D1.1 Farm to Fork practitioners' needs and requirements

SEVT

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List of Abbreviations& Definitions

Abbreviation	Definition
AOPs	Agro-ecological and Organic Practices
DSTs	Digital and Space-based Technologies
EU	European Union
EC	European Commission
IPM	Integrated Pest Management
INM	Integrated Nutrient Management
AI	Artificial Intelligence
FAO/WHO	Food and Agriculture Organization of the United Nations
LCA	Life Cycle Analysis
GMO	Genetically Modified Organizations
DSS	Decision Support System
GDRP	General data protection regulation
F2F	Farm to Fork
IAB	Industry Advisory Board
EIP-AGRI	Agricultural European Innovation Partnership
Q	Question
IoT	Internet of Things

Executive Summary

Exploring the practitioners' of agrifood chain perceptions, needs, drivers and barriers concerning Agro-ecological and Organic Practices (AOPs) and Digital and Space based Technologies(DSTs),is essential for identifying the special characteristics of each group and country,providing valuable information for the current level of awareness, knowledge and exploitation of these practices and technologies. Lack of awareness and low level of AOPs and DSTsadoption can greatly affect the achievement of the European Union (EU) Farm to Fork Strategy targets.

The aim of this report is to **gain a wide insight into the main perceptions, needs, drivers and barriers of the Agrifood chain practitioners, concerning the AOPs and DSTs and to translate it into specific recommendations which will contribute to the design of systemic innovation and to support the future activities of the project**. This report presents the outcomes of the on-line survey that took place in the context of Task 1.1.

Building on the data collected, descriptive and inferential analysis were applied to explore relations, patterns, and potential groupings, producing meaningful intelligence that can feed the subsequent tasks of the project. **The key findings of the survey analysis, including the understanding of agri-food practitioners' perceptions and needs, reveal the main drivers and barriers as well as their support needs upon which PestNu can better target and plan the project's foreseen actions**. The report is structured as follows:

Section 1 provides a short introduction of the scope of the project and the main targets of the survey.

Section 2 presents an up-to-date literature review regarding the AOPs and the DSTs.

Section 3 includes all information related to the on-line survey design and implementation.

Section 4 is the most extensive section of the report and ithas been designed to present in a clear way the main outcomes of the survey analysis. We first present descriptive findings closely related to practitioners groups and the participating countries followed by the perceptions and estimations of the participants for the levels of awareness, understanding and penetration of the Farm to Fork Strategy and its targets, the reduction of pesticides and fertilizer use and the loss of nutrients, the familiarity, use and future exploitation of the AOPs & DSTs, the incentives which are more appropriate for their adaptation, and for the most suitable training and networking activities.

Section 5 presents a summary of the key findings analysis, conclusions, and recommendations.

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1. Introduction

The coronavirus crisis has shown how vulnerable we all are, and how important it is to restore the balance between human activity and nature. The current food and farming systems require a fundamental transformation considering the increasingly worrying environmental, health and socio-economic challenges that have emerged regarding the overuse of hazardous pesticides and fertilisers, and loss of nutrients. Industrial agriculture is largely responsible for the depletion of natural resources based on the increased population and increased demand for food production. In terms of environmental impacts, more than 11% of the EU landscape is affected by moderate to high soil erosion [1]. Agriculture can impact in different ways the adequate chemical and good quantitative status of groundwater and surface waters. Water quality may be negatively affected by the presence of pesticide residues, nutrients from fertilisers, or sediments from soil erosion. On average 44% of total water abstraction in Europe is used for agriculture. The rise in intensive agriculture, and associated land-use change, is also a major driver of biodiversity loss. Recent data on EU Biodiversity indicates that 60% of species and 77% of habitats assessed are in an unfavourable condition of conservation, that intensive farming is an important factor leading to biodiversity loss while the decline of pollinators is reducing yields. Additionally, pesticide residues on vegetable and fruits pose human health to chronic diseases and deaths from over exposure [2 &3].

In the last decade, the European Commission (EC) has funded several projects for Integrated Pest Management (IPM), Integrated Nutrient Management (INM) and Precision Farming tools. Despite the major steps, progress has not been satisfactory either because many national action plans failed to be established within the five-year legal deadline, many haven't harmonized at the EU level, standards for the innovative technologies and methods have not yet been designed by international organisations or regulations were not adopted by EU farmers. Also, many precision farming tools/technologies and organic products have not yet been demonstrated and tested in real case scenarios from primary production to consumption and multi-actor synergies with all Farm to Fork stakeholders were insufficient. Finally, overall technical solutions to support farmers in their decision-making and investment needs are still required especially to small and medium-sized farms, for a business-driven innovation and market uptake.

PestNu targets the field -testing and demonstration of DSTs and AOPs under a systemic approach to reduce the pesticides and fertilisers use, and loss of nutrients.

The novel DST which are under examination, are:

- AI robotic traps for real time pest monitoring;
- Autonomous mobile robots for pesticide monitoring and 3D spot spraying;
- Earth Observation missions with robust Agroradar AI algorithms to map soil/plant nutrients and pest plant inputs using Copernicus data/services; and
- in-situ and real-time nutrient analysers.

All the DST will be interconnected to a user-centric cloud-based farm management system, which features a robust Decision Support System (DSS) integrated with a blockchain based system for DST data evidence, integrity, and AI models verification and with a cybersecurity platform to prevent cyber-attacks and Internet of Things (IoT) vulnerabilities.

The examined AOPs are:

- On-site production of biofertilisers from agricultural waste-waters through a robust automated drainage recycling system via an innovative enzymatic hydrolysis procedure;
- Novel foliar biopesticide formulated by circular bioeconomy operations, targeting fungal diseases with biostimulant effect; and
- Advanced nutritional programs for organic farming.

The showcase systemic DST & AOP solutions will be demonstrated and tested in aquaponic and hydroponic greenhouse and open field vegetable cultivation in Greece and Spain. A pesticide reduction program will evaluate the maximum residue and the acceptable daily intake levels to ensure vegetable's food safety and Life Cycle Analysis (LCA) activities will be performed.

The first step of the project is to draw an overall view of the users' needs and requirements to identify country and practitioners' groups specific needs and to benchmark on EU level through surveys involving relevant stakeholders.

The consortium will also explore relations, patterns, and potential groupings, producing meaningful intelligence that can feed the project activities applying system thinking to the specificities of creative approaches to regional, national and harmonization with EU level.

The purpose of Task 1.1 is to collect information from the farm to fork practitioners for their perceptions, needs, drivers and barriers concerning AOP and DSTs and to produce a comprehensive report for the sector which will translate the user requirements for real case situations into system ones (functional and non-functional), covering the whole systemic innovations design and efficient support (easy to use, cost affordable, safety) for users along the Farm to Fork chain.

The outputs of this Task will be directly used in WP2, WP3, WP4, WP5 and WP6.

2. Theoretical Background

2.1. Agro-ecological and Organic Practices (AOPs)

According to Wezel A., 2017, agroecological practices can be characterized as agricultural practices aiming to produce significant amounts of food while valorising ecological processes and ecosystem services by integrating them as fundamental elements in the development of the said practices, as opposed to simply relying on external inputs such as chemical fertiliser and synthetic pesticide applications, or on technological solutions such genetically modified organisms. This assumes that biological processes can replace chemical or physical inputs while limiting external costs, particularly environmental costs. Based on processes that decrease external inputs and negative environmental consequences, such as nutrient cycling, biological nitrogen fixation, natural regulation of pest and diseases, soil and water conservation, biodiversity conservation and carbon sequestration, agroecological practices contribute to improving sustainability of agro-systems. Agroecological practices include cover crops, green manures, intercropping, agroforestry, biological control, resources and biodiversity conservation practises [4].

FAO/WHO Codex Alimentarius Commission, (1999) defines "Organic farming as holistic food production management system, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, considering that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system" [5].

Organic farming is characterised by the prohibition of most synthetic chemicals in both cropand livestock production [6]. However, it incorporates a range of other management practices, many of which are uncommonly/exceptionally utilised in conventional systems. Some of these practices are intrinsic (e.g. avoidance of soluble inorganic fertilisers and synthetic pesticides), whilst others are only encouraged by the standards (e.g. field margin management to promote natural predator populations) [7].

In the organic farming practices the use of chemical synthetical pesticides and fertilizers is prohibited. The practices advocate healthy products free from components that may harm humans and nature and include but are not limited to industrial pesticides, fertilizers, clones, GMOs, chemical medications, hormones, growth-boosters, etc.

The AOP technologies and methods, show low level of adoption from the farmers. Soil and nutrient problems, based on deficiency, can often be identified by means of various soil, site and crop-related indicators. For problems related to the overuse of nutrients, the on-farm indicators are less clear from visual assessment [8]. More sophisticated experiments by farmers are avoided due to high costs and the difficulty in changing away from long-established farming methods. Moreover, farmers are sceptical of adopting organic practices (e.g.biofertilizers, biopesticides) or continue their organic production activity only where financial support is provided [9]. This attitude arises from the low reported yields and production volumes and many farmers see organic farming as risky. This impacts consumers as the organic food products in market are expensive. The farmers believe that market aspects and institutional and regulatory factors are the key barriers to the development of organic farming. Crucial to be mentioned is, that many of the bio-products that appear in the market e.g. biopesticides formulated by agro/food wastes which are not under the organic rules, thus the product cannot be used in organic farming [10].

Therefore, treatment protocols and protocols for field-scale assessments of biofertilizers and biostimulants (used inbiopesticides) should be established and followed by manufacturing industries. Many barriers and challenges appear to circularity of protected cultivation under circular economy systems (aquaponics, greenhouses) [11]. Soilless cultivation systems and especially closed or re-circulating hydroponic systems can significantly reduce fertilizer run-off but not eliminate it, and the spent nutrient solution must be ultimately collected and treated at the end of the crop cycle. If the water used contains solutes that are not absorbed by the plants, then continuous reuse of the drainage solution in closed hydroponic systems will result in salt accumulation. Therefore, many greenhouse growers operate open fertigation systems, i.e. are not recycling nutrient solutions. This practice of discharging used nutrient solutions as wastewater entails severe environmental problems and is a waste of water and fertilizers. Moreover, advanced climate and fertigation control systems and DSS are important tools to control the inputs and outputs of closed/semi-closed greenhouse system and significantly affect the degree of circularity obtained. In addition, the advanced use of data to enhance the optimal use of inputs and the growing environment increases the potential to grow more organically. All these result in high investment costs making labour intensive to maintain a certain level of circularity. Until currently, optimal solutions for circularity have not been developed for all regions around Europe.

2.2. Digital and space-based technologies

Digital and space-based technologies are tools, systems, and methods for precision and smart agriculture e.g. geographical information systems, remote sensors for water and nutrient stress and insect detection, proximate sensors for soil (N concentration and pH) and crop conditions, robots both ground and aerial for monitoring yields, Decision Support Systems for integrated pest and nutrient management, etc.

Digital and space technologies in precision farming in Integrated Pest Management (IPM) and Integrated Nutrient Management (INM) have not yet been demonstrated, due to deficits in user-oriented research at basic, applied and particularly cost/benefit analysis level, and due to a lack of technology transfer programmes and support resources that are necessary for business-driven innovation and market uptake. Most EU projects that are funded via public resources are performed by research centres and universities. Most of them are robust but are far from the real situation of the primary production to consumption since close collaboration with all Farm to Fork stakeholders was insufficient. Also, they are currently under development in research laboratories and companies isolated not only from other research groups but also from standards designed by international organisations [12]. Additionally, the benefit of current precision farming systems for IPM and INM to the citizen of farms is not always clear as investments are required, and the actual reduction of inputs may not always be readily known. Some cost-benefit tools do exist, but they are designed for specific scenarios, climatic conditions, and cropping systems. Also, the information needed to calculate the economic benefits may be lacking. Other gains, such as social, and some environmental benefits, are difficult to quantify and most likely to be underestimated. Also, the existing practices should specifically be designed for small and medium-sized farms need to be affordable and easy to use and contribute to high crop production and yield since an initial investment is required and due to their limited revenues cannot be adapted. So new business models are needed to avoid this lack of adoption.

Another problem is that the current DSS are based mainly on collected data and translating these data into useful information for daily farm management are still insufficient. There is a serious disconnection between farmers' needs and the DSS that are on offer are facing lack of user-friendly visualization interfaces and follow-up of informed decisions for auto-making decision processes and data evidence and integrity [13 & 14]. Also, they are not sufficiently scalable and adaptive to efficiently manage, complex and dynamic data environments. Finally, digitization in farming ecosystems and the rapid evolution and usage of smart communication technologies and tools, bring new threats and risks which generate an enormous exposure to cyber security threats and vulnerabilities [15].

3. Survey Description

3.1. Overview

The survey was created by SEVT in collaboration with the project's consortium. The main mean for the execution of the survey was the on-line questionnaire. The aim of the survey was to capture and understand the insights of the farm to fork practitioners for the:

- Farm to Fork Strategy and the feasibility of its targets,
- reduction of pesticides and fertilizer use and the loss of nutrients,
- familiarity, use and future exploitation of the AOPs & DSTs as well as the incentives which are more appropriate for their adaptation, and
- most suitable training and networking activities.

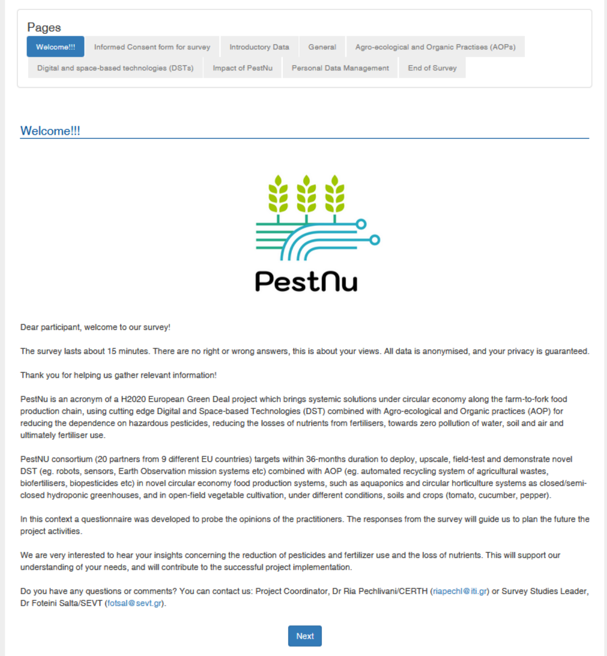

Figure 1: The introductory landing page for participants of the survey

The survey, as indicated in Figure 1, was developed, and designed in English, using the online EUsurvey tool, and it was translated into 7 different languages, as follows:

- English
- German
- Greek
- Italian
- Portuguese
- Spanish
- Swedish

Atthe beginning of the project, a first draft of the questionnaire was circulated among the partners for discussion. Following the first draft, the questionnaire was refined, and it comprises of 9 main sectors. The 9 sectorsinclude64questions and is estimated to take no more than 15 minutes to be completed. The survey gives an overall introduction to the participants, contact details for the project, the personal management data policy and it is asked to consent for their participation. Additionally, the survey also allows for participants to give their email in case they want to receive further project information.

3.2. Questionnaire structure

As it is referred above, the questionnaire comprises of 9 main sectors which are described below:

1. Welcoming note
2. Informed Consent form for survey
3. Introductory Data
4. General
5. Agro-ecological and Organic Practises (AOPs)

6. Digital and space-based technologies (DSTs)
7. Impact of PestNu, Incentives, Training/Networking & Standards
8. Personal Data Management
9. End of Survey

All information was collected in compliance with the general data protection regulation (GDPR) of the European Union and was used solely for research and statistical reasons. No natural person can be identified from the provided data. Furthermore, if someone wanted to participate had to agree to the terms and conditions set out to a dedicated consent form that was included at the beginning of the online survey questionnaire. Finally, the management policy of datasets is described in detail in a specific sector of the online survey.

The questionnaire is presented in Annex I.

3.2.1. Welcoming note

In this section, the participants receive the main elements for the scope of the project, the aims of the survey and the contact details of the Project Coordinator and Survey Studies Leader.

3.2.2. Informed Consent form for survey

In the second section, it is provided the Informed Consent form for the survey where it is described in detail what kind of information is needed. This section includes 2 questions where the participants are asked to agree or not whether their participation is voluntary and if their responses can be used by the PestNu Consortium for the work in the project and also can be used for scientific research papers. If a participant chooses "No" as an answer in one or both questions, the survey ends.

3.2.3. Introductory Data

In the "Introductory Data" section, 2 mandatory questions are included. The first one is referred to the type of practitioner where 4 options are given:

- Farmers
- Farmers' agents (e.g. farmers' associations/co-operations, agrifood wholesalers, supermarkets, grocery stores, etc.)
- Agricultural suppliers and services (e.g. stores that sell pesticides, fertilisers, plants etc)
- Agronomists or related professions

The second one is referred to the country where 10 options are provided:

- Austria
- Cyprus
- Greece
- Ireland
- Italy
- Portugal
- Spain
- Sweden
- United Kingdom
- Other

If someone selects "Other" a new field opens and it is asked to indicate the country.

3.2.4. General

In this section, 8 questions are included aiming to provide insights into the importance of the reduction on the dependence on hazardous pesticides use, loss of nutrients from fertilizers and reduction the environmental footprint alongside the level of awareness of the targets of the Farm to Fork EU strategy for sustainable safe, nutritious, and healthy food production and the feasibility the target set by Farm2Fork. In the 6 out of 8 questions, the Likert Scale is used while the remaining two are open questions in which the participants have to refer to the reasons they consider the reduction of chemical pesticides, hazardous pesticides and fertilizers according to the targets of the F2F Strategy is not feasible.

3.2.5. Agro-ecological and Organic Practises (AOPs)

The section opens with an introductory note providing the definitions for the Agro-ecological practices and Organic farming practices as well as a brief description of the AOPs which will be further developed in the PestNu project. It includes 19 questions, 10 of them use the Likert Scale, 4 are open type, 1 is multiple choices, 2 uses the dichotomous scale (yes, no) and 1 is raking.

The main aim of this section is to get a deep insight into the awareness, the familiarity, and the use of the AOPs. More specific, the included questions target to estimate the level of awareness for the Agro-ecological and organic practices, how well they have been tested in real case scenarios, how common are in each participating country, if they have used some of them, if they are encouraged from their local suppliers to use biofertilizers or biopesticides and to rank the main characteristics/features they are looking for in biofertilizers or biopesticides.

3.2.6. Digital and space-based technologies

In this section an introductory note provides the definition for the Digital and Space-based Technologies as well as a brief description of the DSTs that will be further developed in the PestNu project. It includes 12 questions, 9 of them use the Likert Scale, 1 is open type, and 2 use the dichotomous scale (yes, no).

The main aim of this section is to get a deep insight into the awareness, the familiarity and the use of the DSTs. More specific, the included questions target to estimate the level of awareness for the Digital and Space-based Technologies, how well they have been tested in real case scenarios, how common are in each participating country, if they have used some of them, the motives for further use and the usefulness of the PestNu DSTs.

3.2.7. Impact of PestNu, Policies, Training/Networking & Standards

This section comprises of 4 sub-sectors:

- Impact of PestNu
- Incentives for the DST and AOP implementation
- Training
- Networking
- Standards

The main aims are to estimate the impact of the project to the Farm to Fork practitioners and the market demand for such technologies, to define the main factors that contribute to the low adoption of existing DSTs and AOPs and the incentives which could encourage EU farmers to adopt such innovations to investigate the appropriate form of training and their willingness to participate in training activities and to assess the level of existing networking and of standards.

