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PESTICIDES AND SUSTAINABILITY: A ROMANIAN FARMERS' PERSPECTIVE

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Abstract

The purpose of this study is to explore the perceptions and knowledge on sustainable use of pesticides of young farmers from Transylvania. The authors of the study have opted for a qualitative approach, and to this end, seven focus groups were conducted. The findings show that farmers understand the importance of adhering to recommended dosage and avoiding unnecessary treatments as part of a sustainable pesticide use practice. However, they identified several barriers to adopting these practices, including cost, access to information, and concerns about efficacy. When asked how authorities could support sustainable practices, the participants suggested increasing subsidies, offering training sessions, launching awareness campaigns, and developing supportive public policies. Considering the impact of this topic at the EU level and the lack of detailed research, this study opens the door for future quantitative research regarding the transition to sustainable agriculture.

Key words**:** *agricultural practices, EU policies, farmers` behaviour, perceptions, sustainable use of pesticides*

INTRODUCTION

The reduction of risks associated with pesticide use is a major concern for the European Union, supported by the 'From Farm to Fork' strategy and the Directive on the Sustainable Use of Pesticides (SUD) adopted in 2009 (European Commission, 2009) [9]. The aim of these initiatives is to improve the pesticide use in order to reduce the negative impact on the environment and human health, but maintaining crop efficiency (Lykogianni et al., 2021) [31]. The implementation of these measures varies between European Union (EU) Member States, with each adapting them to their local conditions through National Action Plans (European Commission, 2009) [9]. At the European level, the goal is the reduction of chemical pesticides and associated risks by 50% until 2030 (European Commission, 2009) [9]. This target represents a significant challenge for the agricultural sector, as both Romania and other EU member states are key players in the production and trade of cereals and oilseeds (rapeseed, sunflower, soy), where pesticide use has been demonstrated to exert a direct impact on yields (European Commission, 2024a) [12]. While pesticide utilization is imperative for food production preservation, their improper application can result in deleterious environmental and health consequences. A reduction in their utilization, coupled with the identification of suitable alternatives, stands to benefit both agricultural producers and consumers (Toader et al., 2024) [39]. According to the National Institute of Statistics (2025a) [21], between 2011, the year in which Member States were obliged to transpose the provisions of the Sustainable Use of Pesticides Directive into national legislation, and 2023, the last year for which official data are available, the amount of pesticides used in agriculture in Romania decreased by 11.06%. Conversely, the area of land where pesticides were applied exhibited an increase of 52.21% (National Institute of Statistics, 2025b) [22]. The regions of southern Muntenia, western, south-eastern, and south-western Oltenia have the most extensive areas where plant protection measures are applied (Popescu et al., 2021) [35]. The observed trend of decreasing quantities used is consistent throughout the

period under study. Consequently, fluctuations in usage were exclusivelyobserved among different types of pesticides. Specifically, during the period spanning from 2015 to 2017, there was a decline in the utilization of insecticides and herbicides. However, there was a notable increase in the consumption of fungicides when compared to the period from 2011 to 2013 (Stoicea et al., 2022) [37]. Nevertheless, data from the European Commission reveals that Romania has exceeded the target value for the utilization of the most hazardous pesticides (European Commission, 2025a) [15], underscoring the necessity for augmented efforts at the national level. The less positive results of the pesticide use reduction process are also determined by the fact that the majority of farms in Romania practice conventional agriculture, of which only 1% are organic farms, occupying an area of 3.5% of the UAA (Eurostat, 2020) [17]. In this context, integrated pest management (IPM) becomes essential for the transition to a more sustainable agricultural model, as it can support the economic competitiveness of European agriculture by reducing the dependence on pesticides (Lamichhane et al., 2016) [29]. To achieve this goal, it is essential for farmers to work together to maintain both the quantity and quality of their crops (Lamichhane et al., 2016) [29]. This approach includes the utilisation of a range of methods, including agricultural, mechanical, physical, and biological practices (Barzman et al., 2015) [2]. In addition, integrated pest management includes strategies for pest prevention and control, continuous monitoring, and decision-making guided by economic considerations, non-chemical approaches, and the targeted application of pesticides (Barzman et al., 2015) [2]. The European Union has established eight principles for sustainable pest management, with the objective of assisting farmers in adapting to local conditions (European Commission, 2025b) [16]. Projects such as the Farmer's Toolbox for Integrated Pest Management have identified barriers and determinants to IPM adoption and have contributed to significant reductions in pesticide use (Joint Research Centre, 2025) [23]. Meanwhile, Horizon projects are exploring innovative solutions, including the utilization of digital technologies and agro-ecological practices, to assist farmers in adopting more environmentally friendly and efficient methods (European Commission, 2022) [10]. Research indicates that, despite their familiarity with IPM, farmers frequently receive insufficient training, underscoring the necessity for further educational resources (Piwowar, 2021) [34]. Since the implementation of IPM depends on the local context and human resources play a central role in its management (Kvakkestad et al., 2021; Van den Berg & Jiggins, 2007) [28, 41], there are a number of factors that influence the decision to adopt sustainable and environmentally friendly practices. The level of knowledge possessed by farmers with regard to pesticides has been identified as a substantial predictor of their behaviour and choices concerning pesticide use and pest management. Despite the prevalence of farmers relying on readily available and immediate sources of information, those who opt for unbiased sources are more likely to adopt environmentally friendly practices (Creissen et al., 2021) [6]. In spite of the implementation of protective measures, the perception of risk and understanding of the health effects of pesticides remain unsatisfactory (Yang et al., 2014) [44]. It can thus be concluded that education and relevant information can play a major role in risk reduction, especially for those who have experienced adverse health effects (Hashemi et al., 2012) [20]. An examination of the correlation between knowledge levels and pesticide utilisation reveals that a lack of adequate information can result in the unsafe use of pesticides (Bondori et al., 20-21) [3]. Farmers who receive information from sources such as pesticide sales agents or dealers are more likely to utilise pesticides in a manner that poses a greater risk (Bondori et al., 2021) [3]. Furthermore, the reliance of farmers on a solitary source of information, typically the staff at pesticide stores, gives rise to concerns regarding the reliability of the information they receive (Tsakiris et al., 2023) [40]. In contrast, those who receive information from unbiased sources (independent of the interests of

