversity is seen in two ways, a negative one, where biodiversity is detrimental to yield and a positive one, where it could provide better forage in grassland and landscape beauty. They conclude that overall biodiversity is seen as a negligible or negative value.

Nevertheless, biodiversity is a complex term, as described in the literature review, and its complexity might explain why it is difficult for farmers to understand it. Moreover, farmers also need profitable production, and a balance must be found. All the stakeholders must consider the protection of biodiversity and the environment. More research could be done on the project to learn more about the farmers' values regarding biodiversity.

The last sub-criterion in environmental concerns is the increase in water quality. Different studies show that water quality was considered a relatively import outcome of implementing sustainable practices (Michel-Guillou et al., 2006; Cranfield et al., 2010; Power et al., 2013; Dudley et al., 2017; Maas et al., 2021). However, the AHP results show that it is not a factor of importance, with a global priority of 0.058 for being involved in the project. The direct benefits are not necessarily visible to the respondents. Nevertheless, water quality and availability are a primary concern in the EU. The "water

plan" presented in France in 2023 by President Macron is an example, as it will be one of the French government's priorities in environmental policies (Élysée, 2023).

Economic benefits

As mentioned before, according to the framers, this factor is the less important one, with a weight of 0.128. With a global priority of 0.053 for reliable and stable incomes, 0.052 for market advantages, and 0.024 for subsidies. Thus, while the economy is undoubtedly one of the most critical factors of their work, they do not consider it as important as the three others for being involved in conservation projects.

A first explanation could be that they do not receive direct payments from the project, so they might consider that being in this project does not help them financially. However, practices encouraged by the project, such as wildflower strips, nest boxes, windbreak trees, cover crops, and bio-corridors, are eligible, depending on the countries, to receive them. On the other hand, some of these practices might not be rewarded, or the price might need to be higher to be considered relevant by farmers. Despite this, subsidies for organic farmers are still crucial as they can represent a consequent part of incomes (Kujala et al., 2022). Furthermore, farmers might also need to be better informed about public schemes. For example in a previous research, in the Czech cluster, only one farmer said he was well-informed about it, and in the other countries, between 33.3% and 71.4% said they felt well-informed about it (Rellensmann et al., 2022).

Another explanation, as mentioned by Dessart et al. (2019), could be the lowest yield in organic farming and the fact that farmers will be more worried about the yield losses than the potential incomes due to the input decrease and market opportunities. However, the subsidies should compensate for this, as well as the market prices, and the result might be interpreted in this way. Indeed, the local priority of market advantages is 0.403. Thus, selling organic or biofriendly products might give them advantages, such as access to premium markets, higher prices for sustainable products, or opportunities to tap into eco-conscious consumers. In the literature, it is one of the first motivations to increase the farm's profitability (Cranfield et al., 2010; Kelemen et al., 2013; Barghusen et al., 2021)

Moreover, regarding the yield, even if they might be lower in organic agriculture, farmers considered that overall, the income might be more stable and reliable, with a local priority of 0.413. This result underscores that farmers value financial stability and predictability in their agricultural activities, even if organic agriculture yields might be less reliable than conventional (Knapp et al., 2018). However, as mentioned before, 70.6% of the respondent have different activities, which can

diversify the source of income and stabilise the global income. Moreover, reduction in input cost and AES also significantly impact stabilising farm incomes (Harkness et al., 2021).

These results highlighted that farmers' motivations are a complex mix between different factors. The AHP requires concise questionnaires, with simple comparison. This design, while offering efficiency, imposes limitations on the depth of exploration for certain topics. Notably, aspects such as social factors influencing motivations have not been examined due to these constraints. To delve deeper into these complex dimensions, complementing the questionnaire with qualitative interviews could offer a more comprehensive understanding.

Communication channels

The second AHP is about exploring farmers' communication channels. Figure 18 shows the global priorities of each channel. It appears that face-to-face communication is strongly favoured (0.636) compared to traditional media (0.171) and the Internet (0.168), which are closed. Nevertheless, these channels should not be forgotten, especially if the projects want to target young farmers.

The literature on European communication preferences is poor compared to China or developing countries. Thus, this research provides a reasonable basis.