The section is constituted by totally 20 questions, 3 of them use the Likert Scale, 7 are open type, 5 use the dichotomous scale (yes, no) and 5 are multiple choices.

3.3. Survey dissemination

A wide dissemination campaign was launched in January 2022 and the survey was shared among all 20 partner organisations, across 9 participating countries (Greece, Italy, Spain, Portugal, Austria, Sweden, Ireland, Cyprus & United Kingdom). The core means for dissemination were via direct email contacts, social media platforms (Facebook and Linked) and personal contacts through phone calls or meetings. Contacts from the Industry Advisory Board (IAB) and from other European projects and partnerships, such as EIP-AGRI were also used for the dissemination of the survey..

The main target groups were:

- Farmers
- Farmers' agents (e.g. farmers' associations/co-operations, agrifood wholesalers, supermarkets, grocery stores, etc.)
- Agricultural suppliers and services (e.g. stores that sell pesticides, fertilisers, plants etc)
- Agronomists or related professions

3.4. Sample

In the survey were analysed 382 responses in total, coming from 12 countries (the participating countries in the project plus, Latvia, Nigeria & Brazil). Data collection took place from January to February 2022 through several dissemination practices.

4. EU-level Survey Analysis

4.1. Descriptive Analysis

4.1.1. Demographics and main variables

This section presents the main findings of the descriptive characteristics of the sample and the responses that were collected from all involved countries and practitioners. Starting from the sample's distribution among the practitioners, the total number of responses per practitioner type (Q3) are presented in Table1. As we can see, the majority of the participants are Agronomists or related professions, followed by Farmers and fewer from Agricultural Suppliers and services and Farmer's agents. It was expected that the Agronomists would contribute significantly more than the other categories since they are more familiar with the core interest of the survey and they are in immediate contact with the farmers. In Table 1, an analytical breakdown of the amount of responses collected per practitioner type is presented. Figure 2 shows the graphic representation of the responses and each percentage.

Table 1: Sample distribution per practitioner type

Practitioner type	Responses	Percentage
Farmers	114	31%
Farmers' agents (e.g. farmers' associations/co-operations, agrifood wholesalers, supermarkets, grocery stores, etc.)	30	8%
Agricultural suppliers and services (e.g. stores that sell pesticides, fertilisers, plants etc.)	32	9%
Agronomists or related professions	194	52%
Total	370	100%

Source: Authors' calculations

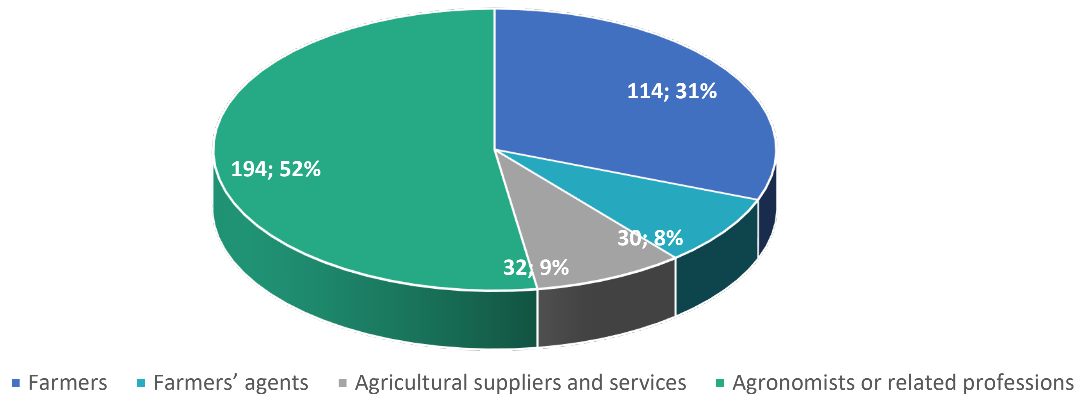

Figure 2: Sample distribution per practitioner type

The next question (Q4) concerned the spatial distribution of the sample. The breakdown of the responses per country is presented in Table 2. the distribution of the sample per country and per practitioners' type is displayed in Table 3. As we can see, most of the responses are coming from Greece, Portugal and Spain, followed by Austria, Cyprus, Sweden, Italy and the United Kingdom. The differences in the participation may are due to the different number of project partners in each country (Greece is represented by 5 partners in the consortium and Sweden by 1)as well as the different type of organizations (Universities, Research Centres, Business Support Organizations, etc.) which affects the size of questionnaires distribution.In the Table 2, below, an analytical breakdown of the numbers of responses collected per country is presented. Figure 3 shows the map of the participating countries.

Table 2: Sample distribution per country

Country	Responses	Percentage
Austria	31	8%
Cyprus	31	8%
Greece	102	27%
Ireland	1	0.3%
Italy	17	4%
Spain	65	17%
Sweden	18	5%
Portugal	98	26%
United Kingdom	16	4%
Other	3	1%
Total	382	100%

Figure 3: Distribution of the collected responses at European level

In all participating countries, most of the replies are coming from Agronomists followed by Farmers, as we can see in Table 3 and as it is displayed in Figure 4.

Table 3: Sample distribution per country and per practitioner type

Country	Farmers		Farmers' agents		Agricultural suppliers and services		Agronomists	
	Number	%	Number	%	Number	%	Number	%
Austria	10	8.8	3	10.0	5	16.1	13	6.7
Cyprus	12	10.6	1	3.3	1	3.2	15	7.8
Greece	30	26.5	7	23.3	5	16.1	53	27.5
Ireland	0	0.0	0	0.0	0	0.0	1	0.5
Italy	12	10.6	1	3.3	2	6.5	2	1.0
Spain	14	12.4	5	16.7	10	32.3	33	17.1
Sweden	8	7.1	1	3.3	1	3.2	8	4.1
Portugal	14	12.4	11	36.7	6	19.4	67	34.7
United Kingdom	13	11.5	1	3.3	1	3.2	1	0.5

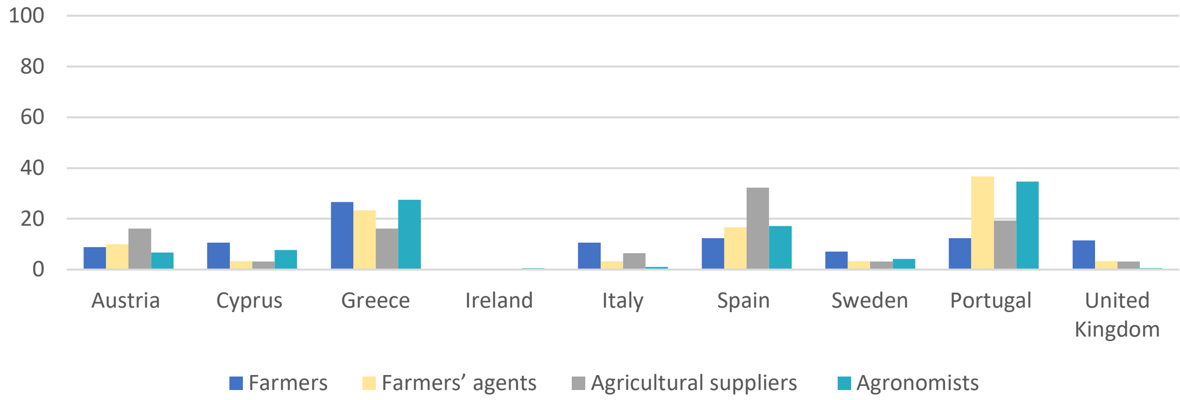

Figure 4: Sample distribution per country and per practitioner type

4.1.2. Pesticides use, loss of nutrients and Farm to Fork EU strategy

Regarding the importance of the reduction:

- on the dependence on hazardous pesticides use (Q5),
- of the loss of nutrients from fertilizers (Q6), and
- of the environmental footprint (Q7)

the results indicate that most participants consider them as 'Very important' or 'Extremely important'. Figure 5 shows the percentage distribution of importance, in the above 3 questions.

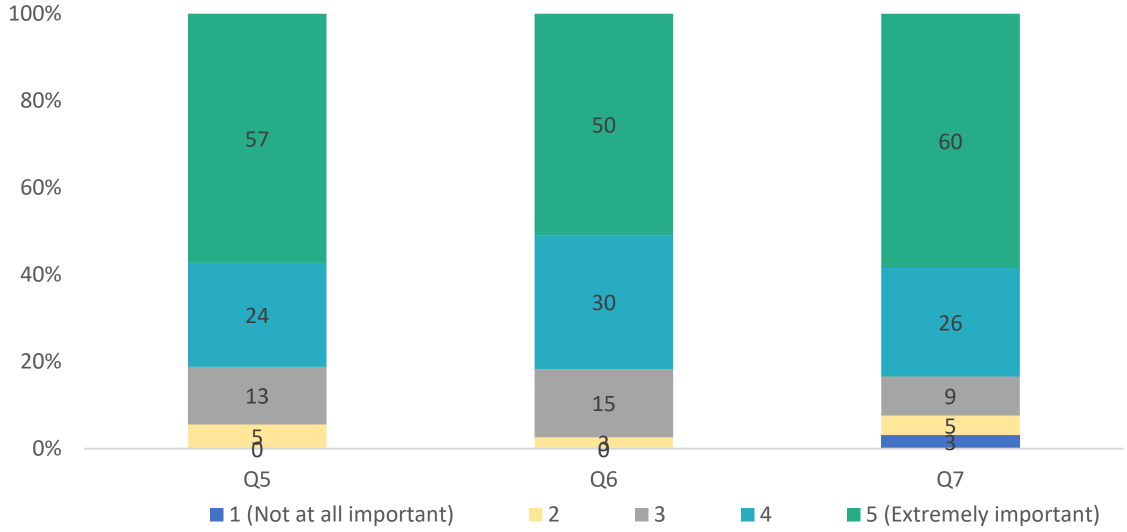

Figure 5: The estimation of the participants for the importance of the reduction on the dependence on hazardous pesticides use, of the loss of nutrients from fertilizers and of the environmental footprint

Focusing on the responses per practitioner group (Figure 6) and taking into consideration the mean importance, the highest score of importance is observed among the Agronomists and the lowest among Farmers. In Table 4, the mean importance for all practitioners is presented in detail.

Table 4: Mean importance for the reduction on the dependence on hazardous pesticides use, the reduction of the loss of nutrients from fertilizers and the reduction of the environmental footprint by practitioner type

Practitioner type	Mean Q5	Mean Q6	Mean Q7
Farmers	4.17	4.18	4.02
Farmers' agents	4.30	4.17	4.30
Agricultural suppliers and services	4.34	4.19	4.19
Agronomists or related professions	4.34	4.35	4.50

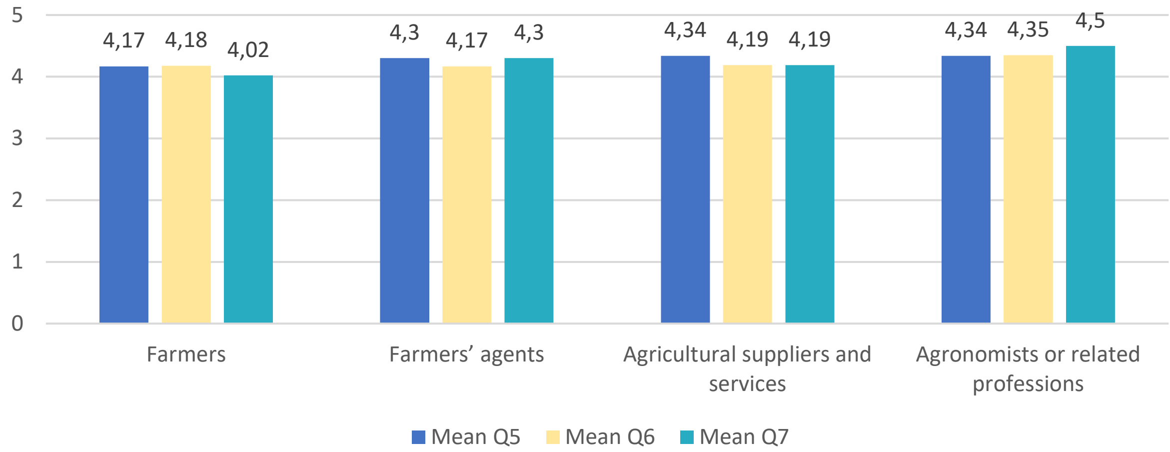

Figure 6: The mean importance of the reduction on the dependence on hazardous pesticides use, the reduction of the loss of nutrients from fertilizers and the reduction of the environmental footprint per practitioner type.

If we see the mean distribution of importance per country, we get similar results for all participating countries as is indicated in Figure 7 and in Table 5.

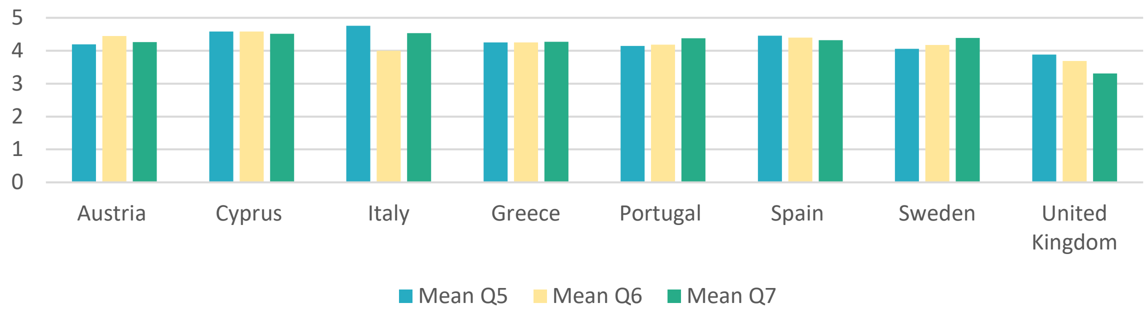

Figure 7: The mean importance of the reduction on the dependence on hazardous pesticides use, the reduction of the loss of nutrients from fertilizers & the reduction of the environmental footprint per country

The results indicate that all practitioner types in all participating countries consider that the reduction in the dependence on hazardous pesticides use, the reduction of the loss of nutrients from fertilizers and the reduction of the environmental footprint are issues of high importance for them.

Table 5: The mean importance of the reduction on the dependence on hazardous pesticides use, the reduction of the loss of nutrients from fertilizers and the reduction of the environmental footprint per country.

Country	Mean Q5	Mean Q6	Mean Q7
Austria	4.19	4.45	4.26
Cyprus	4.58	4.58	4.52
Italy	4.76	4.00	4.53
Greece	4.25	4.25	4.27
Spain	4.15	4.18	4.38
Sweden	4.46	4.40	4.32
Portugal	4.06	4.17	4.39
United Kingdom	3.88	3.69	3.31

The next question (Q8) concerned the level of awareness of the targets of the Farm to Fork EU strategy for sustainable safe, nutritious, and healthy food production which is a hot issue for the agri-food sector. In Figure 8, the results are presented for the whole sample. 30% of the participants declares that it is ‘Very’ or ‘Extremely aware’, 22% ‘Moderate aware’ and 48% responded that it is ‘Not at all aware’ or ‘Slightly aware’. The mean of the sample is 3.25 which indicates a moderate level of awareness of the F2F European Strategy.

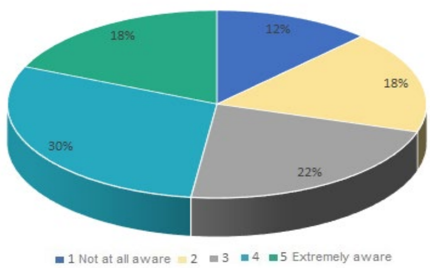

Figure 8: Awareness for the targets of the EU F2F strategy

Table 6: Mean awareness for the targets of the EU F2Fstrategy per practitioner group

Practitioner	Mean Q8	Mean Q9	Mean Q11
Farmers	2.61	2.55	2.75
Farmers' agents	3.47	3.00	3.10
Agricultural suppliers and services	3.66	2.68	3.09
Agronomists or related professions	3.48	3.16	3.29

In Table 6, the mean awareness per practitioner group is presented. If we examine the level of awareness in each participating practitioners' group (Figure 9) in more detail using the mean for each group, it is revealed that the lowest score of awareness for the EUF2F Strategy is among the participating Farmers while the other 3 groups of practitioners have similar scores and close to 3.5, indicatinga moderate level of awareness. Among participating countries, the lowest awareness is presented in UK and the highest in Spain (Figure 10).

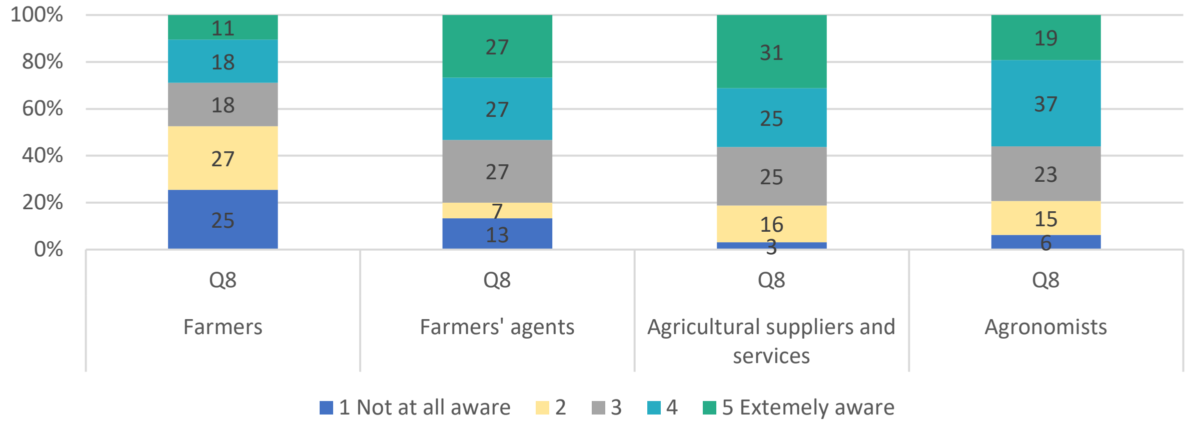

Figure 9: Level of awareness for the targets of the F2F EU strategy per practitioner group

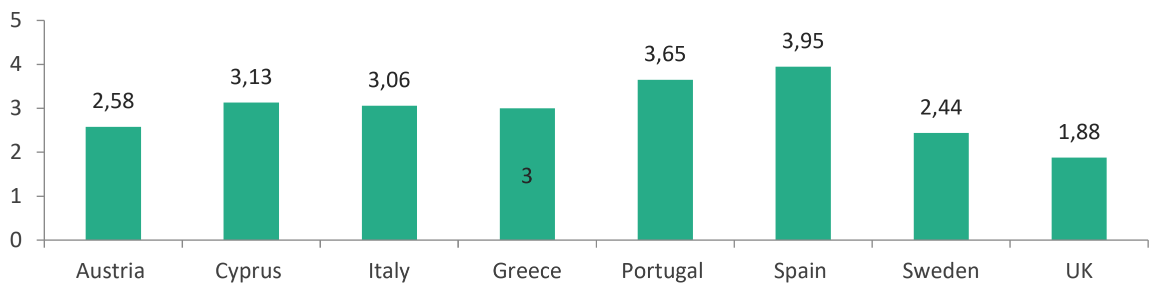

Figure 10: Level of awareness for the targets of the F2F EU strategy per country

Moving one step further, we have asked the participants how feasible they consider the 2 main targets of the European F2F Strategy:

- The reduction of the overall use and risk of chemical pesticides by 50% and the use of more hazardous pesticides by 50% by 2030 (Q9).
- The reduction of the nutrient losses by 50%, which will reduce the use of fertilizers by at least 20% by 2030 (Q11).