manufacturers and distributors) are more likely to adopt environmentally friendly practices and innovative pest management solutions (Tsakiris et al., 2023; Goeb & Lupi, 2020) [40, 19]. In this context, it is imperative to acknowledge the level of awareness and knowledge of pesticide risks among farmers in order to correctly assess and implement the necessary safety measures (Damalas & Koutroubas, 2018) [8]. The study by Bagheri et al. (2019) [1] demonstrates that levels of knowledge have a significant impact on intentions regarding the application of pesticides. The implementation of effective educational strategies is therefore imperative in order to encourage the adoption of more sustainable practices. Research conducted by Piwowar (2021) [34]. Between 2013 and 2017 demonstrates that 35.5% of farmers are not well informed about sustainable practices, indicating the necessity for additional training programmes. This conclusion is further substantiated by the findings of Lekei et al. (2014) [30], who determined that reading product labels constitutes a primary source of information for farmers. Consequently, it can be concluded that access to suitable sources of information and knowledge about pesticides is imperative for the adoption of sustainable practices in agriculture (Damalas & Koutroubas, 2018) [8]. Nevertheless, it is essential that education assumes an active role in empowering farmers' behaviour and raising their awareness of the risks associated with pesticides if this knowledge is to be applied correctly (Calliera & L`Astorina, 2018) [4]. Thus, continuing education becomes an essential component in promoting the sustainable use of pesticides, a factor with an impact on both human health and the environment (Calliera & L`Astorina, 2018) [4]. Improving risk awareness can include the use of different training methods, media campaigns and expert advice in order to promote sustainable use of pesticides (Bagheri et al., 2019) [1]. This aspect becomes a priority in the EU policy and legislation, given the fact that life long education promotes the adoption of environmentally friendly practices and improve public health (Lykogianni et al., 2021) [31]. According to Yang et al. (2014) [44] farmer-specific education programmes would reduce pesticide use by increasing their understanding of the risks and benefits of adopting environmentally friendly practices. Moreover, in order to ensure a proper dissemination, it is important that the information comes from sources they are already familiar with, as well as through associations of which they are members (Bagheri et al., 2019) [1].

The adoption of sustainable practices by farmers is also influenced by their perceptions and attitudes. For instance, studies undertaken by Maican et al. (2021) [32] demonstrate that economic motivations exert a greater influence on performance than job satisfaction on family farms in Romania. This may serve to explain the farmers' resilience in the face of adverse perceptions of farm work. Consequently, personal motivation and attitudes towards agricultural work directly influence the decision to adopt organic techniques or to continue with conventional methods. Mellon-Bedi et al. (2020) [33] identify personal satisfaction as a key factor in this process, but also significant barriers such as uncertainty and lack of resources. The perception of pesticide use is a pivotal factor in this decision-making process. While 73% of farmers in Romania believe that organic products comply with regulations, this percentage is lower than the EU average of 83% (European Commission, 2023) [11], reflecting a general mistrust in the effectiveness of regulations on organic farming principles. Despite the EU's ongoing monitoring of pesticide residues, with 96.3% of samples analysed in 2022 falling within legal limits (Eurostat, 2024) [18], public perception continues to be a challenge. In Romania, this lack of confidence in compliance with pesticide legislation can have a negative impact on farmers' decisions. It is therefore imperative to promote changes in public perceptions and further education to encourage more sustainable behaviour among farmers. Finally, in addition to perceptions and attitudes, farmers' awareness and information play an important role in their decisions, and protecting biodiversity requires both individual actions by farmers and collective actions and

appropriate policies (Kelemen et al., 2013) [25].

It is evident that clear regulations and support from the relevant authorities are significant factors in determining farmers' willingness to adopt more sustainable solutions, and biopesticides are an example of an essential tool to address environmental pollution and support sustainable agriculture (Campos et al., 2018) [5]. A study conducted in Norway by Kvakkestad et al. (2021) [28] revealed that the majority of cereal farmers adopt integrated pest management (IPM) practices not only in response to economic reasons, but also because of intrinsic motivation. Following the implementation of SUD in 2015, 41% of farmers reported a significant increase in IPM use, suggesting that clear regulations can incentivise farmers to adopt more sustainable practices. Kaiser and Burger (2022) [24] emphasise that policies based solely on subsidies and financial incentives are not sufficient to bring about behavioural change among farmers. They contend that such policies must be complemented by farm advisory services tailored to different types of farms and stronger regulatory and control measures to ensure responsible pesticide use and more effective environmental protection.