Face-to-face

Farmers favour face-to-face communication, especially with other farmers, with a local priority of 0.476. Workshop with scientists (0.162) and project meetings (0.171) that reunite all the stakeholders and some citizens are of lowest importance for farmers. These results show that farmers prefer verbal communication to transfer information and will prefer it if it comes from a peer. Trust is an essential factor in changing farmers' behaviour and for them to listen, as well as visualizing the practices on site rather than spending a long time on a meeting (Cawley et al., 2023). Moreover, the results indicate a potential disconnection between farmers and scientists. The trust issue can be an explanation, as farmers could think that scientists do not have their best interest at heart, leading projects without considering them, their needs, and their experiences (Rust et al., 2022). During the project meeting, a farmer said, "It is always the same; all the decisions are taken in Prague." This show that the trust of farmers in scientist and politicians is low and that the communication between these parties is perceived as being in one way. These results align with the ones of Maas et al. (2021), which explain that farmers consider scientific content of low importance when deciding on their farms. Nevertheless, it is important to include scientists in the social network of farmers to implement the best practices on farms for farmers and the environment.

Traditional media

The results show that magazines are preferred to other sources of information to transfer information. Once again, farmers will prefer specialised magazines to scientific content. However, scientific magazines arrived in second position. It is also important to remind that most of the farmers from the project went to university. The phone is the third traditional media they prefer. These media are important to reach national but also local citizens and farmers. To transfer information magazines can be an important tool.

Internet

The Internet is increasingly important in daily life, especially in developed countries. Farmers ranked it in third place, but it must be addressed, and it is undoubtedly the easiest way to transfer information between clusters or from universities to their clusters. Moreover, young farmers are the ones using the Internet the most. Thus, if conservation projects want to involve the next generations of farmers, it should be considered in communication strategies.

On the three possibilities that farmers had, they chose social media first (0.362), than project website (0.321) and finally specialised websites (0.317). Thus, there is a slight preference for social media, but overall, the three weights are closed. Regarding social media, their preferences are clearly for YouTube (0.512) and Facebook (0.199). These results align with the ones of Ćirić et al. (2018), which found that these two social media are the most used among farmers, with a higher use rate for females farmers under 30 highly educated .

Recommendations for the project

This master thesis tries to answer two steps of communication strategies: to understand its audience and choose a proper communication channel.

AHP results show that engaging farmers in conservation projects rely on different criteria but that organic farmers, farmers with high education or farmers with environmental sensibility are willing to get involved because of their values and beliefs, their considerations to people's health, and their concerns for the environment, before economic benefits. According to their answers, farmers engaged in this project will stay on it in the future, which shows a willingness to take responsibility towards society and the environment. However, they cannot do it alone.

Regarding communication at a global scale, project websites and social media (X ex-Twitter and Facebook) are the best options to inform farmers and other citizens and collaborators about what is

happening in the project. Moreover, an annual project meeting on the farms to reunite all the project stakeholders is a good idea to create a link between them.

The FRAMEwork's project website is clear, but some parts still need to be completed, such as the explanation regarding the activities in the Czech Republic. The website was updated during the summer, and much information has been added. They publish podcasts and videos about the project or different problems related to the project. Creating a YouTube channel could be interesting for publishing these videos as it is the most social media used by farmers. The project website is an excellent instrument to inform the public of what is done in the project and for farmers to follow what is happening in the other clusters. In the AHP, farmers indicate that scientific magazines were the second most important traditional media. Thus, publishing articles on the website is a good idea. Nevertheless, articles have yet to be published on the website, where only reports, posters or long deliverables are found. Creating some small reports for farmers with scientific knowledge could be interesting.

By reuniting farmers together, the project promotes local agriculture. Thus, local communication should be developed to inform farmers and the population. Face-to-face communication should be the primary tool. Nevertheless, traditional media and social networks should not be forgotten as they help reach a larger audience, but also a local one.

The project should emphasise that oral communication and direct avenue are essential. It should reconnect farmers and scientists. Indeed, the communication from the university to farmers goes only by the facilitator. During data collection, some facilitators explained that they wanted to avoid over-burdening farmers and that farmers were unwilling to answer the questionnaire, even if the project asked it. The project is also trying to implement a video game, and they need some help with reluctance from farmers. Thus, these examples show again that farmers, scientists, and policymakers, experience difficulties working together. Some workshops or field trips where scientists are working as farmers and the opposite with invitations to universities could be organised to show the work of the different parties in their daily occupations (Adamsone-Fiskovica et al., 2022). As mentioned, visualising practices is essential; it could recreate links (Cawley et al., 2023). Some open days could also be created to welcome other citizens. Nevertheless, it should be interactive, so everyone feels included and does not just listen to others speaking. Moreover, scientists must give feedback to farmers on their research; this could be done during annual project meetings as it is nowadays, but also through email, brochures, or social media.

The project has an X (ex-Twitter) account and a Facebook one. However, the result shows that farmers use these social media sparingly. Nevertheless, these media are still important to communicate the results to the citizens. Still, the younger farmers are using social media, and creating local accounts,

as is already the case in England, is essential to inform and transfer knowledge. Moreover, communicating on forum groups or agricultural websites to inform other farmers about this project could be a plus.