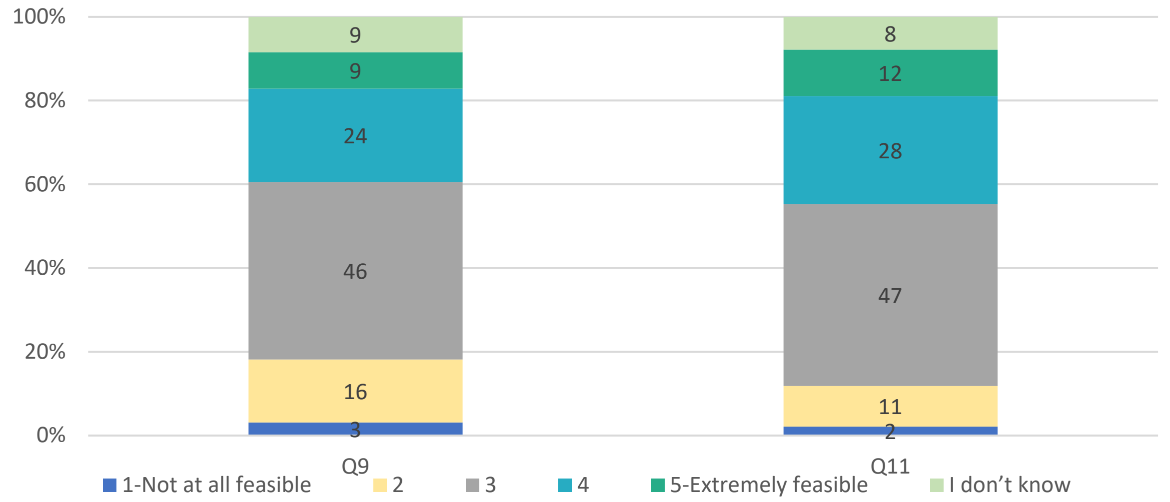

Figure 11: Feasibility of F2F targets for all participants

The participants consider that the achievement of set targets as not very feasible, especially among the practitioners' groups of Farmers and Agricultural Suppliers and services. In Figure 11, the concentrated estimation of feasibility of F2F targets for all participants is presented, while in Figure 12 the estimation of the feasibility of F2F targets per practitioner groups is displayed. A big percentage of farmers have answered 'I don't know' about the feasibility of F2F targets which can be combined with the low level of awareness, indicating a gap in farmers information.

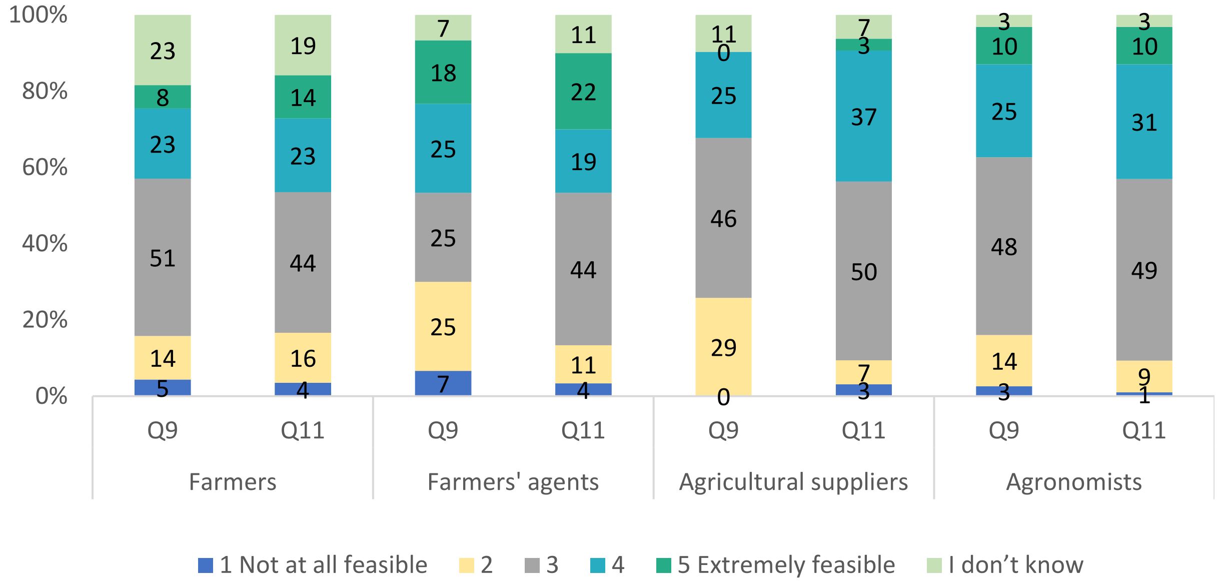

Figure 12: Feasibility of F2F targets per practitioners' groups

In Figures 13& 14 the mean feasibilities of F2F targets per practitioner group and per country are presented. In all cases of the practitioners groups,no major differences are observed among the two targets. Concerning the countries, Spain gives slightly higher mean feasibility scores while UK the lowests. In the Figure 15, the mean feasibility of F2F targets per practitioner group and per country is presented.

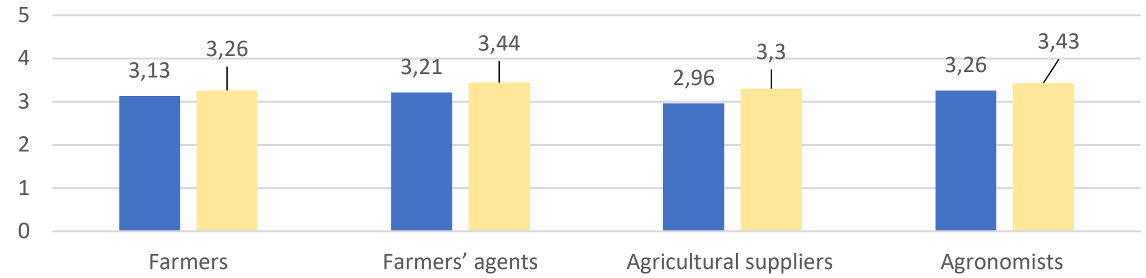

Figure 13: Mean feasibility of F2F targets per practitioner type

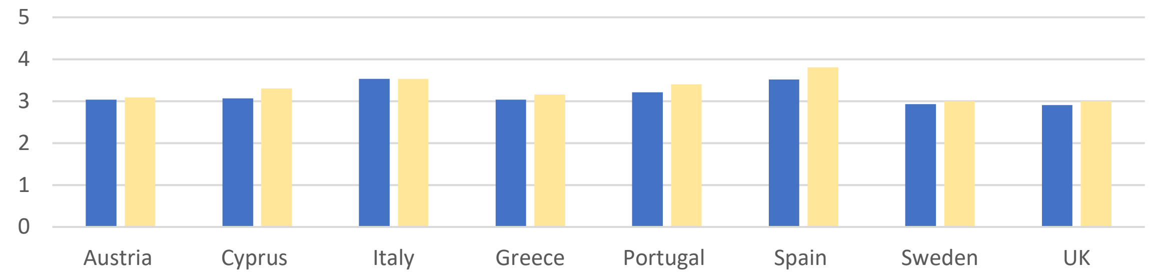

Figure 14: Mean feasibility of F2F targets per country

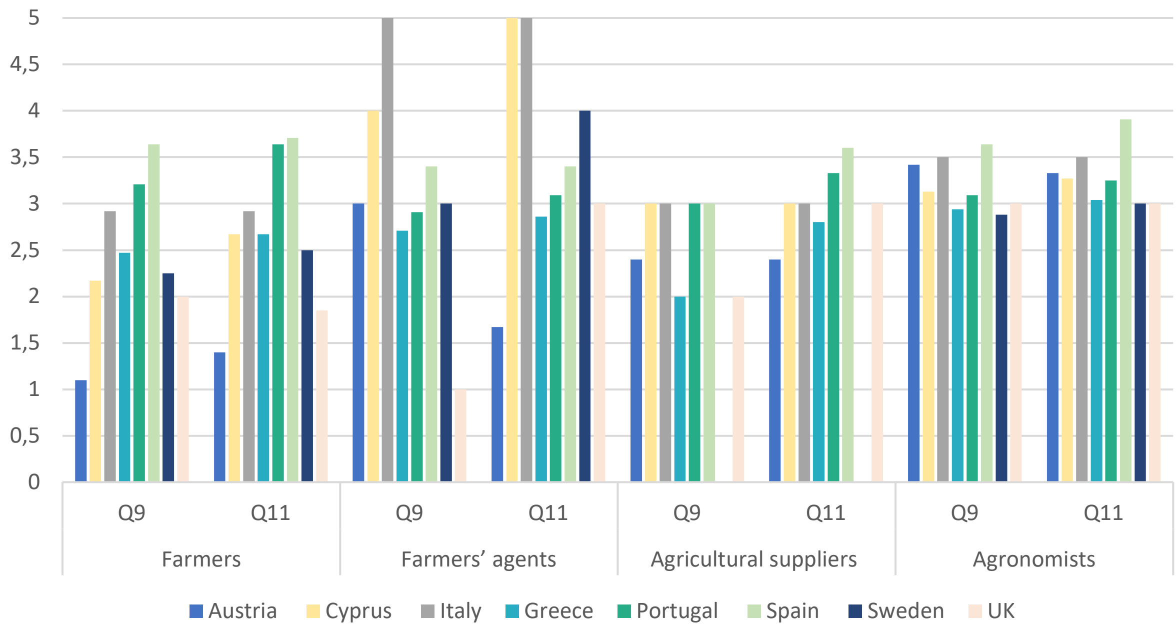

Figure 15: Feasibility of F2F targets per practitioner group and per country

The section closes with 2 more questions (Q10 & Q12) which have been addressed to the participants who had considered the achievement of F2F targets as 'Not at all Feasible' or 'Slightly Feasible'. These participants were asked to mention the reason for their estimation. According to the received responses, the participants have given the following reasons:

- The conventional means are considered more efficient.
- There is a lack of awareness among farmers and it is very hard to accept changes since they believe that the pesticides and fertilizers are absolutely necessary for their production.There is need for training.
- There is a lack of appropriate infrastructures to be used byfarmers to reduce their dependence onfertilizers and pesticides.
- The replacement of the fertilizers and pesticides is expected to cause a reduction of the Europeanagri-food production which will have the following consequences:
  - To jeopardize the food security, especially under the view of continuous increase of global population and the food safety.
  - To increase products price.
  - To increase the dependence on imports.
  - To increase the costs for the farmers and to reduce the agrifood sector profitability.
  - To increase the competitiveness of the agrifood sector of non-EUcountries since they will not operate in such strict environment.
  - To affect the European competitiveness in total.
- There is unavailability of cost-efficient alternatives and a lack of alternative products at a reasonable price.
- The approval processes for new products are expensive and time-consuming.
- The application of alternative products (pesticides, fertilizers) may need extended use since they have lower effectiveness which finally may lead to higher environmental impact.
- The emergence of new pests, enemies and diseases which are not common in the European area may be difficult to be dealt with alternative products.
- Very limited timeframe to achieve the targets.
- There isn’t anadequate impact assessment of the planned transition.

4.1.3. Agro-ecological & Organic Practices (AOPs)

The fifth part of the questionnaire was referring to the Agro-ecological & Organic Practices and the first question concerned the awareness ofAOP in general (Q13). From the received responses, in the total sample of participants it comes up that most of the participants (58%) declare that are “Very” or “Extremely aware”of these practices in general, 27% “Moderate aware” and only 15% “Slightly” or “Not at all aware” as it is displayed in Figure 16.The score for the mean awareness is 3.59 indicating a good level of awareness of the various AOPs.

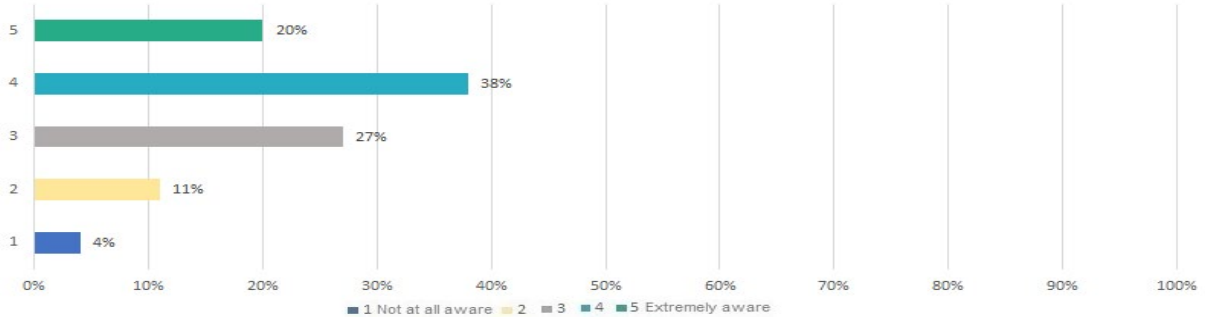

Figure 16: Awareness for the AOPs

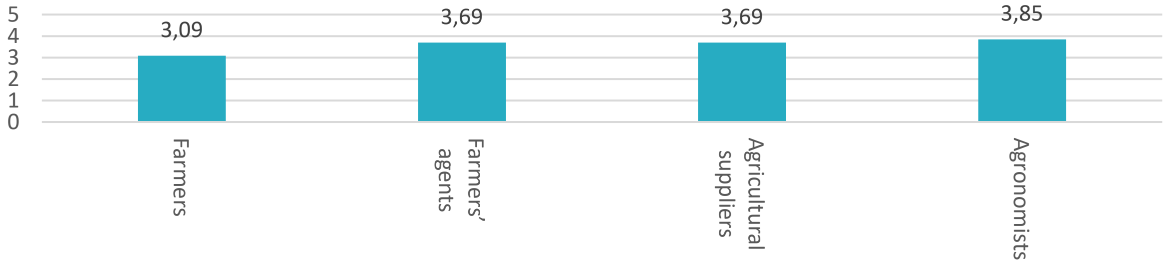

Figure 18: Mean awareness for the AOPs per practitioner group

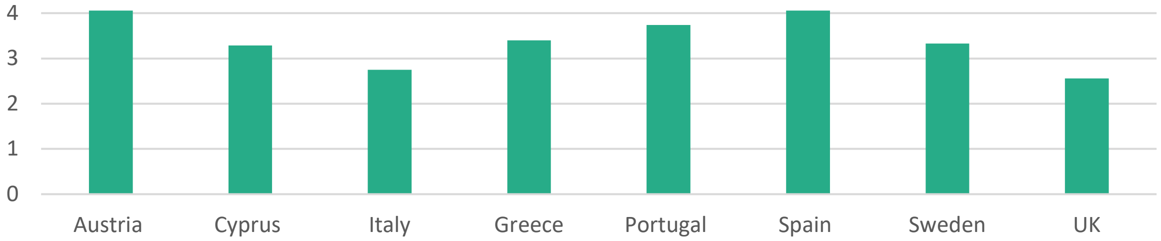

Figure 17: Mean awareness for the AOPs per country

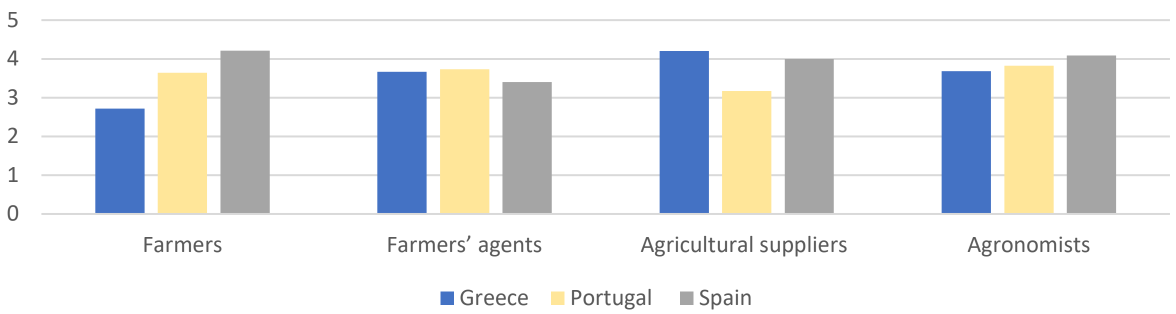

Figure 19: Mean awareness for the AOPs per practitioner group in Greece, Portugal and Spain

If we examine the awareness per Practitioner Group, we see that Farmers' group has slightly lower score in mean awareness (3.09) while the Agronomists' group, as it was expected, presents the highest score. If we see the distribution among countries, the highest scores are found in Austria, which presents the highest percentage of Organic Farming in Europe according to Eurostat Data of 2020, followed by Spain, Portugal and Greece and the lowest in UK (Figures 17& 18) [17].

In Figure 19, the mean awareness for the AOPs in Greece, Portugal and Spain and per practitioner group is presented. In the group of Farmers, the lowest scores of the mean awareness are presented in Greece and the highest in Spain. For the Farmers' agents the lowest score is coming from Spain and the highest from Greece while for the Agricultural Suppliers and Services the highest score is coming from Greece and the lowest from Portugal. Finally, for the group of Agronomists and the related professions, the highest score is coming from Spain and the lowest from Greece.

The next step was to ask the responders who had declared that they are "Very Aware" or "Extremely Aware" if all these practices have been tested enough thoroughly in real case scenarios (Q14). As it is presented in the Figure 20, the 18% of participants declares that these practices are 'Very' or 'Extremely Demonstrated', the 41% declares that these practices are 'Demonstrated', the 18% 'Slightly' or 'Not at all Demonstrated' and the 3% declares 'I don't know'. The mean level of Demonstration is 3.27, indicating a moderate estimation for the level of the AOPs demonstration in real case scenarios.

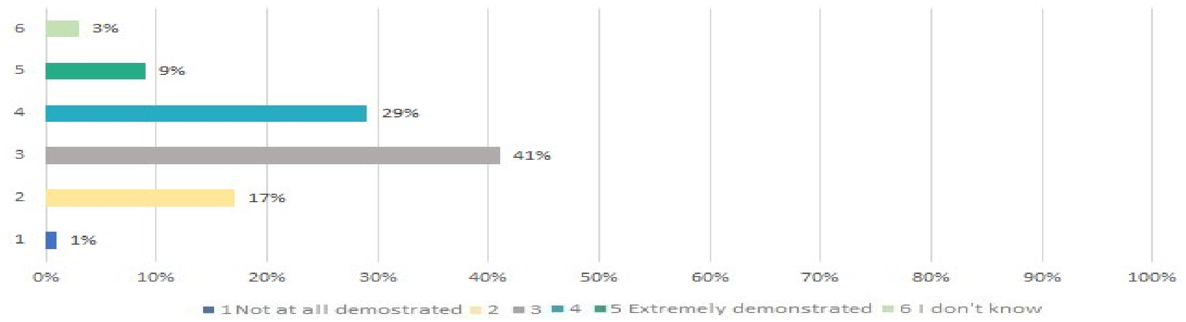

Figure 20: Demonstration of AOPs in real case scenarios

The practitioners' group have similar mean estimations for the demonstration of the AOPs in real cases scenarios as indicated in Figure 21. Examining the situation per country, the highest mean scores are achieved in UK and the lowest in Sweden as indicated in the Figure 22.