In the context of the ongoing discourse on the factors that influence farmers' decisions, it is imperative to acknowledge the significance of economic and social factors. These elements exert a substantial influence on the utilization of pesticides and the adoption of sustainable practices. As Kelemen et al. (2013) [25] emphasise, although farmers can contribute to biodiversity conservation by reducing pesticide use and protecting soil, their decisions are influenced not only by personal intentions but also by economic and social factors. The financial implications associated with pesticide use, as well as the market dynamics influenced by such products, can, in some instances, render the adoption of eco-friendly practices less economically viable, in spite of the obvious environmental benefits (Kelemen et al., 2013) [25]. Despite a decline in pesticide sales within EU Member States (Eurostat, 2024) [18], the absence of explicit and directly applicable EU legislation on the sustainable use of pesticides risks undermining the achievement of the 2030 targets. In this context, the European Commission is seeking solutions to ensure both food security and environmental protection. One such initiative is the Strategic Dialogue on the Future of EU Agriculture, initiated in January 2024 (European Commission, 2024b) [13]. The final report of this dialogue, presented in September 2024, proposes recommendations for the reform of the Common Agricultural Policy and the creation of a temporary fund for sustainable transition – the Agrifood Just Transition Fund (European Commission, 2024c) [14].

This literature review identified a gap in the existing research, as the majority of studies focus on analysing trends and amounts of chemicals used in Romanian agriculture, risks and impacts on non-target species, modelling crop distribution to promote organic farming, or comparing how SUD is applied in EU Member States. However, there is a very limited number of studies dealing with knowledge, perceptions and determinants of sustainable use of pesticides. Consequently, the objective of this study is to explore farmers' perceptions of sustainable use of pesticides and to identify actual practices implemented on their farms. This research makes an important contribution by providing insight into the attitudes and behaviours of Romanian farmers, a topic that has been insufficiently researched. The study will provide valuable insights into the local context and identify barriers to the adoption of more sustainable practices.

The specific objectives of the study are as follows: to investigate farmers' pesticide use practices, to analyse their perceptions of risks and impacts on health, biodiversity and soil, to assess their knowledge of sustainable pesticide use, to identify barriers and types of support needed to adopt sustainable practices. The following research questions have been identified:

Q1: What are farmers' pesticide use practices?

Q2: What are farmers' perceptions of the risks and impacts of pesticides on health, biodiversity and soil?

Q3: What is the level of knowledge that farmers have regarding sustainable use of

pesticides, and what precautions do they take when handling and using pesticides?
Q4: Finally, what are the main barriers and what kind of support do farmers consider necessary to adopt sustainable pesticide use practices?

MATERIALS AND METHODS

In order to address the research questions, the qualitative research method was employed, with the focus group method being utilized. It allows in-depth exploration of participants' opinions, perceptions, and experiences, offering an effective way to understand farmers' behaviours and attitudes (Krueger & Casey, 2015) [27], while also encouraging communication and interaction (Kitzinger, 2000) [26]. The research aimed to gather relevant data and explore perceptions and understanding of the topic (Wilkinson, 1998) [43]. The research tool used was the facilitation grid. The group of participants selected for the discussions organized within the framework of the study consists of 68 students from the specialisations Agriculture (2nd and 4th year) and Agricultural Mechanisation (4th year), full-time and distance learning students at the University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca. Participants took part in the study on a voluntary basis, and the inclusion criteria were the presence of field crops (cereals, technical crops, forage crops) in the farm structure, regardless of the cultivated area, and the actual involvement of the participant in farm activities. The participants work on family farms, together with other family members. All farms are located in the region of Transylvania and in terms of typology they are either vegetable or mixed farms, but in all cases the vegetable component is present. In terms of size, most of the farms are between 76 and 150 hectares. In terms of age, the majority of students enrolled in full-time education are young, aged between 20 and 22, with one notable exception - a participant aged 74. In contrast, distance learners are on average over 40 years old. The groups are composed of both men and women, but it is noteworthy that two of the three distance learning groups are predominantly male. Practical experience in agriculture varies according to the type of education. Full-time students, because of their young age, have little experience of farming, generally coming from farms set up and run by their parents. In contrast, their distance learning peers have much more experience as they are active on their own farms. To conduct the research, 7 focus groups were organised, one for each study group. The discussions were moderated by a facilitator, took place in the library building of the University of Agricultural Sciences and Veterinary Medicine of Cluj Napoca, from November 2024 to January 2025, were audio recorded and each session lasted on average one hour. The recordings were then transcribed using the 'Dictate' function in Microsoft Word, with spot corrections to ensure the accuracy of the text. The qualitative data were analysed using Nvivo (Pro version 12.2.0.443) from QSR International. The transcripts from the focus group discussions were split into seven sets, each representing one group of participants. These sets were then uploaded to the platform. Once the responses were imported, they were organized and coded according to the themes in the facilitation grid. These themes included the current use of pesticides, knowledge of their sustainable use, perceptions of environmental risks and impacts, safety measures adopted, willingness to adopt sustainable practices, and resources needed to do so. As part of the analysis, we used visualization tools such as word clouds (generated by WordClouds from Zygomatic) and word trees (generated by SimpleMind Pro from ModelMaker Tools) to examine the frequency of words and interactions between them, and to identify correlations between terms relevant to the research. The analysis focused on both the most common words and those that, although less common, were considered significant in the context of the discussions.