Local communities can be reached via traditional media, especially local ones. For example, farmers are reading magazines; thus, adding an article could be effective. Newspapers have not been tested in this research; writing articles about the results in the local press could also increase the project's impact. The project records podcasts, and facilitators or farmers could do the same on radio or TV to reach local farmers. It will also explain project activities and reach other people, as biodiversity is a societal problem that everyone should tackle. It is important to involve farmers in the communication, to make them the project owners and not just the little hands doing what the project tells them to do. They could sell the benefits of it during meetings or conventions.

While communicating with farmers, the project should make the message clear and adapted. As experienced in this master thesis, farmers' schedules are busy. It is also essential to adapt the message regarding the cluster; for example, some words should not be used in the ex-communist countries where this legacy is still present, such as “collectively” or “collaborative”. Different support should be used as videos, images, sounds, presentations, and experiments. Further research could be done on this topic to test which support provokes the strongest reaction.

Some help could be furnished to farmers to inform them to have access to AES. As mentioned by (Rellensmann et al., 2022)), not all farmers involved in the project are enrolled in AES and well-informed about it. It is also an example of differences between the West and the East clusters. Indeed, the Estonian and Czech clusters are the less well-informed on AES in the project.

Conclusion

This master thesis is based on the observation that society and the Earth are evolving fast and that humankind needs to adapt and adjust. Agriculture is at the heart of these challenges to feed the population and tackle environmental issues, as it is one of the main drivers. Thus, agricultural actors and farmers need also to adapt. Project conservations are a tool to help farmers implement sustainable practices and develop their businesses, opportunities, and network. We explored farmers' motivations and communication preferences by employing the Analytic Hierarchy Process (AHP), unearthing nuanced insights that extend beyond conventional paradigms.

This research addressed two fundamental research questions. Firstly, the multifaceted motivations driving farmers to embrace conservation projects have been explored. It became evident that financial incentives are just a fraction of the equation. Farmers' involvement stems from personal values, health considerations, and a commitment to environmental protection. This holistic perspective reshapes the narrative, positioning farmers not only as profit-driven persons but as stewards of the collective future.

Secondly, communication preferences among farmers have been explored. Oral interactions within their peer networks resonate deeply among them. Meanwhile, digital media emerges as a potent conduit for younger farmers to connect and influence on regional, national, and global scales.

Policy Recommendations

The implications of these findings go far beyond individual farms, echoing through international policy considerations. To develop the full potential of farmers' commitment to conservation, policymakers must implement strategies that align economic incentives with intrinsic values. Recognising that engagement transcends financial motivation, policy frameworks should highlight the broader significance of sustainable practices for personal well-being, community vitality, and environmental balance.

In parallel, targeted efforts should amplify awareness campaigns, bridging the gap between environmental concerns and agricultural action. By developing a shared sense of responsibility, farmers, scientists, policymakers and local communities should work together to tackle challenges that resonate across borders. This collective work to develop global solutions mandates the redefinition of farmers' roles as environmental stewards, increasing their well-being and social role.

Novelty and Implications

This study's novelty lies in its approach using the AHP to understand farmers' behaviour through their motivations and communication preferences. It highlights that there are beyond financial compensation and that farmers should be the first actors to tackle environmental issues. Conservation projects are a powerful tool to connect farmers, scientists, policy makers, and citizens to be at the heart of environmental fighting and be social platforms.

On a practical plane, these findings emphasise the need for customised communication strategies. Tailored approaches that cater to generational preferences amplify the effectiveness of outreach, catalysing engagement. The symbiotic relationship between farmers and the broader population emerges as support for societal transformation, underscoring the potential to combine efforts in safeguarding the planet.

In conclusion, this study serves as a call to action to reconceptualise agriculture's role in shaping the future. By understanding farmers' motivations and communication dynamics, we present a paradigm shift with profound implications for policy, practice, and global cooperation. Agricultural adaptation should be considered at a societal level, where farmers and society embark hand in hand toward a sustainable horizon.

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Appendices

Appendix 1: Questionnaire

Presentation

This questionnaire will serve to collect data for a master thesis, which aims to identify the best ways to communicate about biodiversity conservation to get more farmers involved in a project like the Framework project. To identify the key messages, it is important to understand your vision of biodiversity and what prompted you to join the Framework project. The results obtained will be anonymized.

Thank you in advance for your participation.

Questionnaire

Personal data

Country:

.....

Sex: ☐ Male ☐ Female

Age: ☐ 18-25 ☐ 25-35 ☐ 35-45 ☐ 45-55 ☐ 55+

Educational level: ☐ Secondary ☐ High School ☐ University

How many years have you been farming?