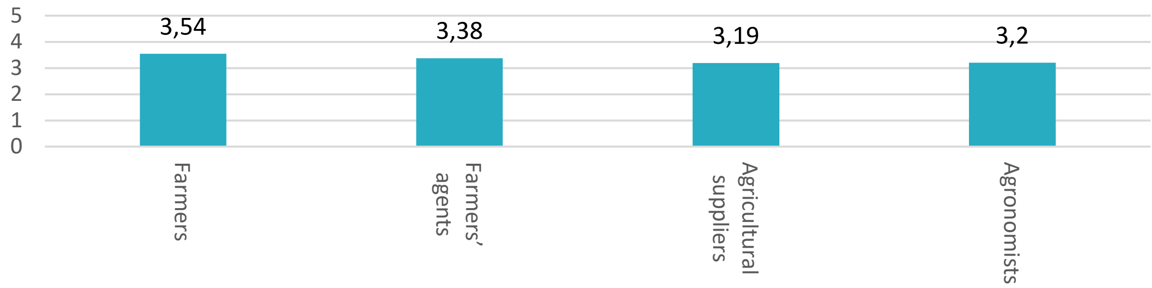

Figure 21: Mean Demonstration of AOPs in real case scenarios per practitioner group

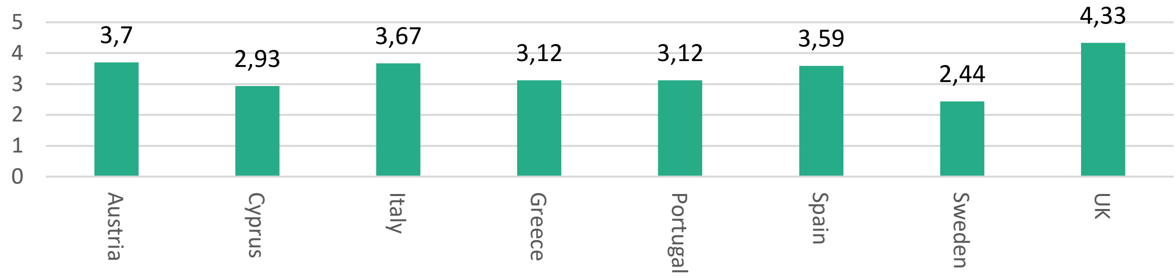

Figure 22: Mean Demonstration of AOPs in real case scenarios per country

In the next question (Q15), the participants were asked to indicate the most appropriate sources for receiving information for AOPs.In Figure 23, the preferred sources are indicated with the most of responders choosing the ‘Websites of relevant public organizations, such as Ministries of Agriculture and Agrofood, National Agricultural organizations for the protection and insurance of agricultural activity, etc.’, followed by ‘Agriculture Universities & Research Centres’.

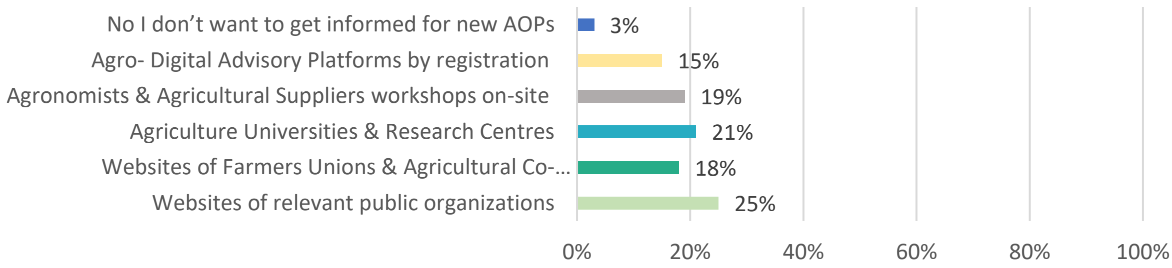

Figure 23: Preferred sources received information for the AOPs

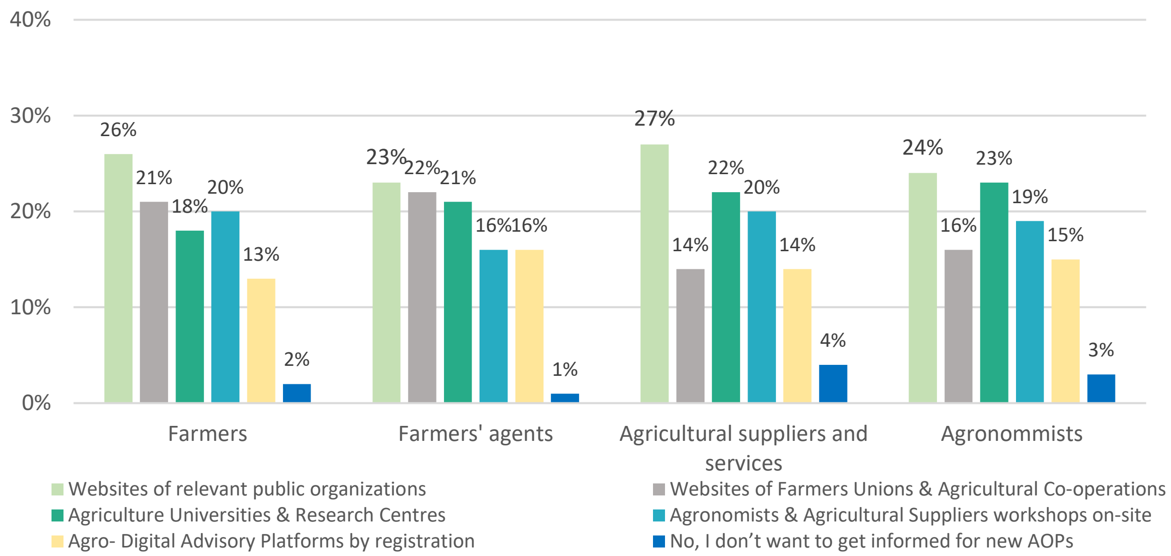

Figure 24: Preferred sources received information for the AOPs per practitioner group

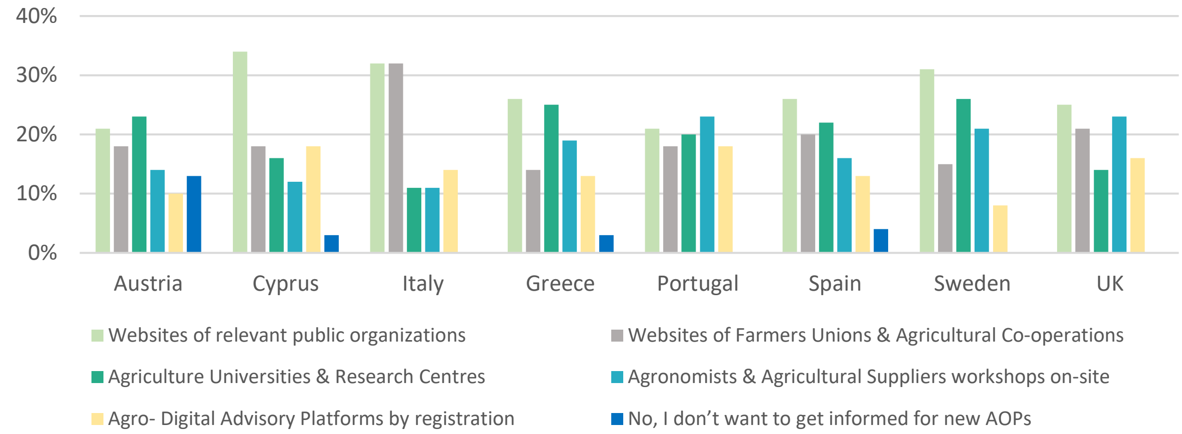

Figure 25: Preferred sources received information for the AOPs per country

If we examine the distribution per practitioner group (Figure 24), the 'Websites of relevant public organizations' remains the first choice, while the second choice varies according to the type of the practitioners. Only a small percentage of participants (3%) responded that they are not interested to get informed for the AOPs. At countries level the 'Websites of relevant public organizations' remains the first choice in all cases (Figure 25).

Examining how common the AOPs in the participating countries (Q16) are, the perceptions of the participants are presented in Figure 26. The 14% of the participants declared that the AOPs are 'Very' or 'Extremely common' in their country, the 47% 'Moderate common' and the 39% 'Slightly' or 'Not at all common'. The mean score is 2.73 which indicate that the participants believe that AOPs are moderate common in their countries.

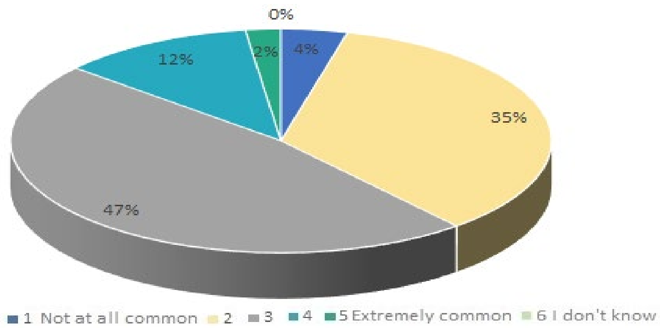

Figure 26: How common are the AOPs

The distribution per practitioners' group is presented in Figure 27, where it is obvious that all groups have similar estimation for the penetration of the AOPs in their countries, which is moderately common. Concerning the countries distribution, the highest scores of means are achieved in Spain, Austria & Sweden and the lowest in Cyprus & the UK (Figure 28). Examining the distribution of the practitioners' group in Greece, Portugal and Spain, it is concluded that all groups have provided similar estimation on how common AOPs are (Figure 29).

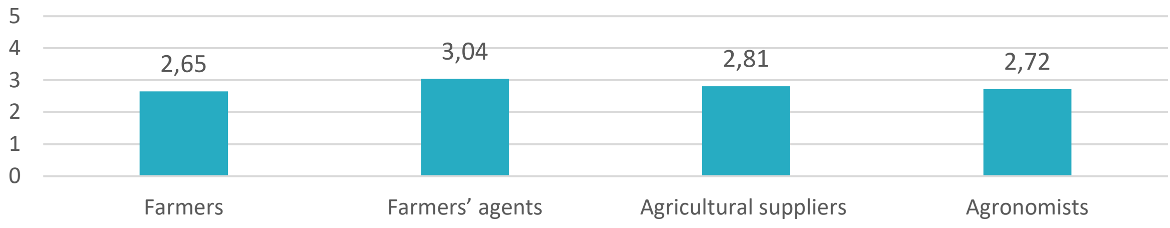

Figure 28: How common are the AOPs per practitioners' group

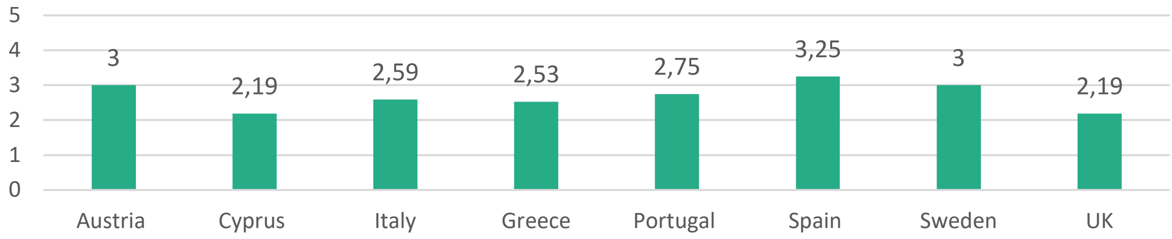

Figure 27: How common are the AOPs per country

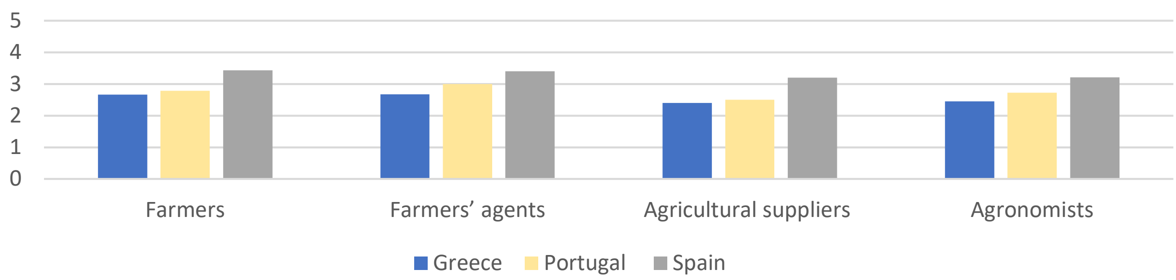

Figure 29: How common are the AOPs per practitioners' group in Greece, Spain and Portugal

Moving a step further, the participants were asked to declare how likely it would be for them to adopt AOP on their facilities (Q17). 48% has responded ‘Likely’ & ‘Very likely’, 25% ‘Moderate likely’ and 11% ‘Very Unlikely’ and ‘Unlikely’, as indicated in Figure 30. The mean of likeliness is 3.7. The results show a willingness from the practitioners to adopt AOPs.

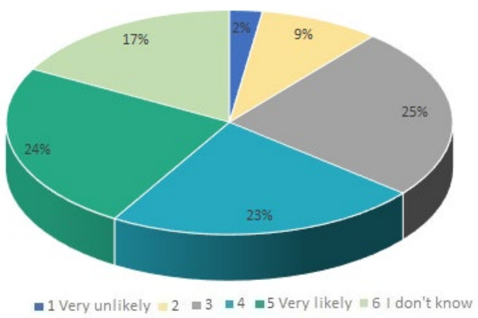

Figure 30: Likeliness to adopt AOP in their facilities

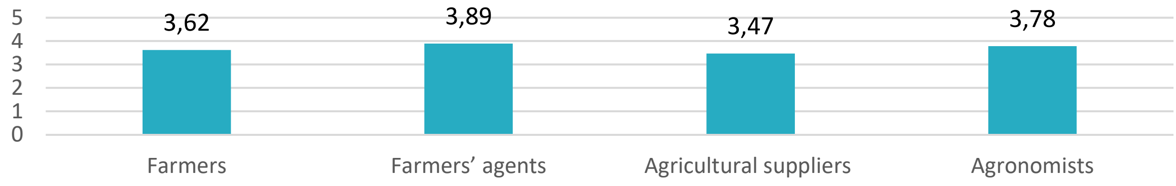

Figure 31: Likeliness to adopt AOP in their facilities per practitioners' group

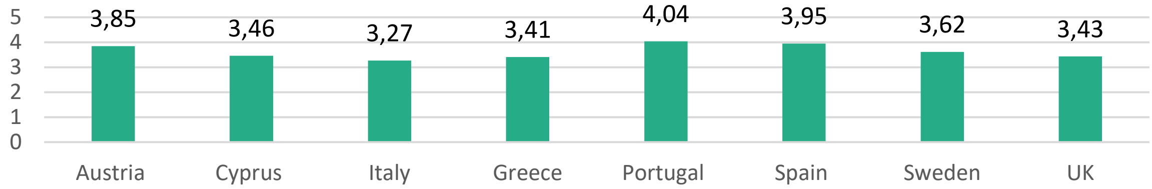

Figure 32: Likeliness to adopt AOP in their facilities per country

The distribution per practitioners' group is presented in Figure 31, where it is obvious that all the groups declare that it is quite likely to adopt AOPs. Concerning the countries distribution, the highest scores of means are achieved in Portugal and the lowest in Italy (Figure 32).

In the next question (Q18), the participants were asked to reply if it would be more likely to adopt agro-ecological practices and if they were applied to a higher extent by others in their regions. Most of the participants have answered yes (64%) and only 16% said no (Figure 33).

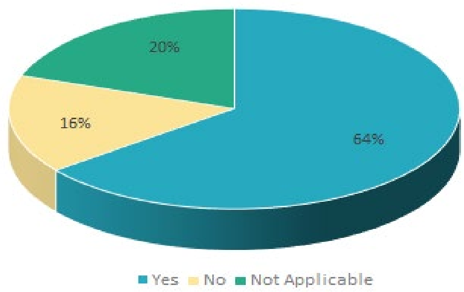

Figure 33: Likeliness to adopt AOPs if they were applied to a higher extent by others in their region

Then the participants were asked (Q19 & Q21) if they believe that there are appropriate solutions for the reduction of nutrient loss and the substitution of hazardous pesticides and fertilizers. The mean estimation for appropriate solutions for the nutrient loss was 3.62 while for the reduction of hazardous pesticides and fertilizers was 3.11 indicating that the participants believe that there are slightly more appropriate solutions for the reduction of nutrient loss (Figure 34).

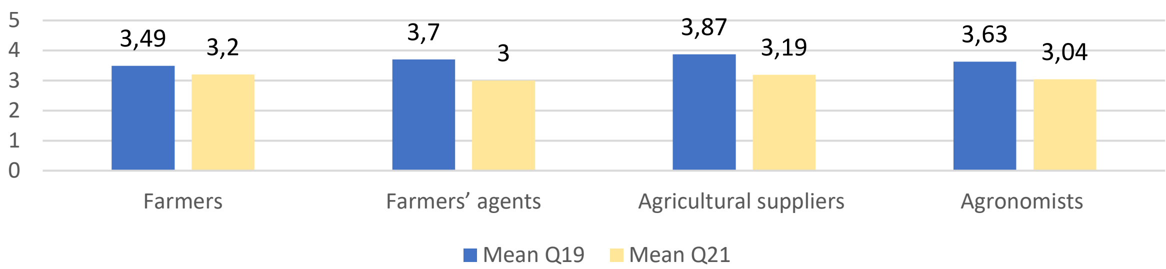

Figure 34: Mean estimation for the existence of appropriate solutions for the reduction of nutrient loss and the substitution of hazardous pesticides and fertilizers per practitioner group

If the mean response of the participants per practitioner group will be examined, in all cases, it is estimated that for the reduction of the nutrient loss there are more solutions (Figure 35). Taking into consideration the mean number of responses per country, we obtain the same results with the exception of Cyprus and Italy (Figure 36).