RESULTS AND DISCUSSIONS

The initial segment of the discussion centred on the presentation of the practices employed by farmers on their own farms; consequently,

the responses to the first research question of the study were explored.

Some common themes can be distinguished among the motivations of young farmers, such as continuing the family tradition, a passion for agriculture, economic opportunities and capitalising on inherited land, and also the satisfaction of providing food for their families and communities. As one participant described:

- *I am motivated by the joy of providing food for others.*

The majority of participants providing details regarding the nature of their agricultural enterprise were from vegetable farms, followed by mixed farms. With regard to the geographical origins of the farms under investigation, the majority were located in the counties of Satu Mare (n=11), Alba, Bistrița-Năsăud, Mureș, Sălaj, Maramureș, Sibiu, Cluj and Covasna. In relation to the nature of the farm, the majority of participants possessed family-owned farms, with a significantly smaller number owning independent farms (n = 5). The majority of participants possessed farms ranging in size from 76 to 150 ha, followed by 0-25 ha and 26-75 ha. This suggests that the focus group participants predominantly own small and medium-sized farms, with only three participants having farms between 601 and 1,200 ha. Young farmers who have taken over the business as a family inheritance have larger landholdings, averaging 159 ha. At the same time, two thirds of those who inherited the farm are vegetable farms, while one third are mixed. The majority of farmers engage in conventional farming practices, with one organic farmer and two others who have farms in conversion. Although this study is qualitative in nature, the findings appear to be consistent with national-level data, which indicate that only 1% of farms are organic (Eurostat, 2020) [17]. The remaining farmers have only sporadic areas in conversion, primarily motivated by the payment schemes offered under the Common Agricultural Policy by the Agency for Payments and Intervention for Agriculture (APIA). This result reflects national trends and highlights the slow transition to organic farming. This transition is influenced more by external financial incentives than by the widespread adoption of sustainable principles. The predominant crops in the farms surveyed were maize (n = 54), followed by wheat (n = 44) and sunflower (n = 25). Other crops cultivated on the farms include alfalfa, barley, and two-row barley, as well as soybeans, rapeseed, triticale, oats, clover, and fodder crops, which are specifically cultivated for use as animal feed. Also in the case of inherited farms, there is a predominance of maize, potatoes, wheat and sunflowers, which may indicate either an inertia and an inability to diversify and adapt to changing market requirements, or a motivation to continue the family tradition. Figure 1 shows the most common words used by farmers when discussing farm typology.

Fig. 1. Most common words used by participants in the focus group sessions when discussing farm typology.
Source: Original/Own results.

With regard to pest control, the most frequently mentioned methods by the focus group participants were the use of chemical pesticides (regarded by respondents as the most effective and easiest to use), crop rotation, seed treatment, electric fencing and hunting. In terms of equipment and machinery used for pest control, participants mentioned herbicide equipment (n=25) and plant protection machines (n=14), drones (n=2), sprayers (n=2), spraying equipment (n=2) and self-propelled systems (n=1). Cooperation with other farmers for pest control is constrained by envy,

competition and lack of trust. A similar conclusion is reached by Stallman & Fames Jr. (2015) [36], who mention that economic and social factors such as envy and competition can be significant barriers to cooperation among farmers. While there may be sporadic dialogues initiated for the resolution of shared challenges, such as the emergence of a novel pest, the majority of farmers exercise caution in the dissemination of information regarding their treatment methodologies, driven by concerns regarding competition. In contrast, Stallman and Fames Jr. (2015) [36] suggest that factors such as perceived benefits, similarity of neighbouring farms, community involvement and shared concerns about the environmental impact of pesticides play an important role in farmers' decisions to cooperate in pest management. Cooperation with neighbours is rare and often problematic, influenced by antagonistic behaviour and lack of trust. Associations and cooperatives are perceived as being useful only in terms of obtaining European funds, but do not provide real support in dealing with day-to-day problems. Farmers' perceptions of the ineffectiveness of these organizations are commonly attributed to the perceived inadequacy of the members' agricultural knowledge, which hinders the development of cooperative relationships. These findings underscore the necessity for more accessible and trust-based cooperation initiatives between farmers that overcome economic and social barriers, thereby facilitating the exchange of knowledge and more sustainable practices in pest management. Similar conclusions are reached by Stallman and Fames Jr. (2015) [36], who demonstrate that farmers would prefer informal local initiatives, which are more accessible and trusted, to regional ones. In contrast, Wang et al. (2023) [42] underscore the pivotal role of farmer interactions, particularly within institutionalised frameworks, in the propagation of optimal environmental practices. Concurrently, Goeb and Lupi (2021) [19] demonstrate that the exchange of experiences and best practices among farmers plays a pivotal role in enhancing their knowledge of pesticide use. In addition, Lamichhane et al. (2016) [29] illustrate how collaboration contributes to the sustenance of sustainable and high-quality agricultural production.