☐ 0-5 ☐ 5-10 ☐ 10-15 ☐ 15-20 ☐ 20-25 ☐ 25-30 ☐ 30-35 ☐ 35-40 ☐ 40-45 ☐ 45+

What is the size in hectares of your farm? ☐ <10 ha ☐ 10-30 ha ☐ 30-100 ha ☐ 100+ ha

You are doing: ☐ Conventional agriculture ☐ Organic agriculture ☐ Both

If you are an organic farmer, when have you done your conversion? And how many hectares approximately have you in organic agriculture?

.....

.....

What sustainable practices have you implemented on your farm?

.....

.....

.....

What do you grow on your farm? Please specify. (You can choose as many answers as you want)

☐ Arable Crops ☐ Vegetables ☐ Fruits (trees) ☐ Fruits (other) ☐ Livestock ☐ Other

.....

.....

In this questionnaire, you will have to compare elements two by two thanks to a scale ranging from 1 to 9. The more you move towards an element (right or left), the more it is important for you. You should fill only one box per row. The signification of the number is as follows 1 = Equal importance; 3 = Moderate importance; 5 = Strong importance; 7 = Very strong importance; 9 = Extremely important; 2, 4, 6, 8 = Intermediate values.

Here is an example based on food. If the question is: what do you prefer, chocolate or vanilla?

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Chocolate									X									Vanilla

The one indicates that you like both equally.

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Chocolate											X							Vanilla

Here it means that the importance of vanilla for you is moderately more important compared to chocolate.

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Chocolate	X																	Vanilla

Here, for you there is only chocolate.

With respect to the following factors (in green) and based on your experience, in the future will you choose to get involved or not in a conservation project, such as Framework?

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
To protect the benefits from biodiversity (e.g., pollination, weeds and pest control…)																		
Getting involved																		Not getting involved
To increase water quality																		
Getting involved																		Not getting involved
To protect animals and plants																		
Getting involved																		Not getting involved
Subsidies (e.g. from the European Commission)																		
Getting involved																		Not getting involved
Market advantages (e.g., from selling biodiverse-friendly products)																		
Getting involved																		Not getting involved
Reliable and stable income																		
Getting involved																		Not getting involved
To decrease farmer's exposition to pesticide																		
Getting involved																		Not getting involved
Food safety																		
Getting involved																		Not getting involved
To increase job satisfaction																		
Getting involved																		Not getting involved
To better fit with your own values																		
Getting involved																		Not getting involved

Thank you for completing the first part. In this second part we need to see how you will rank the main motivations in relation to each other.

Environmental concerns																	
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
To protect the benefits from biodiversity (e.g., pollination, weeds and pest control…)																		To increase water quality
To protect animals and plants																		To increase water quality
To protect the benefits from biodiversity (e.g., pollination, weeds and pest control…)																		To protect animals and plants
Economic benefits																		
Subsidies (e.g. from the European Commission)																		Market advantages (from selling biodiverse-friendly products)
Reliable and stable income																		Market advantages (from selling biodiverse-friendly products)
Subsidies (e.g., from the European Commission)																		Reliable and stable income
People's health																		
To decrease farmer's exposition to pesticides																		Food safety
Value																		
To increase job satisfaction																		To better fit with your own values
Motivations																		
Environmental concerns																		Economic benefits
People's health																		Economic benefits
Personal values																		Economic benefits
People's health																		Environmental concerns
Personal values																		Environmental concerns
People's health																		Personal values

While communicating about biodiversity conservation, which channel do you prefer?

	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Face to face:																		
Workshops with farmers																		Project meeting

Workshop with scientists																		Project meeting
Workshop with farmers																		Workshop with scientists
Traditional media:																		
Phone																		Scientific magazines
TV																		Scientific magazines
Radio																		Scientific magazines
Professional magazines																		Scientific magazines
Phone																		Professional magazines
TV																		Professional magazines
Radio																		Professional magazines
Phone																		Radio
TV																		Radio
Phone																		TV
Internet:																		
Social media																		Specialized websites
Project website																		Specialized websites
Social media																		Project website
Social media:																		
Facebook																		Twitter
YouTube																		Twitter
Instagram																		Twitter
Facebook																		Instagram
YouTube																		Instagram
Facebook																		YouTube
Face to face																		Internet
Traditional media																		Internet
Face to face																		Traditional media

Acknowledgment

Thank you for taking the time to answer these questions. Your response will be really helpful for this master thesis and to improve the communication of the project to meet your expectations. You will be sent a summary of our findings.

Appendix 2: Certificate of completion