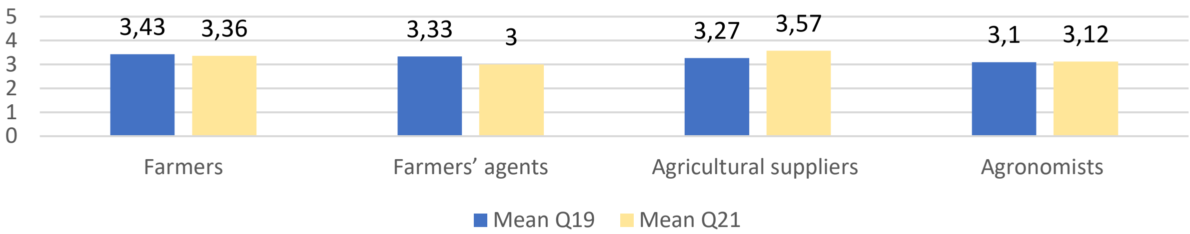

Figure 35: Mean estimation for the existence of appropriate solutions for the reduction of nutrient loss and the substitution of hazardous pesticides and fertilizers per country

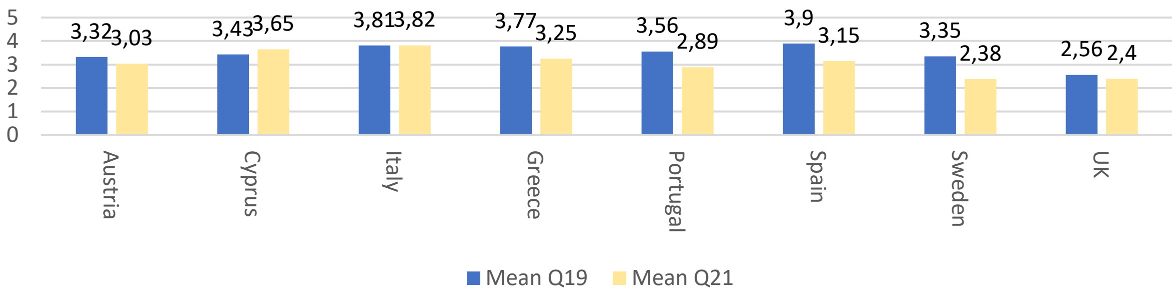

Figure 36: Mean estimation for the existence of appropriate solutions for the reduction of nutrient loss and the substitution of hazardous pesticides and fertilizers per country

Then the participants who had responded that there are 'Many Solutions' or 'Multiple Solutions' were asked to declare their estimation on how much all these solutions have been tested in real case scenarios(Q20 &Q22). The mean response for the reduction of nutrient loss was 3.17 and for the substitution of hazardous pesticides and fertilizers 3.22 indicating a moderate estimation for the demonstration of the existing solutions in real conditions. If we examine the mean responses per practitioner group and per country, we obtain Figures 37 & 38. The responses are similar in all cases. The UK has been excluded from the analysis per country due to a limited number of responses.

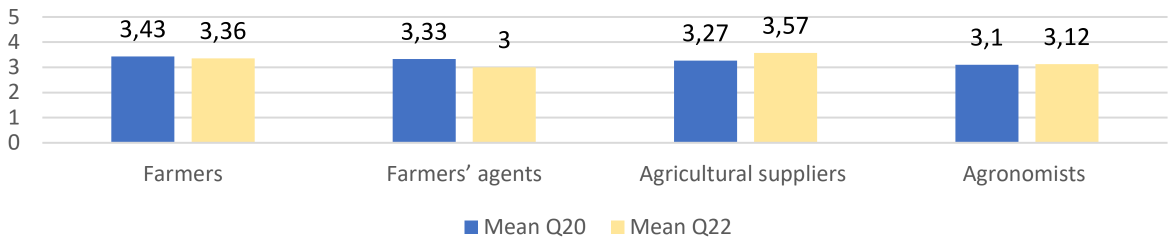

Figure 37: Mean estimation for the demonstration of existing solutions for the reduction of nutrient loss and the substitution of hazardous pesticides and fertilizers per practitioner group

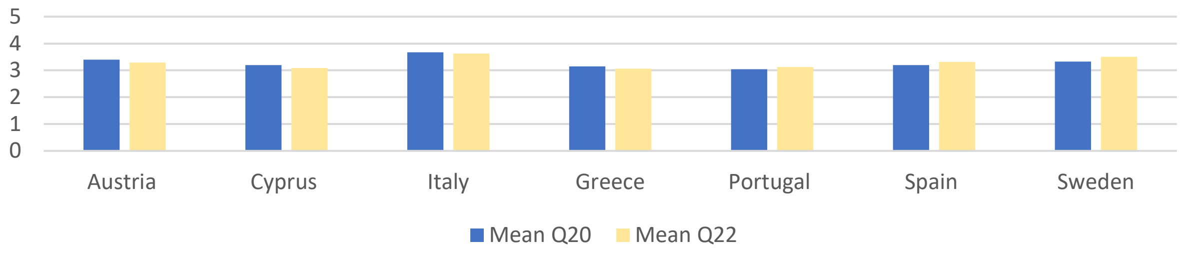

Figure 38: Mean estimation for the demonstration of existing solutions for the reduction of nutrient loss and the substitution of hazardous pesticides and fertilizers per country

In the next question (Q23) the participants were asked if their local agricultural suppliers promote the use of biopesticides and biofertilizers. 31% of participants has responded ‘Yes’, 20% ‘No’ and 49% ‘Sometimes’ (Figure 39).

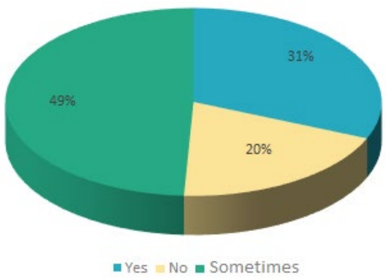

Figure 39: Promoting the use of biopesticides and biofertilizers by local agricultural suppliers and advisors

If we examine the distribution per practitioner group, there are variations in the responses: The farmers have almost equally distributed their replies among ‘Yes’, ‘No’ and ‘Sometimes’, while in the other 3 groups the answer ‘Yes’ and ‘Sometimes’ varies among 86% and 90% while the answer ‘No’ is at the level of 10-14%. This difference among farmers and the remaining groups responses, probably indicates a gap in the communication between the farmers and the suppliers (Figure 40).

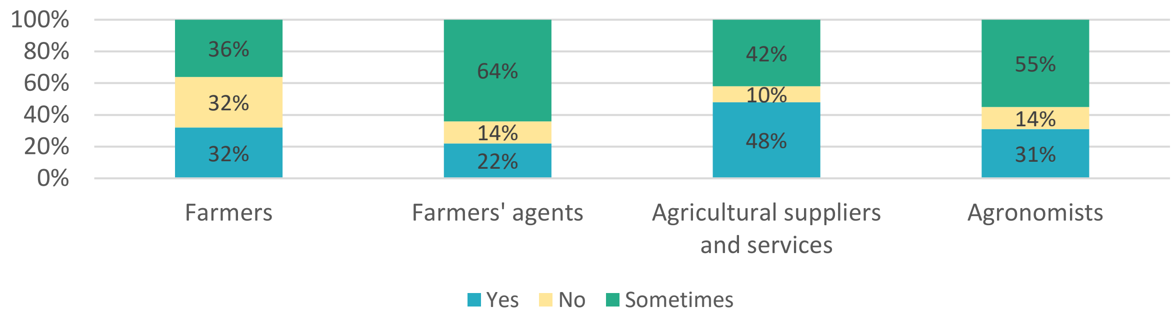

Figure 40: Promoting the use of biopesticides and biofertilizers by local agricultural suppliers and advisors per practitioner group

Examining the responses per country, in Austria and Spain, the local agricultural suppliers promote more biopesticides and biofertilizers while the other countries have similar percentages of 'Yes' and 'No' answers (Figure 41).

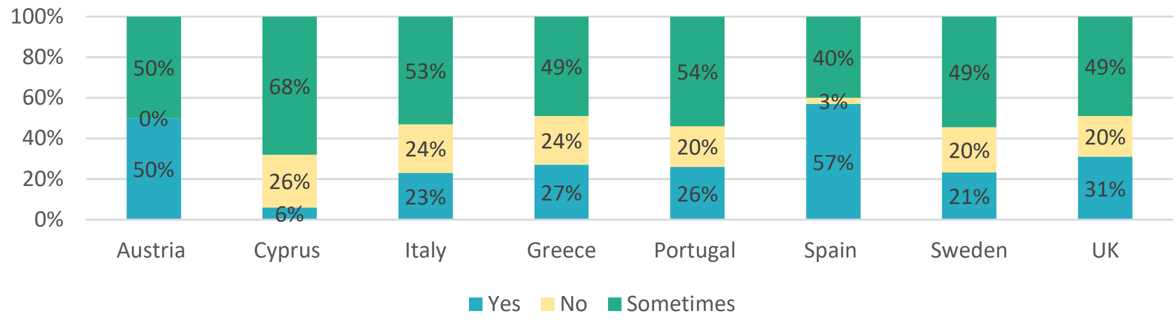

Figure 41: Promoting the use of biopesticides and biofertilizers by local agricultural suppliers and advisors per country

After that it was investigated if the participants have ever used biofertilizers or biopesticides in their fields (Q24). Te 43% responded 'Yes', 29% 'No' and 28% 'Not Applicable' (Figure 42).

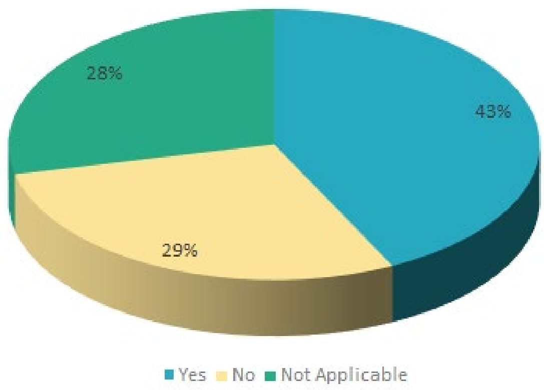

Figure 42: Use of biofertilizers or biopesticides

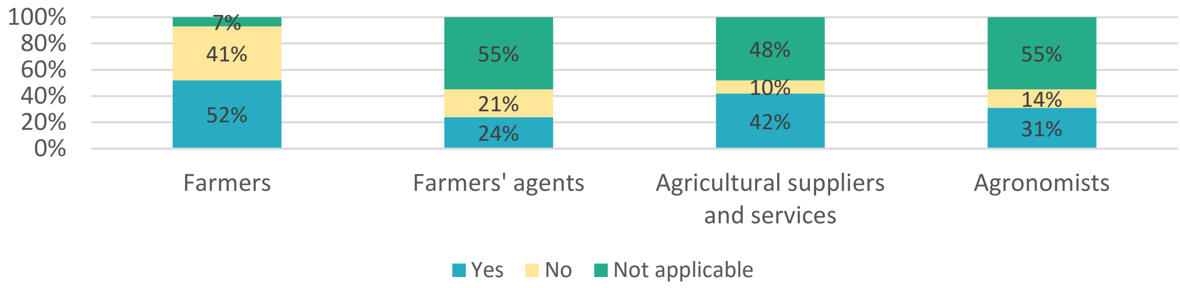

Figure 43: Use biofertilizers or biopesticides per practitioner group

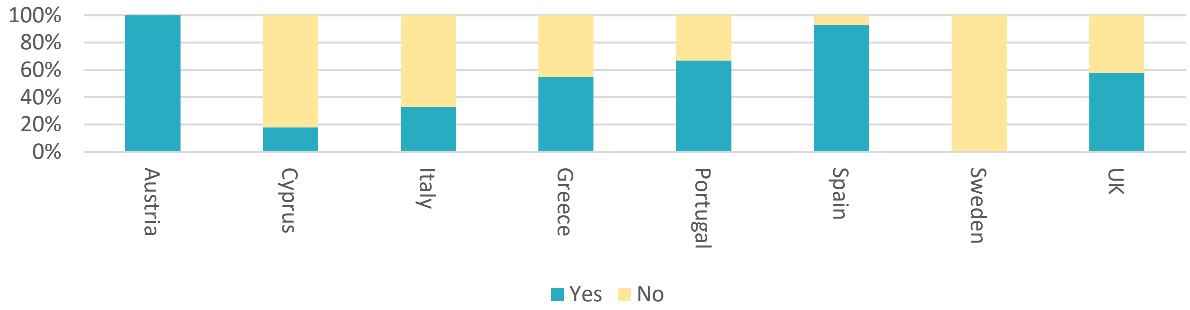

Figure 44: Use biofertilizers or biopesticides by Farmers in each participating country

Checking the responses per practitioner group, as it was expected, they mainly come from Farmers. The other groups have mainly replied that this question has no application to them. With regard to the Farmers' case, 52% said 'Yes', and 41% 'No' (Figure 43). If the responses of farmers would be examined per country, biopesticides and biofertilizers are utilised more in Austria and Spain (Figure 44).

Next, the practitioners who had replied positively with regard to the usage of biopesticides and biofertilizers were asked to choose from a list of commercially available biopesticide and biofertilizer products which compounds they have used. The designated list of products from which the participants had to select the particular biopesticide and biofertilizer productsis mentioned in detail below (Q25).

Bioagenosol, Neudosan, Phytoseiulus persimilis, Neuseiuluscucumeris, Encarsiaformosa, Orius, Chrysopa, Finalsan, Equisetum plus, Xentari, Steinernemafeltiae, Silicosec, Rhizivital, Sluxx, Spruzit, Boni Protect, Vitisan, Trichostar, Wetcit, Nützlinge, Compost, Jede Menge bin Bio Bauer (Gemüsebau), Trichogramma, Wirtschaftsdünger, Zwischenfruchtanbau, Kleegras, Gesteinsmehl, Kupfer, Rapsöl, Intercrop clover grass, Copper, Rapeseed oil, Vitsan, Beneficial insects, Neemoil, Bacillus, Terpenes, Bio Agenasol, Basfoliar, Sulfur, Schwefel, Neem, Botanigard, florbac,Schafwolldünger, Pheromone, Nebel, Multikraft Pheromone, Mist, Multikraft, Bioadosol, Alginur, Italpollina, Bacilli, Natural pyrethrins, Manure, Organic potassium, Humic fertilizers, Plant extracts with fungicidal and bactericidal action, Soil inoculation with beneficial microorganisms for the solubilization of soil elements and their absorption by the plant, Rhizobacteria, Biostimulants, Plant extracts and oils, Potassium salts, Humobio, Patent kali, Aktivit, Serenade, Disper, Plast off, Algae, fish & oilsextracts, Bacilus of thuring, Leaf seaweed, Pellets mixed dung, Caolin, Garlic hydrosol, Siro Agro 2 7-L, Nitrification retardant, Bacteria to control leptidoptera, Selective and directed materials to control specific pests, Release of predatory insects, Natural pyrethroids,Infused with nettle plants, Minhoca compost, Algae-based biofertilizers, Bacillus thuringiensis, Bacillus subtilis, Bacillus amyloliquefaciens, Spinosad, Sulphurs, Trichoderma, Solid organic matter (pellets), Liquid organic matter, Amino acids, nitrogen-fixing bacteria and phosphorus solubilizers (Bulhnova), Atmospheric nitrogen fixers, Phosphorus and Potassium solubilizers, Products based on fungi and bacteria against pests and diseases, Azadiractina, Jabones, Kytos (chitosan), Millennial, Viserion, Drekkar, Bacilus, Mycorrhizae, Orange oil, Kdos, Fertilizers-terra plus 1-2-3, Ecozen Amino, Pedrin, Liquid Humus (Nostoc) Bio N, Bio P, Bio K, Bulhnova, LIquid fertilizers (Flecotec, Bombardier), Foliar fertilizer (Viking-GO, Matrinal fruit), Micronutrients (Fixa Cu, Sergomil, Adimel, Humibor, SIVA copper, Mazi) &Amino acids (Proteins, Servapton), Pyrethrum, rotenone, Potassium soap (Green soap), neeem oil (Olinim), Oil (Bioleat, Citrolina, Laincoil, Hortilina, Benoil), Phytofortifiers (Seryl-Quick, Ecogreen), natural oils (Matrix, Volt miscible), acaricides (Flumit oleo), Bordeaux mixture and cuprocalcium sulfate.

The same practitioners were asked to rank the importance of the following characteristics of the biopesticides and biofertilizers (Q26): Effectiveness, Price and Safety. Analysing the total received responses “Price” was the first one followed by “Safety” and “Effectiveness” (Figure 45).

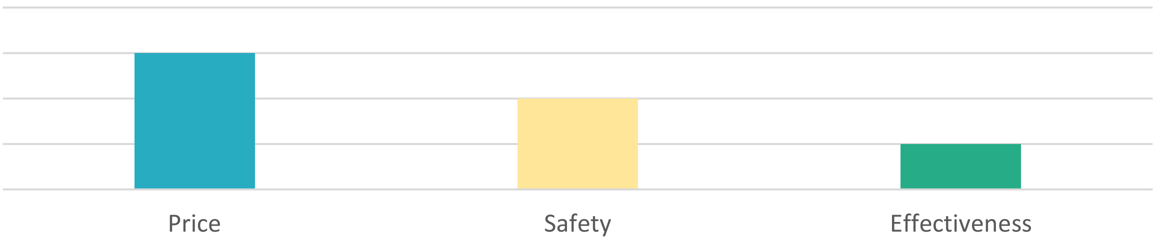

Figure 45: Rank of the main characteristics of biofertilizers or biopesticides

Following, the practitioners who had replied ‘No’ with regard to theusage of biofertilizers or biopesticides were asked to mention how likely it would be for them to use biofertilizers or biopesticides in the near future (Q27). 51% of the responders has replied‘Very’ or ‘Completely likely’, 28% ‘Moderate likely’ and 21% ‘Slightly’ or ‘Not at all likely’. The mean likeliness is 3.43 indicating a quite positive attitude for future use of biofertilizers or biopesticides (Figure 46).

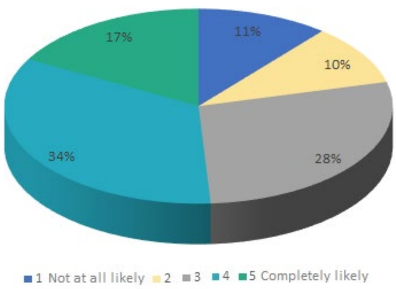

Figure 46: Likeliness to use biofertilizers or biopesticides in near future

The next question was referring to the existence of appropriate guidelines and regulations regarding the reduction of nutrient loss and pesticides and fertilizers’ use (Q28). 22% has responded that there are ‘Many’ or ‘Multiple Guidelines’, 38% ‘Some guidelines’, 22% ‘Zero’ or ‘Few guidelines’ and 19% ‘I don’t know’ (Figure 47). The results indicate a quite low knowledge and familiarity with existing

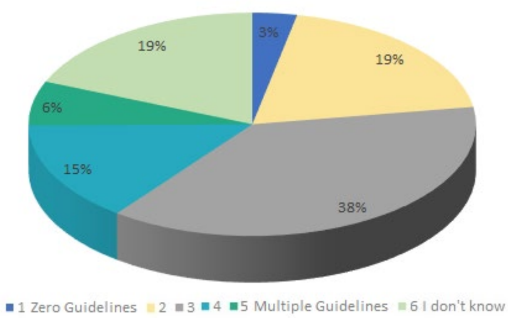

Figure 47: Guidelines & regulations for the reduction of losses of nutrients, pesticides & fertilizers’ use

guidelines and regulations. Concerning the distribution among the practitioners' groups, the mean scores indicate no significant differences among them (Figure 48).