The following interventions are proposed in response to the research question regarding farmers' level of knowledge on the sustainable use of pesticides. Regarding knowledge on sustainable use of pesticides, farmers agree that this includes applying pesticides in the right dose to minimise environmental impact. It is further emphasised by many that the correct dosage must be administered at the optimum time. They argue that excessive amounts should not be applied in ways that affect the soil and non-target wildlife and should only be used when absolutely necessary. Another significant element of the sustainable use of pesticides, according to farmers' responses, is the proper assessment of the need for treatment. They assert that there should be a definitive rationale for the utilization of pesticides, particularly in instances where a pesticide is employed to control a wide spectrum of pests. Furthermore, they emphasize the necessity to evaluate the risks posed by pests and to employ pesticides exclusively in circumstances where there is a demonstrable threat. These responses demonstrate the complexity of the farmers decisions, which are influenced by cost and technology. For more effective implementation, therefore, farmers would need more support from the authorities to give them access to accurate technologies and economically viable solutions. This understanding can serve as a foundational basis for the adoption of sustainable practices, as evidenced by the research conducted by Šūmane et al. (2017) [38]. Focus group participants have also expressed interest in alternative solutions that can reduce pesticide use. These include the genetic modification of plants to enhance their resistance to pests, a strategy that would diminish the necessity for chemical treatments. Additionally, there is a strong preference for advanced technologies that facilitate accurate pest identification, ensuring that treatments are used only when absolutely necessary, thereby conserving resources and reducing environmental impact. In this context, a legislative framework is required to facilitate the implementation of

advanced technologies for reducing pesticide use. The ideas expressed in the discussions are also reflected in the literature, which shows that effective pesticide management can support sustainability in agriculture (Lykogianni et al., 2021) [31]. Quotations from the above discussions are pertinent:

-It is also imperative to consider other agro-technical practices in order to avoid overuse of chemicals.

-The adoption of multifaceted treatment strategies, capable of combating multiple diseases, as opposed to a single one, is recommended. This approach is expected to lead to a substantial reduction in the residue.

Figure 2 shows the conclusions relating to plant treatments and issues.

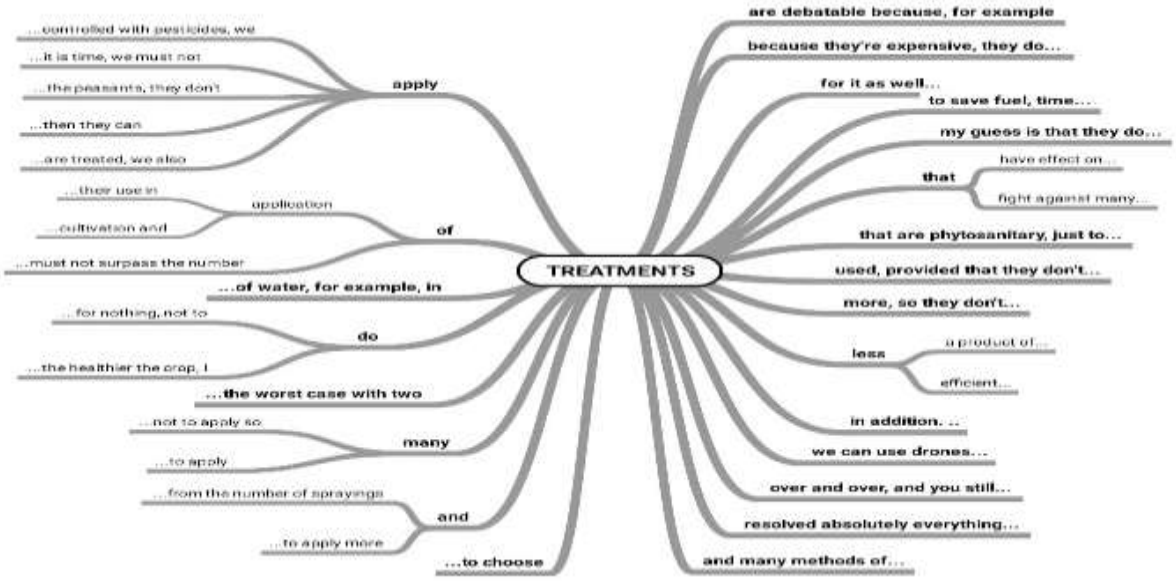

Fig. 2. Phrases most frequently associated by focus group participants with the word 'treatments'
Source: Original/Own results.

Concerning the financial implications of sustainable pesticide use, some farmers assume that accurate application and dosage can lead to cost reductions, even when using organic products. Moreover, recent technological advancements, including drones and advanced equipment, have the potential to reduce costs by ensuring precise pesticide application, thereby conserving water and other resources. Nevertheless, it is acknowledged that the initial costs associated with upgrading existing on-farm machinery to incorporate these advanced technologies can be substantial, potentially impacting short-term profitability. This perspective is further supported by Lykogianni et al. (2021) [31], who argue that adapting to new technologies and changing equipment is a prerequisite for sustainability. The concept of integrated pest management (IPM), which many farmers are moderately familiar with, was discussed, and implementation varies on farms. While many struggle with IPM for large-scale crops, crop rotation is widely adopted. Additional techniques, such as pheromonal traps and natural predators, are also employed, but chemical pesticides remain prevalent due to their effectiveness and cost-effectiveness. Despite its idealism, the integrated management concept's practical application may be constrained by additional costs and complexity, especially in contexts where limited resources are a concern. The findings of Kelemen et al. (2013) [25] further underscore the relevance of economic factors in the adoption of sustainable practices, demonstrating that economic considerations influence the decision to adopt sustainable practices. Some farmers advocate for alternative practices, such as organic fertilization and the utilization of natural predators like crows, as a more environmentally sustainable approach to pest

management. However, these farmers acknowledge that in circumstances where more sustainable methods are not available, chemicals are often the most expeditious and cost-effective solution.