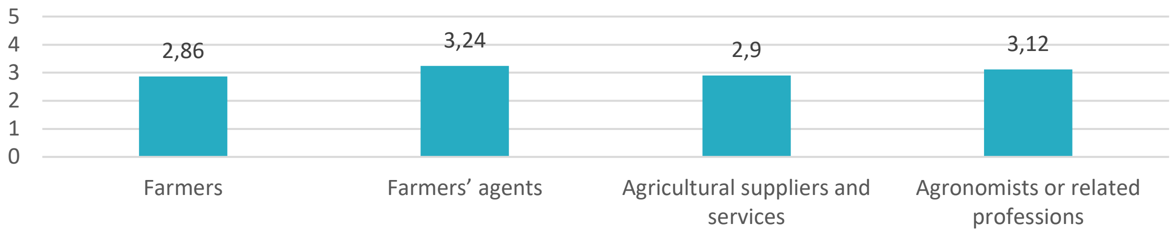

Figure 48: Guidelines, & regulations for the reduction of losses of nutrients, pesticides and fertilizers' use per practitioner group

The participants who had responded 'Zero' or 'Few Guidelines' were asked to indicate what information is mainly missing with regard to the guidelines, regulations, etc. The following suggestions were received:

- The existing guidelines and the regulations are not properly communicated from the relevant Public bodies and Co-operations.
- The existing guidelines must provide practical and not general advice.
- The legislation is extremely scattered, confusing, it changes frequently, and it doesn't provide necessary technical support for its implementation. The whole system is very bureaucratic.
- There are insufficient instructions and guidelines for proper use of fertilizers to reduce NO_3 leaching in the soil derived from discarded greenhouse's drainage solutions. More over there is a lack of information concerning the whole process of nutrient recycling. There is a lack of:
    - standards for calculating nutrient losses,
    - standards to measure the impact of nutrients in agroecological ecosystems,
    - methods of measurement of, for example, the capture of CO_2 in the soil,
    - a general regulation of the use of nutrient leaching in the soil,
    - of guidelines for soil fertility and plant nutrition.
    - of guidelines for the optimal application period for each crop, for suggested substances / bioactive compounds, and
    - a simplified online consulting platform.
- The registration of microorganisms and low-toxicity substances have to be facilitated.

Subsequently, the participants were asked to indicate guidelines and regulations that are familiar to them (Q30). Therefore, an extended list was developed which is mentioned bellow.

- Dir. 2009/128/EC
- EU organic regulation
- Reg.2018/848
- Reg.2021/1165
- Reg.889/2009
- Reg. 1107 / 2009
- Nitrates Directive
- Mar Menor Protection Law CHS precautionary measures
- GAP regulations
- Water Framework Directive (EU)

- Legislation of Nitrate Vulnerable Zones (Action Programs and Code of Good Practices)
- Agriculture and Environment Council for the establishment of Action Programs on Vulnerable Zones to Contamination by Nitrates of Agrarian Origin in the Murcia Region
- Regulations for the Rational Use of Pesticides.
- Royal Decree 1311/2012, which establishes the framework for action to achieve sustainable use of phytosanitary products.
- Order of June 16, 2016, of the Consejería de Agua, Agriculture and the environment.
- Law 3/2020, for recovery and protection Minor Sea.
- Integrated plant protection (IPP)
- Bio-Austria guidelines
- Demeter guidelines
- ÖPUL with UBB
- Guidelines for:Prohibition of burning plant residues, Crop rotation& selection, Prohibition of herbicides, Use of animal waste in agriculture, Green manure, Integrated management of cultures, Use of compost, Maintenance of existing walls/species, Grass between the orchards rows, Rotations with the inclusion of legumes, Intercropping, Use of biofertilizers and natural pesticides, Use of controlled release fertilizers, Continuous monitoring of water and nutrients in the soil, Promotion of auxiliary insects, Use of biostimulants& Fertilization with organic matter from the farm itself.
- Good irrigation and drainage practices
- Good agricultural practices for fertilizer application and irrigation GLOBAL G.A.P. Standards
- Integrated production standards and best practises
- Code of Good Agricultural Practices
- Organic farming practices
- Good practices from Greppa Näringen
- Code for plant protection products
- Code of Good Practices Agrarias Region of Murcia
- Regenerative agriculture practices
- AGRO 205
- Integrated plant Management (IPM)
- Certification standards such as EU-organic, KRAV and Swedish Seal.
- Technical standards for integrated production in crops in the Region of Murcia.
- FAO2019.International Code of Conduct for the Use and Management of Fertilizers.
- Farming Rules for Water (UK)
- Nitrate Vulnerable Zone Regulations (UK)
- Code of Good Agricultural Practice for the Protection of Water (UK)

The final question (Q31) of this section was related to ethical concerns or worries that may arise from the use of the AOPs. All participants have indicated no ethical concerns or worries contrariwise they consider AOPs more ethical.

4.1.4. Digital & Space-based Technologies (DST)

This section starts with a general question about the level of awareness regarding the use of DSTs in agriculture (Q32). From the received responses,31% of the participants declared that they are ‘Very’ or ‘Extremely aware’of these technologies in general, 33% ‘Moderate aware’ and 36% ‘Slightly’ or ‘Not at all aware’, as it is displayed in Figure 49. The Mean Awareness is 2.53 indicating a quite low level of awareness of the various DSTs. Comparing these results with the ones received for AOPs, it seems that there is better level of awareness for AOPs.

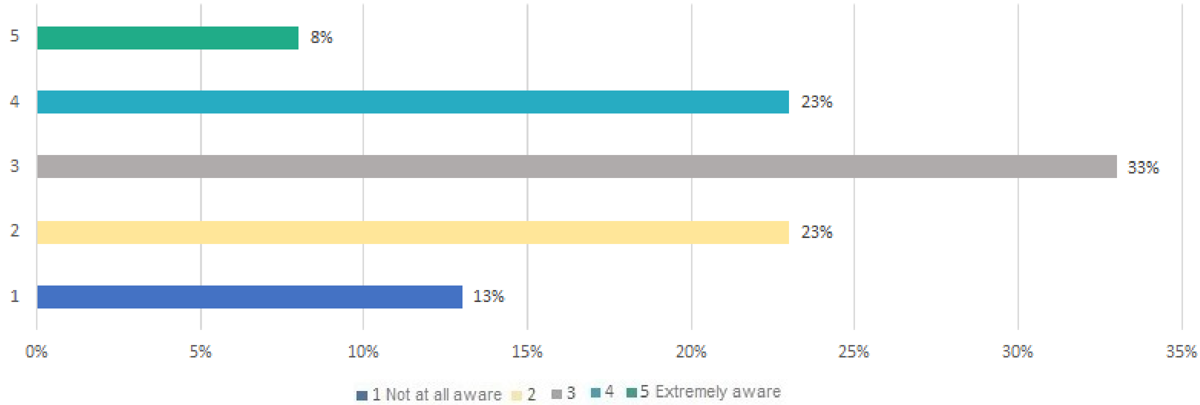

Figure 49: Awareness of the use of digital and space-based technologies (DST)

If we check the distribution among countries, the highest scores are found in Spain and the lowest in Austria (Figure 50). If we examine the awareness per Practitioner group, we observe that Agronomists group has the highest score in mean awareness (3.09) while the Farmers group, presents the lowest. (Figure 51).

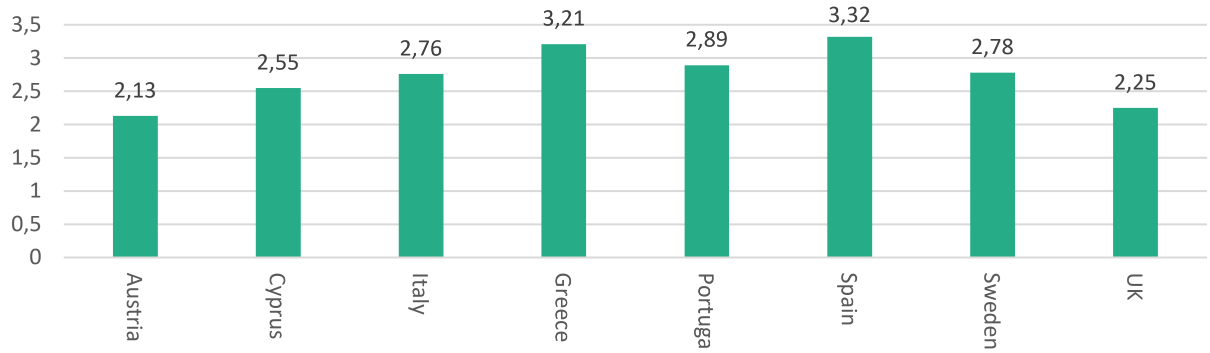

Figure 50: Mean awareness for the DSTs per country

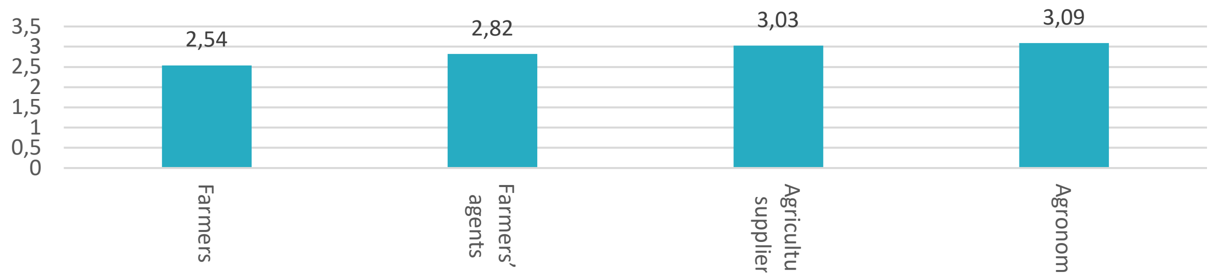

Figure 51: Mean awareness for the DSTs per practitioner group

Examining the distribution of practitioners group in Greece, Spain and Portugal, the mean awareness for all groups varies from 2.7 to 3.7 (Figure 52). The Farmers group presents the lowest score of mean awareness in Greece, while the highest is observed in Spain. For the Agronomists the lowest score is in Spain and the highest in Greece.

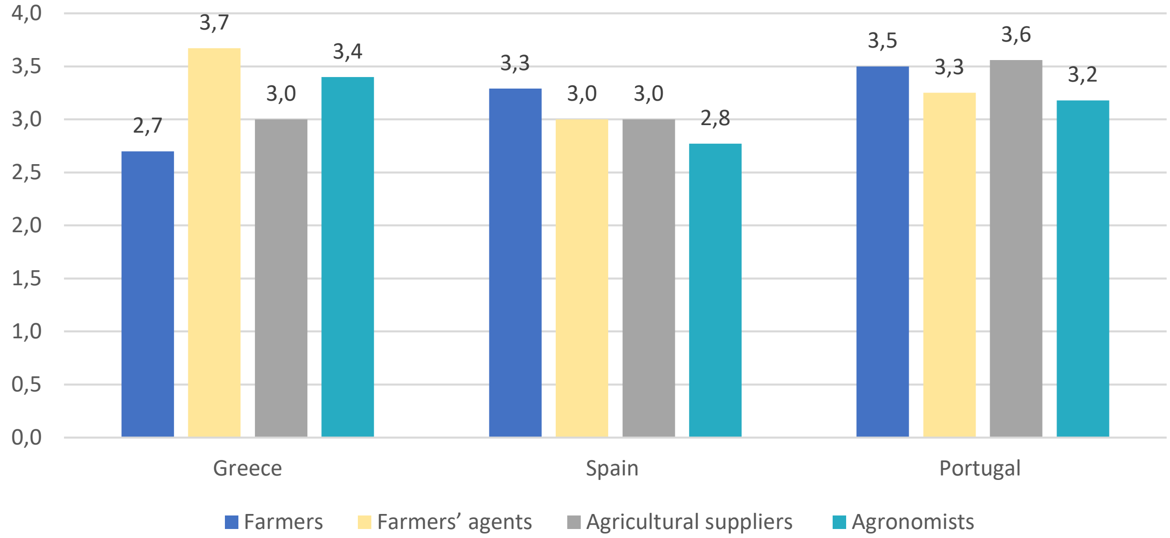

Figure 52: Mean awareness for the DSTs per practitioner group in Greece, Spain & Portugal

The next step was to ask the responders who had declared that they are 'Very Aware' or 'Extremely Aware' in case that all these technologies have been tested enough thoroughly in real case scenarios. As it is presented in the Figure 53, 39% of the participants declared that these practices are 'Very' or 'Extremely Demonstrated', 38% declared that these practices are 'Demonstrated', 20% 'Slightly' or 'Not at all Demonstrated' and 3% declared 'I don't know'. The mean level of demonstration is 3.24 indicating a moderate estimation for the level of the DSTs demonstration in real case scenarios.

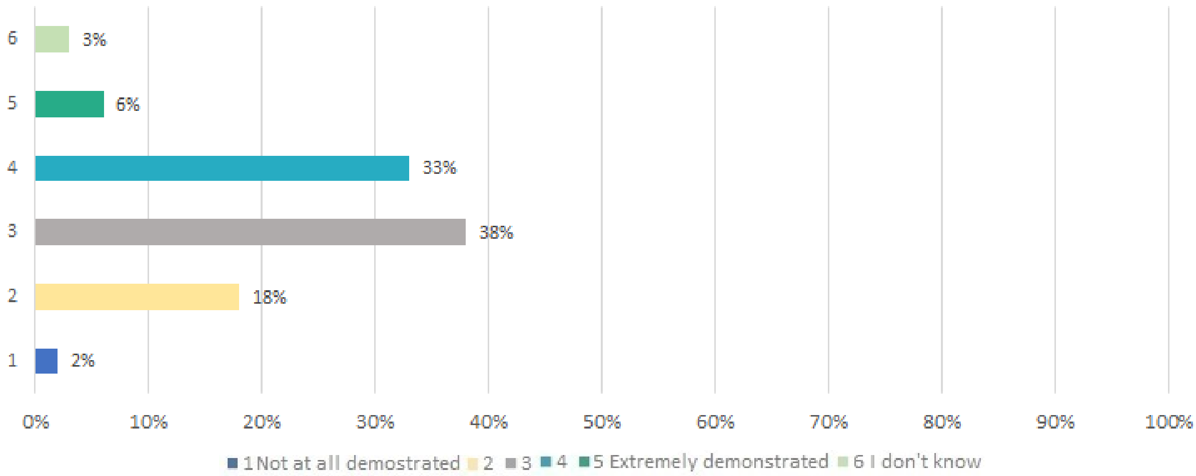

Figure 53: Demonstration of DSTs in real case scenarios

The practitioners' group have similar mean estimations for the demonstration of the DSTs in real cases scenarios as indicated in Figure 54. Examining the situation per country, the highest mean scores iachieved in Spain and the lowest in Cyprus (Austria and the UK have been excluded due to a limited number of responses) as indicated in Figure 55.

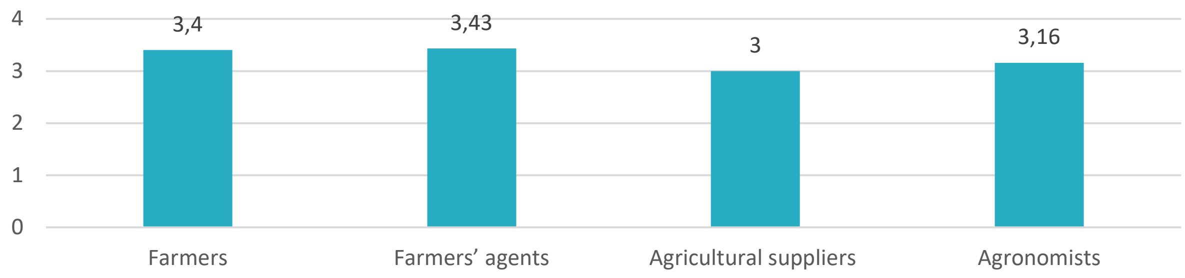

Figure 54: Mean Demonstration of DSTs in real case scenarios per practitioner group

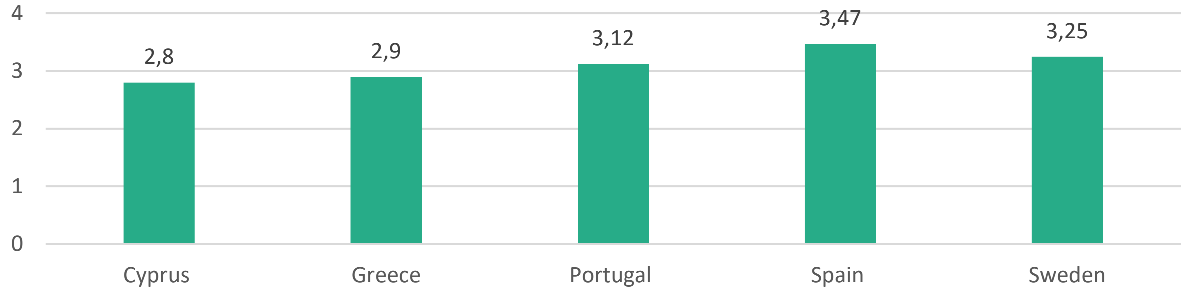

Figure 55: Mean Demonstration of DSTs in real case scenarios per country

Examining how common are the DSTs in the participating countries (Q34), the estimations of the participants are presented in Figure 56. 10% of the participants declared that the DSTs are ‘Very’ or ‘Extremely common’ in their country, 28% ‘Moderate common’ and 52% ‘Slightly’ or ‘Not at all common’. 10% has replied ‘I don’t know’. The mean score is 2.36 indicating that participants’ estimation on how common DSTs are in their countries, is quite low.

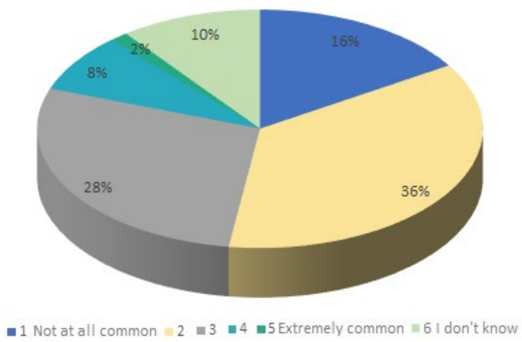

Figure 56: How common are the DSTs

The distribution per practitioners’ group is presented in Figure 57, where it is obvious that all the groups have similar estimation for the penetration of the DSTs in their countries and estimated as ‘Slightly common’. Concerning the countries distribution, the highest scores of means are achieved in Spain & Sweden and the lowest in Cyprus & Austria (Figure 58).

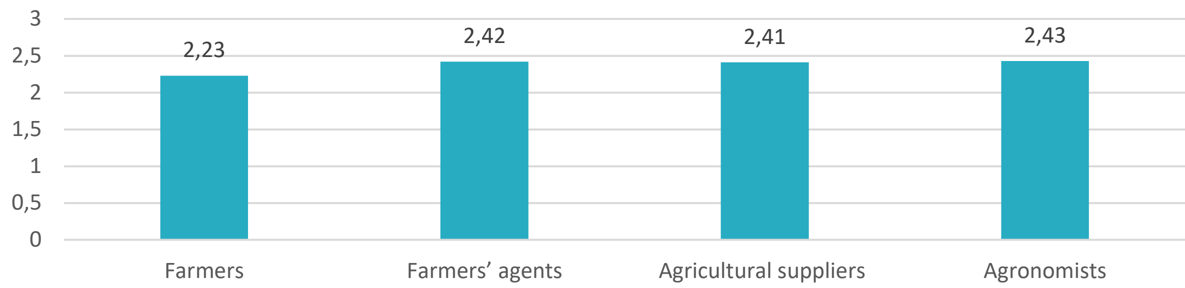

Figure 57: How common are the DSTs per practitioner groups

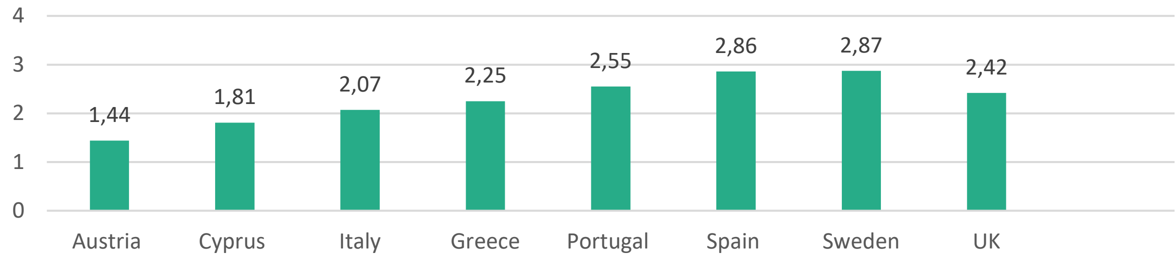

Figure 58: How common are the DSTs per country

Examining the distribution of the practitioners' group in Greece, Spain and Portugal, it is concluded that in Greece all practitioners' groups have similar estimation of how common DSTs are while in Spain and Portugal some variations are observed (Figure 59).

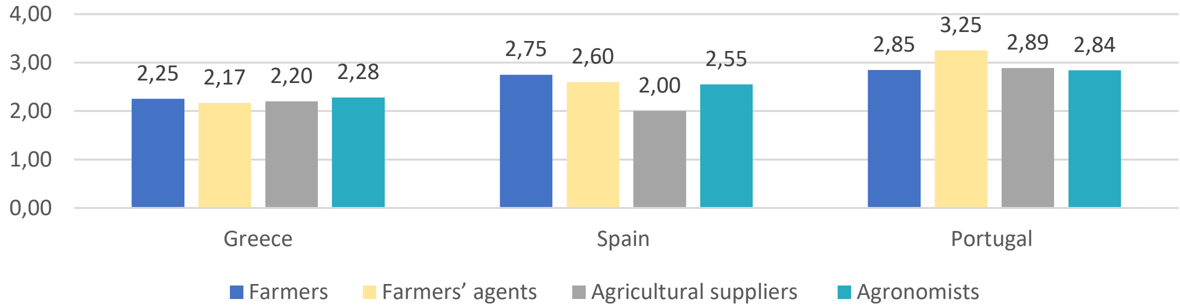

Figure 59: How common are the DSTs per practitioners' groups in Greece, Spain and Portugal

Moving a step further, the participants were asked to declare whether it would be easier for them to apply DST if their use was initiated through licensing, renting frameworks from Agriculture cooperatives or Farmers unions (Q35). 72% of the participants has replied 'Yes', 7% 'No' and 21% 'Not Applicable' (Figure 60). Checking the distribution per practitioners' groups, we observe similar responses from all groups (Figure 61), while with regard the distribution per country some differences were observed in Italy and the UK (Figure 62). The results show that if the use of DSTs was taking place in a more organized and collective way, the exploitation of them would be higher.

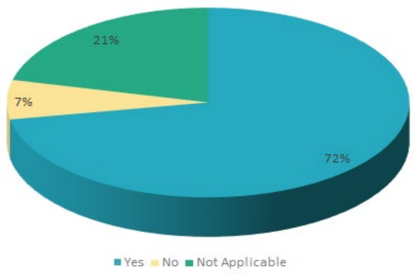

Figure 60: Use of DST through licensing, renting frameworks from Agriculture cooperatives or farmers' unions

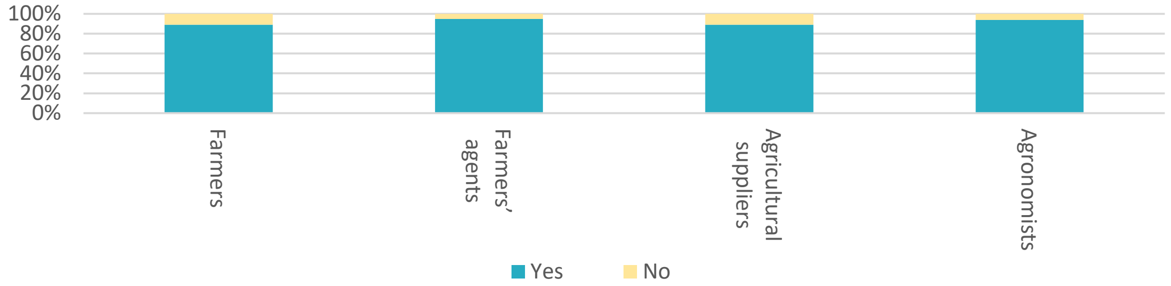

Figure 61: Use of DST through licensing, renting frameworks from Agriculture cooperatives or farmers' unions per practitioner group

After that, it was investigated if they have ever used precision agriculture technologies/tools such as robots, sensors, in-situ analysts, satellite data, etc. (Q36). 43% responded 'Yes' and 57% 'No' indicating a quite low level of DST usage (Figure 63).

Figure 63: Use of DST through licensing, renting frameworks from Agriculture cooperatives or farmers' unions per practitioner group

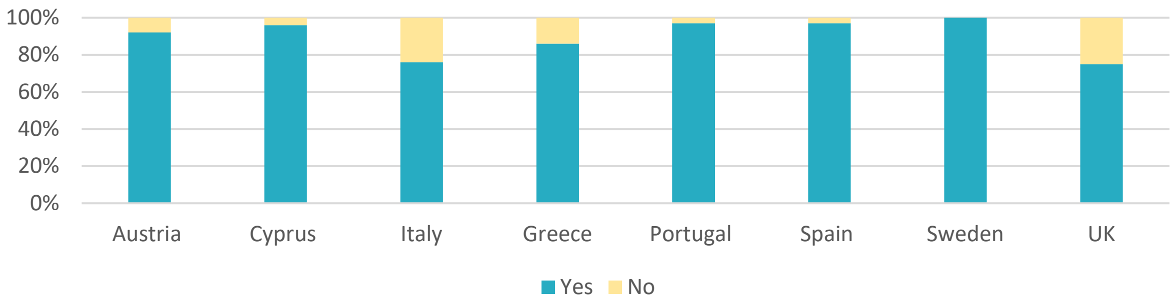

Figure 62: Use of precision agriculture technologies/tools

Checking the responses per practitioner group, the Farmers had the lowest (29%) use of DSTs and the Agronomists the highest (54%) (Figure 64). Examining the responses per country, Austria had the lowest usage and Portugal the highest (Figure 65).

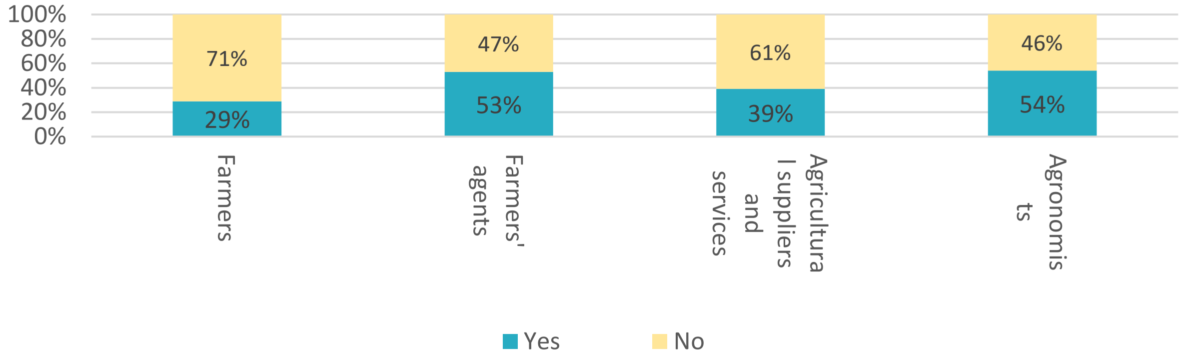

Figure 64: Use of precision agriculture technologies/tools per practitioner group

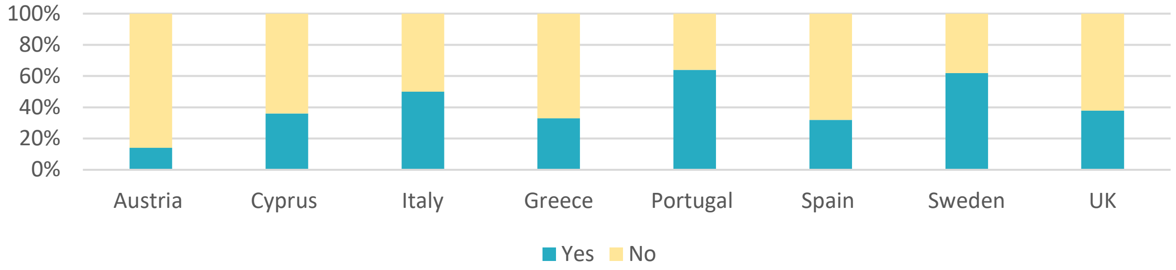

Figure 65: Use of precision agriculture technologies/tools per country

Analysing the responses of practitioners' groups in Greece, Spain and Portugal, it can be concluded that Portugal has the better performance among the three in the usage of DSTs in all groups (Figure 66, Figure 67, Figure 68).

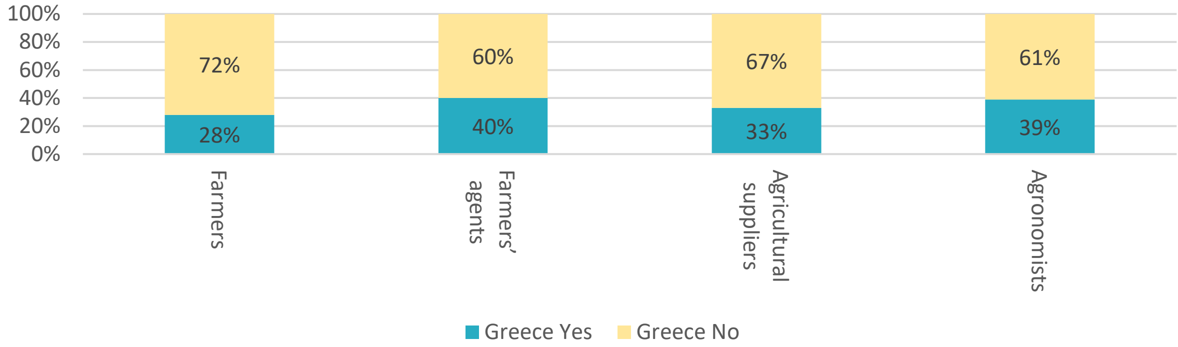

Figure 66: Use of precision agriculture technologies/tools per practitioners' group in Greece

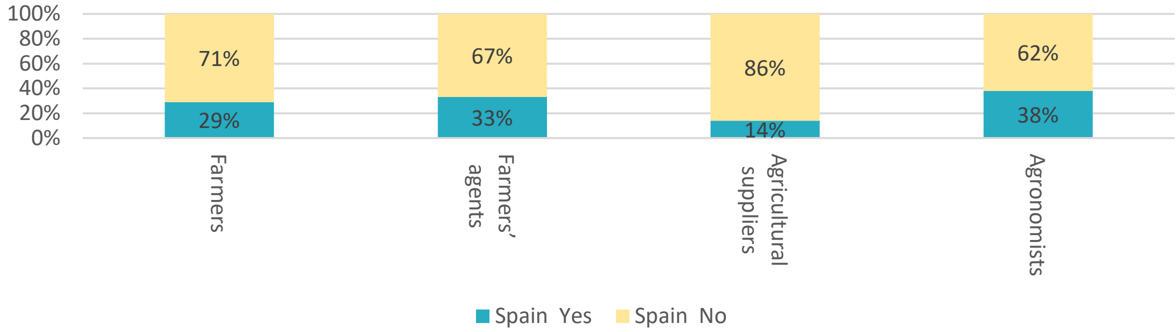

Figure 67: of precision agriculture technologies/tools per country in Spain

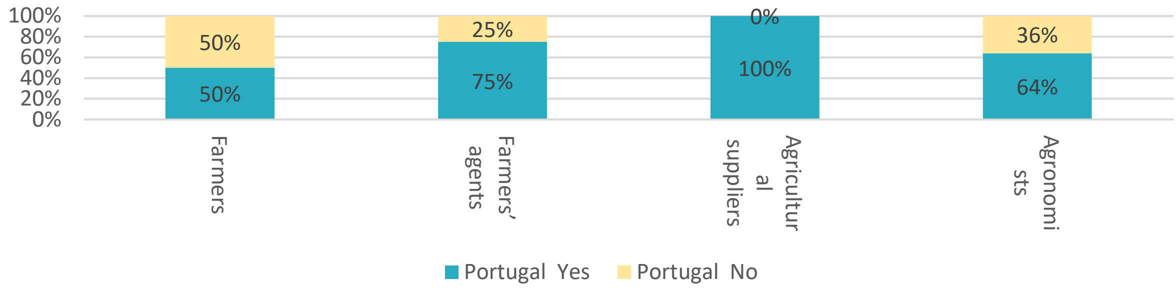

Figure 68: Use of precision agriculture technologies/tools per practitioners' group in Portugal

After that, the practitioners who had replied 'No', in regard to the use of DSTs, were asked to state how likely it would be for them to make use of DSTs in near future (Q37). 41% of the responders has said 'Very likely' or 'Likely', 37% 'Moderate likely' the 22% 'Slightly' or 'Very unlikely', as indicated in Figure 69. The mean scoreis 3.29 indicating a quite positive attitude for future use of DSTs.

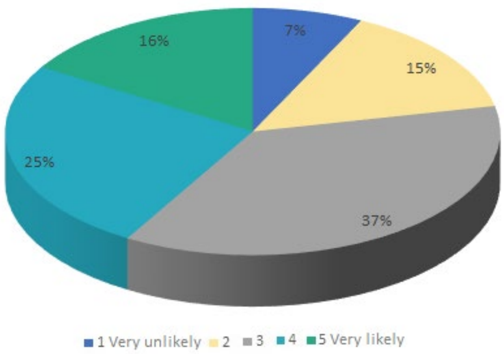

Figure 69: Use of DSTs in near future

Moving a step further, the practitioners were asked for their experience concerning the data visualization of existing precision agriculture, digital and space based commercial systems (Q38). 15% has responded 'Very Bad' or 'Bad', 37% 'Acceptable and 48% 'Good' or 'Very Good'. The mean score was 3.46 indicating a quite user-friendly data visualization (Figure 70). The participants were also asked to indicate the importance of the protection of DST data from cyber-attacks (Q39). 10% has responded 'Not at all important' and 'Slightly Important', 22% 'Moderate Important' and 68% 'Very' & 'Extremely Important'. The mean score was 4.02 indicating a high level of awareness in the issue of cyber-attacks (Figure 71).

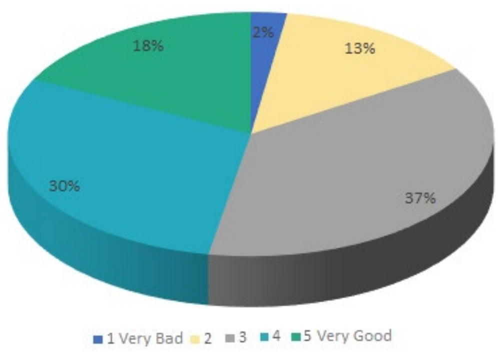

Figure 70: Data visualization of existing precision agriculture digital and space based commercial systems

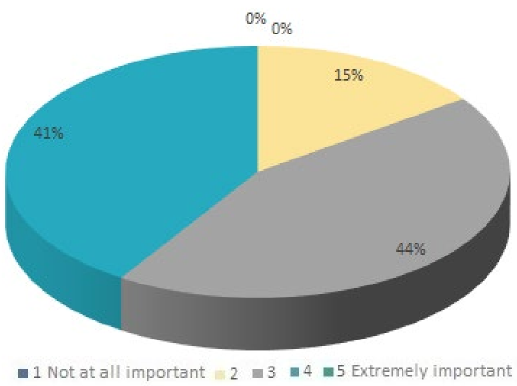

Figure 71: Importance of the DST protection from cyber-attacks

Following, the participants were asked to estimate how useful they consider the use of:

- AI robotic traps for real time pest monitoring and in reducing food losses in the future (Q40)
- Autonomous mobile robots for pesticide monitoring spraying (Q41)

- In-situ and real-time UVC nutrient analysers for the control of soil health (Q42)

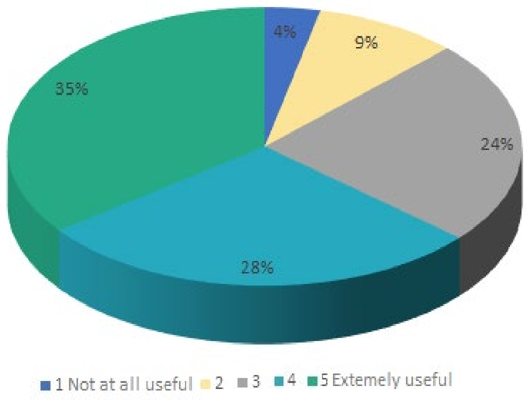

Figure 72: Usefulness of AI robotic traps for real time pest monitoring

For the AI robotic traps, 13% has responded ‘Not at all Useful’ and ‘Slightly Useful’, 24% ‘Moderate Useful’ and 53% ‘Very Useful’ and ‘Extremely Useful’ indicating a positive evaluation (Figure 72).

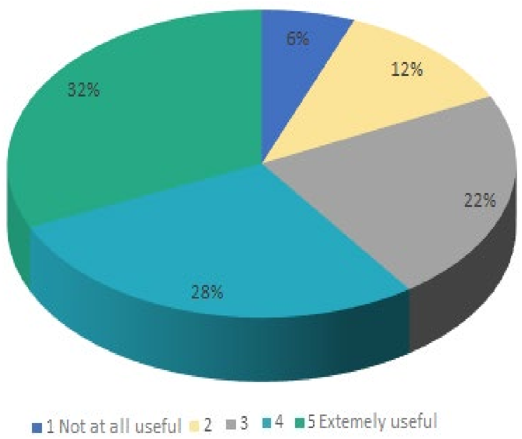

Figure 73: Usefulness of the use of autonomous mobile robots for pesticide monitoring spraying

For the autonomous mobile robots for pesticide monitoring spraying, 18% has responded ‘Not at all Useful’ and ‘Slightly Useful’, 22% ‘Moderate Useful’ and 60% ‘Very Useful’ and ‘Extremely Useful’, indicating a positive evaluation as well (Figure 73).

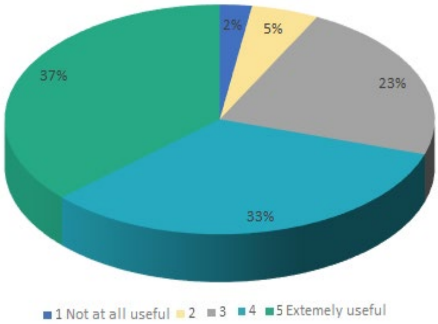

Figure 74: Usefulness of in-situ and real-time UVC nutrient analysers for the control of soil health

For the in-situ and real-time UVC nutrient analysers, 7% has responded ‘Not at all Useful’ and ‘Slightly Useful’, 23% ‘Moderate Useful’ and 70% ‘Very Useful’ and ‘Extremely Useful’ indicating a very positive evaluation (Figure 74). The mean scores of usefulness were3.83, 3.68 &3.97 respectively, meaning that the participants consider more useful the in-situ and real-time UVC nutrient analysers, followed by AI robotic traps and autonomous mobile robots.

Examining the usefulness of the new technologies and how this is estimated per practitioner group, the mean scores indicate that the new technologies are considered as very useful. The best scores are achieved for the in-situ and real-time UVC nutrient analysers for all groups (Figure 75).