In the subsequent phase of the study, the researchers explored farmers' perceptions of the risks and impacts of pesticide use in accordance with the proposed research questions. In relation to their training, farmers participated in compulsory courses administered by APIA, which focused on the appropriate utilization of pesticides, regarding regulations, the storage of substances, and waste management. Participants have expressed that the information was often theoretical and less useful in practice, perceiving the course as a formality. This observation is consistent with the findings of other studies, which have also highlighted the need for improvement in the quality and practical application of farmer training (Piwowar, 2021). Following these mandatory courses, farmers continue to seek additional information from various sources to supplement their knowledge. In this regard, most farmers turn to a wide range of sources to learn about pesticides and farming practices, including the internet, manufacturers' websites, distributors and sales agents, thus supplementing their education with practical information and constant updates. This approach is encouraging, as it suggests that ongoing information provision can contribute to safer pesticide usage (Bondori et al., 2021) [3]. It is a commonly held belief amongst farmers that the younger generation is more open to change and innovation, and more likely to experiment with new technologies and sustainable farming practices. Nevertheless, concerns regarding profitability and risk have been expressed. Figure 3 illustrates the most recurrent terms used by participants in discourse on risk perception and pesticides' impact.

The influence of necessity on the adoption of novel practices is evident, particularly in the context of the challenges posed by a changing farming environment, where traditional pesticides are observed to be less effective.

Fig. 3. Most frequent words used by participants under the heading 'Perception of risks and impacts'
Source: Original/Own results.

Notwithstanding this apparent openness to change, it has been observed by numerous participants that older generations tend to be more conservative, preferring established and safe solutions. However, they recognise that young people bring a more innovative vision and are more willing to share new ideas, especially when supported by experience gained on family farms or through academic education. The validity of this assertion is further reinforced by the findings of Kaiser and Burger (2022) [24].

In contrast, the findings of a study undertaken by Bondori et al. (2021) [3] appear to contradict this perspective, concluding that farmers with more experience are often more aware of the risks involved and may be more inclined to adopt safer practices and protective measures. It is important to note that, on the one hand, the extant academic literature supports the idea that young people bring an innovative vision, which can be beneficial in the context of changes in agriculture. On the other hand, other studies emphasize that more experienced farmers are often more aware of the risks involved and therefore may be more likely to adopt safer practices. We therefore believe that it is important for both groups to work together and learn from each other to achieve more sustainable and safer agriculture. This will require the creation of an enabling environment that encourages collaboration and knowledge exchange. In this context, it is essential to also address the ongoing debate

within the farming community regarding the impact of pesticides, a matter that remains a point of divergent opinion among farmers.

-I think pesticides are very safe, so it depends on each farmer how they work with them. We use gloves and masks when we mix them, so we don't have direct contact with them. The technology's pretty modern these days, we don't have those old tractors without cabs anymore, so when you go to spray, not all the solution comes on you, so you don't have any contact with pesticides on your skin.

-The problem is that in the soil, because of the use of pesticides, all kinds of bacteria have started to die or we're missing the ones that break down air or other plant debris, so now it takes a longer time for them to dissolve.

Whilst there is a predominant perspective that their appropriate utilization, in conjunction with suitable dosages and withdrawal periods, should not have significant negative effects, others argue that excessive use can lead to pollution of soil, groundwater and biodiversity. This highlights the need for awareness campaigns to emphasise the importance of using pesticides responsibly. These campaigns should educate farmers about the negative effects of overuse on soil, groundwater and biodiversity. In terms of health, some farmers argue that exposure to pesticides, especially through improper storage or misapplication, can lead to adverse effects, such as hospitalization of a group of people, demonstrate the risks. Concerning biodiversity, some farmers have reported a decline in insect and animal populations, particularly bees. Conversely, other farmers have considered these effects to be inconsequential, noting that changes are often more evident in specific crops. Figure 4 shows the words most commonly associated with 'affect'.

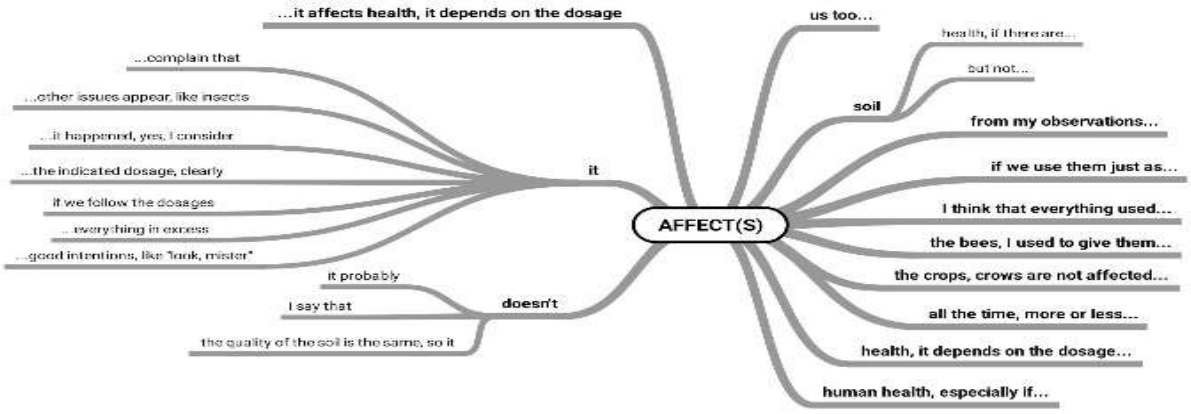

Fig. 4. Phrases most commonly associated by focus group participants with the word 'affect' in the 'Perception of risks and impacts' section
Source: Original/Own results.

A more stringent and effectively enforced legislative framework could play a crucial role in addressing the challenges related to pesticide safety and packaging management. In relation to the implementation of protection and safety measures, the most commonly utilised terms are illustrated in Figure 5.

Farmers participating in the focus group sessions claim that they apply protective measures when using pesticides, using a variety of equipment such as masks, gloves and coveralls. However, they recognise that there are situations when they do not always use these measures for reasons of comfort or because of adverse weather conditions (strong wind, rain).

Some farmers also mention that protective equipment is put aside and only used when necessary, mainly to comply with the requirements of an inspection. With regard to the management of packaging and pesticide residues, the majority of farmers return them to collection centres, with some also using recycling schemes or returning them to distributors.

Fig. 5. Most frequent words used under the heading 'Protection and safety measures'
Source: Original/Own results.

However, challenges are encountered in this process, including the absence of collection points in certain regions. Furthermore, farmers have been observed to choose to incinerate or dispose of packaging, even though this is against the regulations.

Figure 6 shows the most common phrases associated with 'collection' in the focus groups. The final research question formulated in this study is answered by the openness to adopt new practices, the main obstacles encountered or identified on the path to agricultural sustainability, and the recommendations on how the authorities can support farmers.

Willingness to adopt sustainable practices was another topic highlighted in the discussions, and Figure 7 shows the most frequently used words in this respect.

Opinions are divided on biopesticides. Some find them more expensive and less effective than conventional pesticides, while others are willing to use them in the future, especially for healthy production.

Nevertheless, it is widely acknowledged that biopesticides are particularly well-suited to organic farming and small areas, and their effectiveness depends on the quality of the product and trust in suppliers.

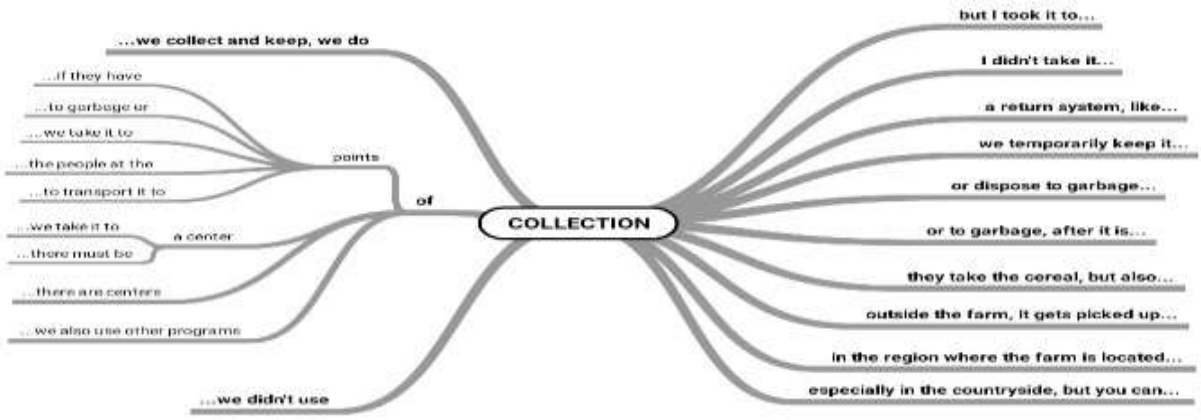

Fig. 6. Phrases most frequently associated by focus group participants with the word 'collection' under the heading 'Protection and safety measures'
Source: Original/Own results.

The primary barriers to wider adoption of biopesticides include high costs, low efficacy and a lack of clear information about products currently on the market. This finding is corroborated by other studies, which demonstrate that the majority of farmers do not intend to reduce the use of pesticide, as they fear significant economic losses (Damalas, 2021) [7]. Financial subsidies are the main driving factor that can motivate farmers to adopt sustainable practices, as they feel it would help mitigate the financial risks and promote a transition towards organic farming methods. However, many recognize that current subsidies are not sufficient to cover the additional costs and associated losses. Furthermore, farmers encounter challenges related to the equipment necessary for sustainable practices and the inability to compete with external markets, particularly in relation to more affordable products from other countries.

Fig. 7. Most frequent words under the heading 'Willingness to adopt sustainable practices'
Source: Original/Own results.

Participants also suggested that legislative amendments and knowledge could encourage sustainable farming. One intervention stressed farmer challenges and a preventative approach to sustainability, not restrictions:

-The most important thing is that public institutions work with the farmer, not against them. I mean, I go to training courses in certain fields and I only see bored people, who haven't got the latest info, and who only do it to be good, to give us a diploma. I'd like the phytosanitary office not only to send me warning notices every now and then, but to have a call centre where I can call them when I have a situation, to ask what the law says and what they recommend. So that when the controls come, it's not just fines.

With regard to the support and resources required, the term 'grants' was a recurring theme, as illustrated in Figure 8. Figure 9 demonstrates the most frequently used words in the 'recommendations' heading.

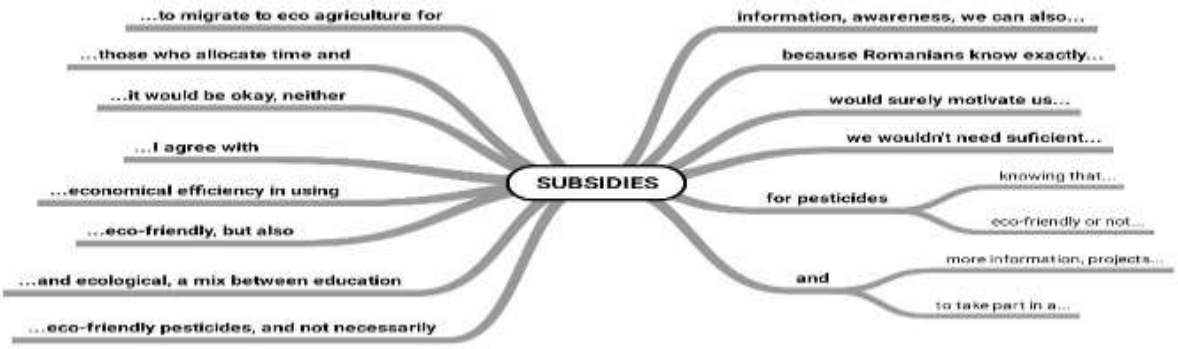

Fig. 8. Phrases most frequently associated by focus group participants with the word 'grants' under the heading 'Support and resources needed'
Source: Original/Own results

Farmers have asserted that in order to engage in sustainable farming practices, it is necessary for substantial financial support, in particular subsidies, to be allocated. This is said to be essential as farmers face significant costs and risks as a result of their commitment to sustainable farming practices.In order to implement these practices, further training is required to acquire the knowledge and skills necessary. In addition, better access to relevant and up-to-date information is required. The validity of these claims is further substantiated by the findings of the study by Kelemen et al. (2013) [24]. It is evident that a significant proportion of farmers do not receive consistent support from the relevant authorities or institutions, and that available subsidies are inadequate in terms of covering production costs and ensuring profitability. With regard to information on pesticide usage, farmers have access to relevant materials, yet these are often regarded as inadequate in terms of comprehensiveness. Many participants find this particularly problematic due to the language barrier.

They point out that most of the materials are in English, and that some Romanian-language information materials would be needed to make them accessible. The majority of farmers expressed the opinion that specialised courses or regular seminars organised by the competent authorities would be beneficial.

Fig. 9. The most frequent words used under the heading 'Conclusions and recommendations'
Source: Original/Own results.

Such seminars should include up-to-date information on new pesticides, correct application techniques and safety rules. It has been observed that a significant proportion of farmers have indicated that, while they are able to source information through distributors, this information is often incomplete or lacking in transparency regarding the potential adverse effects of pesticides. Consequently, Yang et al. (2014) [44] propose stricter pesticide registration and labelling rules, including explicit toxicity levels for humans, as a means of reducing the risks for the environment and for the human health. When it comes to improving their practices, farmers are generally in favour of stricter regulations, especially on the proper doses and equipment. They also recognize the importance of better training that helps mitigate the negative impacts of pesticides. In order to facilitate the adoption of sustainable practices, authorities and organisations should consider the provision of enhanced information to farmers through the implementation of educational campaigns and the allocation of increased financial resources. Farmers also call for simplified administrative procedures and accessible IT platforms where they can find all relevant information and receive guidance. The study of Kelemen et al. (2013) [25] has reached similar conclusions, showing that public policy have a great impact on the promotion of sustainable agricultural practices. Therefore it is important that public authorities be more involved in promoting a constructive dialogue between farmers and public institutions in order to find practicals and realistic solutions.

CONCLUSIONS

Most of the farmers who participated in the focus groups own small and medium-sized farms and practice conventional farming. Pest control is primarily carried out with chemical pesticides, although there is a growing interest in alternative solutions, such as advanced technologies and genetic modification of plants. Collaboration among farmers for pest control is often limited by jealousy and a lack of trust. While associations are seen as useful for obtaining funding, they do not provide real support for managing daily issues. Although farmers are aware of the importance of sustainable use of pesticides, emphasizing the need for correct dosing and proper treatment evaluation, pesticide use remains dominant due to its effectiveness and lower costs. To adopt more sustainable practices, farmers consider ongoing education and financial subsidies essential, requesting up-to-date information and specialized courses. Young farmers, with their academic background and hands-on experience from family farms, are more receptive to change and innovation, making them an important force in adopting new technologies and sustainable practices, but change depends on financial support, access to information, and simplification of administrative procedures.

Future research on this topic should adopt a quantitative approach to more thoroughly examine the factors that influence the adoption of sustainable pesticide use practices, with a particular focus on determining the most effective measures for encouraging behavioral change among farmers. This could include exploring the role of financial incentives, education, and technological innovations in promoting sustainable practices, as well as identifying the barriers to their implementation and the factors that drive farmers' decision-making processes.

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