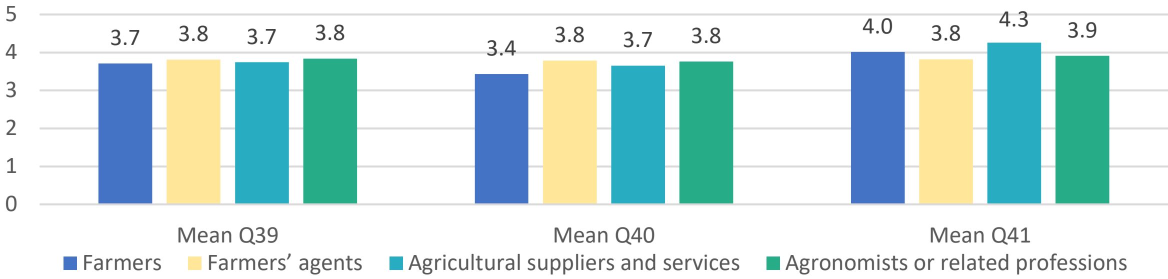

Figure 75: The mean score of usefulness of the use of AI robotic traps, autonomous mobile robots and real time UVC nutrient analysers per practitioners groups

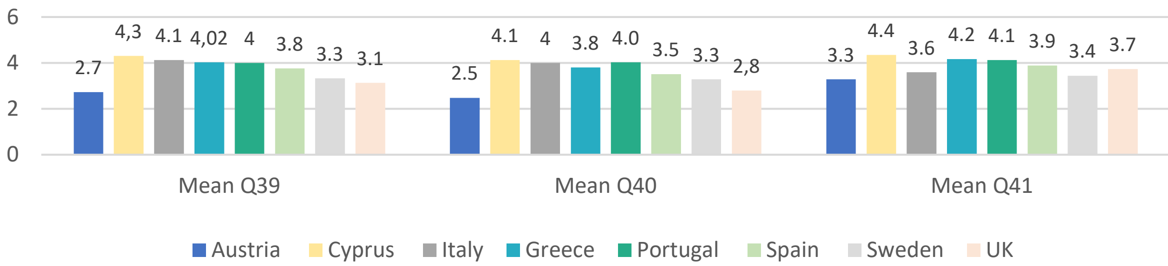

Figure 76: The mean score of usefulness of the use of AI robotic traps, autonomous mobile robots and time UVC nutrient analysers per country

In the distribution per country (Figure 76), the lowest scores of mean usefulness are achieved in Austria and the highest in Cyprus. Concerning the estimation of the usefulness of the 3 technologies, the in-situ and real-time UVC nutrient analysers seems to be considered more useful in all participating countries.

The same picture arises from the distribution of the responses per practitioner group in Greece, Spain and Portugal. All the technologies are considered very useful for all practitioners' groups in the 3 examining countries (Figure 77).

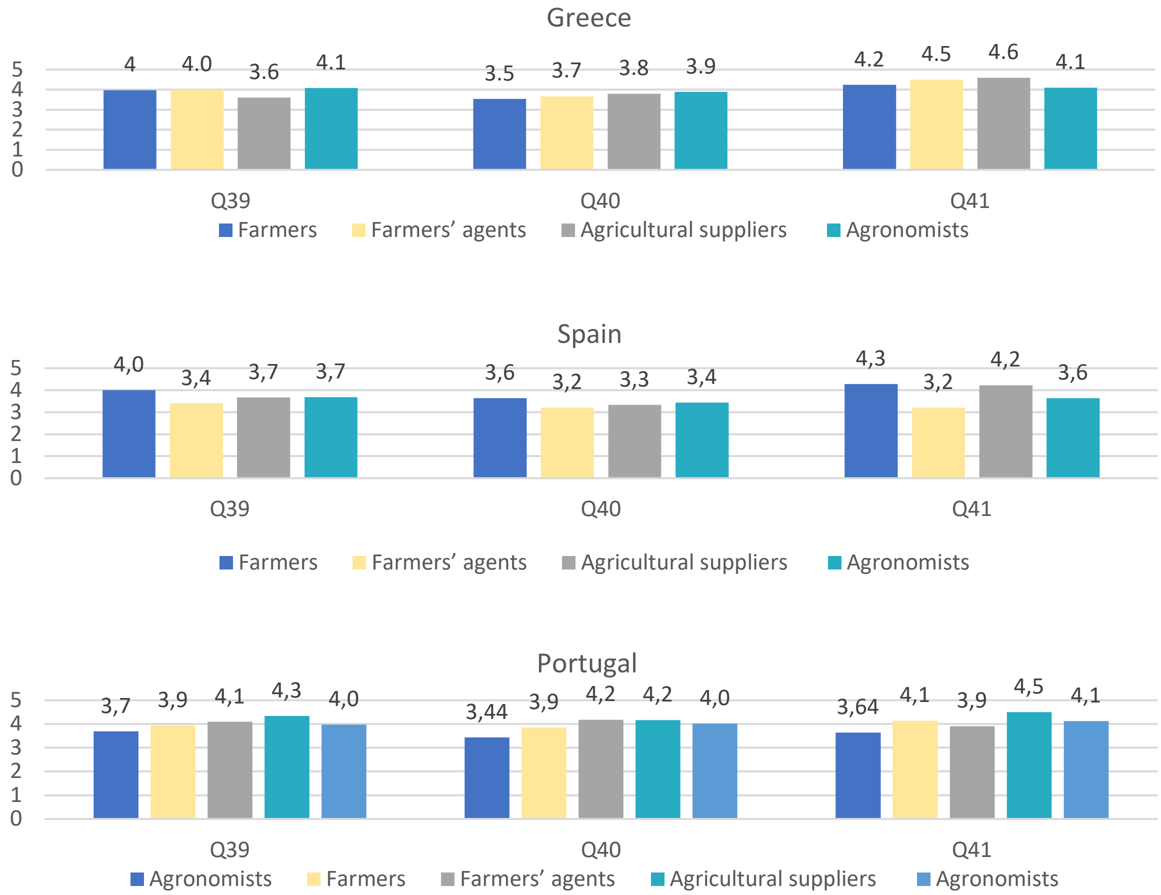

Figure 77: The mean scores of usefulness of the use of AI robotic traps, autonomous mobile robots and time UVC nutrient analysers per practitioner type in Greece, Spain & Portugal

The final question of this section (Q43) was related to ethical concerns or worries that may arise from the use of the DSTs. All participants have indicated no ethical concerns or worries on.

4.1.5. Impact of PestNu, Policies, Training, Networking & Standards

The last group of questions was more general, focusing on the impact of the project, the existing policies, the training and networking activities and the standards the participant knows or follows. These questions will provide to the consortium valuable information for the perception of the participants for future exploitation of the examined practices and technologies and will contribute to the development of targeted training, dissemination and communication activities.

4.1.5.1. Impact of PestNu

The first part of this sector has investigated the impact of the project and the first question (Q44) concerned the willingness of the participants to participate to the pre-pilot and pilot sites activities for co-design, training and policy forming. 41% has responded 'Yes' and 59% 'No', indicating probably a lack of familiarity with the project activities (Figure 78), while in the distribution per practitioner group, the agronomist have shown the highest interest to participate (Figure 79).

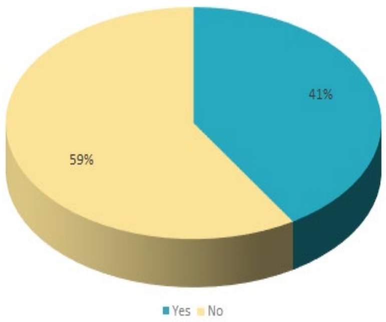

Figure 78: Willingness to participate in the pre-pilot and pilot sites activities for co-design, training and policy making

In the next 2 questions (Q45 &Q47) the participants were asked to estimate which is the level of market demands for innovations similar to PestNu AOPs and DSTs. As it is presented in Figure 80, AOPs & DSTs have similar mean scores, slightly higher than 3, indicating that the participants estimate that there is a moderate level of market demand. Checking the distribution per practitioner group it arises that all groups have similar mean estimation as well (Figure 81).

The participants who had responded in Q45 &Q47, 'Not at all' or 'Slightly' were asked to indicate the

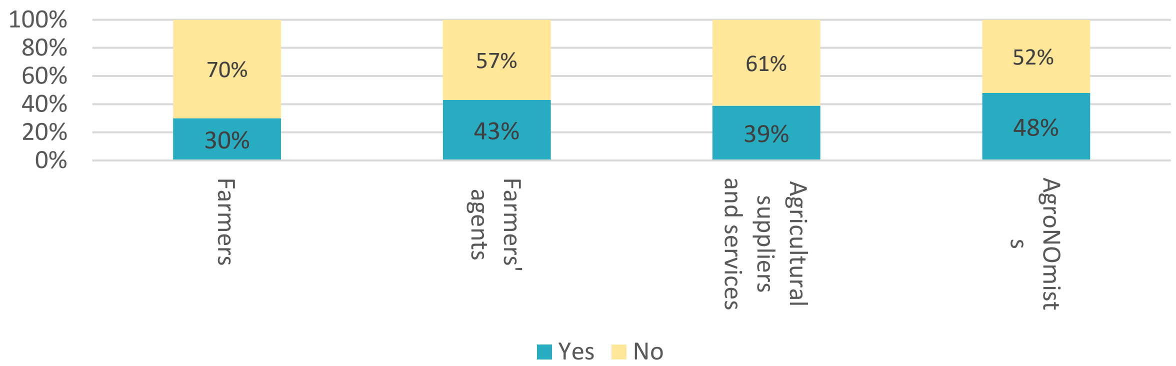

Figure 79: Willingness to participate in the pre-pilot and pilot sites activities for co-design, training and policy making per practitioner group

main factors, which contribute to the lack of market's demand's for such innovations. The responses were included the lack of liquidity, the lack of information for those practices and the limited applications only in very controlled environments like greenhouses.

Figure 80: Mean estimation of market demand for innovations such as PestNu AOPs' & DSTs

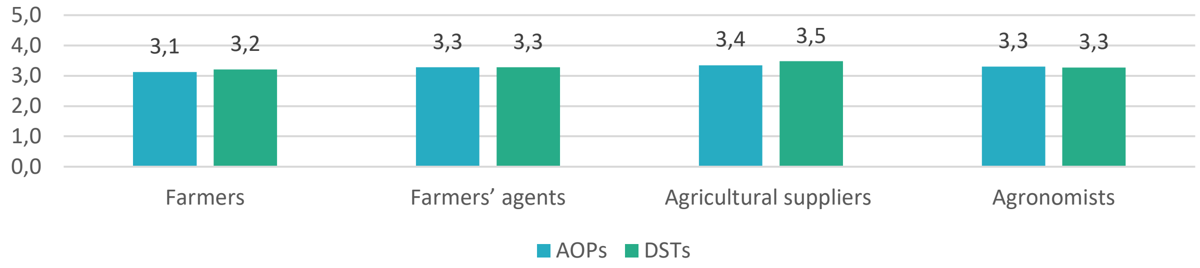

Figure 81: Mean estimation of market demand for innovations such as PestNu AOPs' & DSTs per practitioner group

The last question of this part concerned the willingness of the participants to invest in PestNu AOPs' and DSTs' market introduction. Only 18% has shown strong interest for such investment while the majority (39%) has replied that they are not in position to decide for investments (Figure 82).

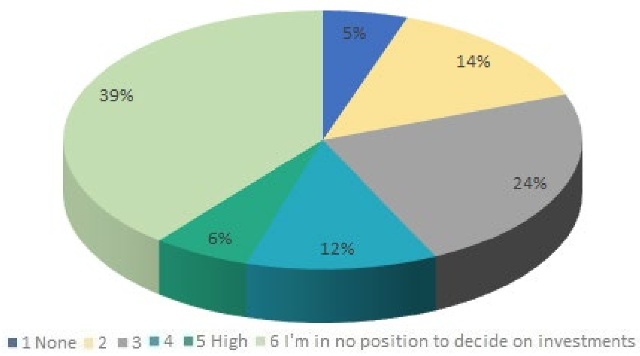

Figure 82: Willingness to invest in PestNu AOPs' & DSTs' market introduction

4.1.5.2. Incentives for DST and AOP implementation

The second part of this section has investigated the incentives for DST and AOP implementation. The first question (Q50) is related to the main factors that contribute to the poor adoption of existing DSTs and AOPs providing 3 predefined options – Cost, Lack of information/training for the available technologies/practices & Low familiarity with new technologies and the possibility to indicate more.

In Figures 83, 84, 85 & 86 are presented the results for DSTs and AOPs, where it is obvious that all these 3 factors significantly affect their adaptation. The Cost seems to be the most important for DSTs and AOPs, followed by Lack of information/training for the available technologies/practices & Low familiarity with new technologies.

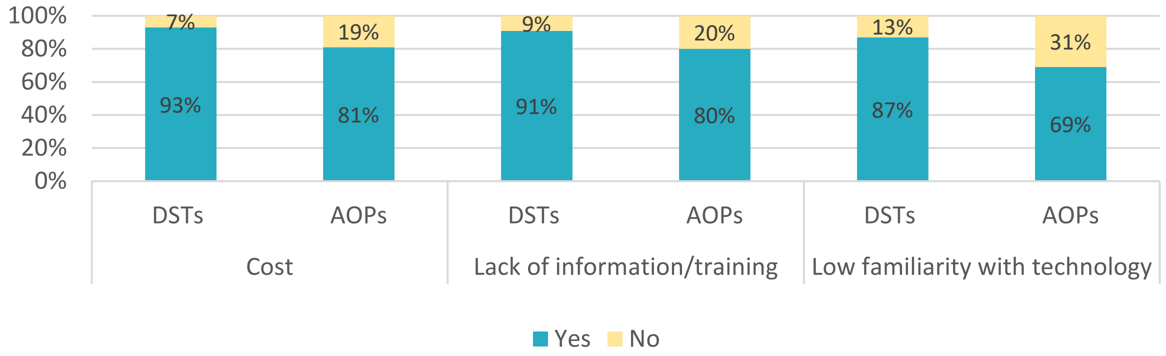

Figure 83: Main factors that contribute to the low adoption of existing DSTs and AOPs

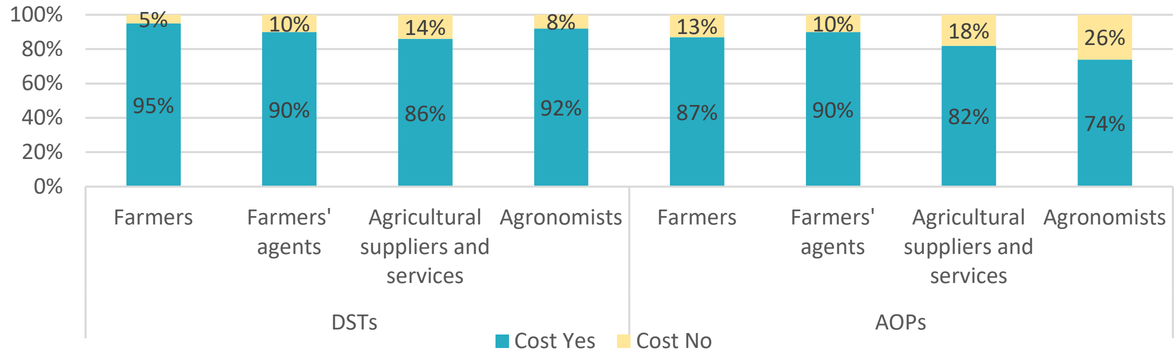

Figure 84: Cost contribution to the low adoption of existing DSTs and AOPs per practitioner group

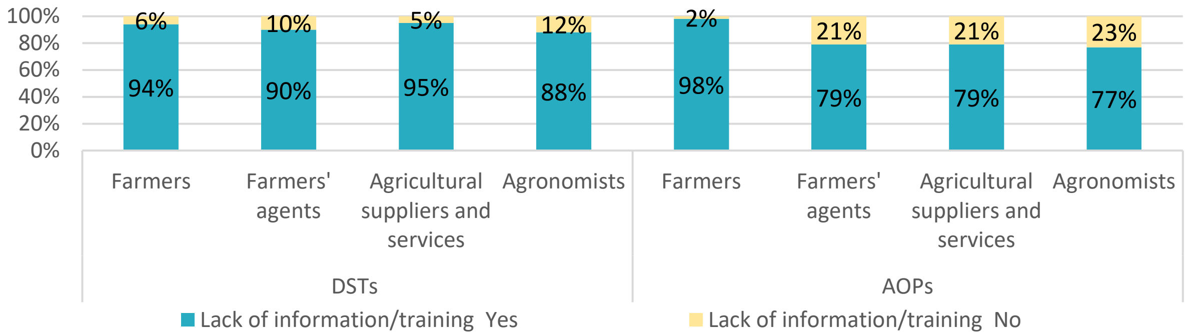

Figure 85: Lack of information/training contribution to the low adoption of existing DSTs and AOPs per practitioner group

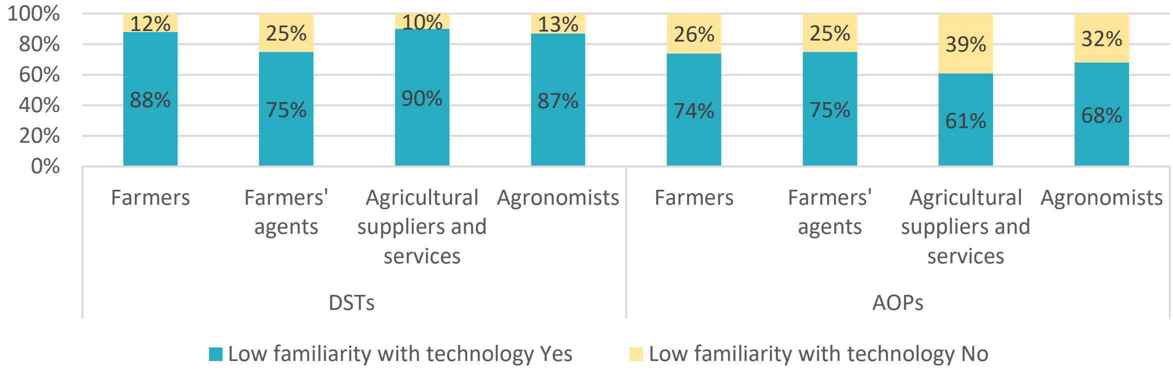

Figure 86: Low familiarity with technology contribution to the low adoption of existing DSTs and AOPs per practitioner group

The participants have also indicated a series of factors that negatively affect the adaptation of AOPs and DSTs, which are listed below.

- The ageand the low educational level of farmers
- The lack of confidence to the effectiveness and the credibility of these technologies
- The consequently high risk and the fear to change or to failure
- The established culture among farmers and cooperatives
- The structure of the Agricultural sector with the existence of high number of small holders
- The lack of research support and trained professionals
- The unclear regulation requirements
- The estimated low economic performance
- The lack of benefits demonstration.

A list of incentives which could encourage EU farmers to adopt Integrated Pest Management and Integrated Nutrient Management technologies and strategies, like PestNu DST and AOP innovations has been developed including the followings (Q51):

- Tax reliefs
- Funding
- Training
- Pricing and bargaining models

As shown in Figure 87, participants were asked to rank the above-mentioned incentives according to their importance. Funding is the most important incentive followed by Tax reliefs, Training and Pricing and bargaining models.

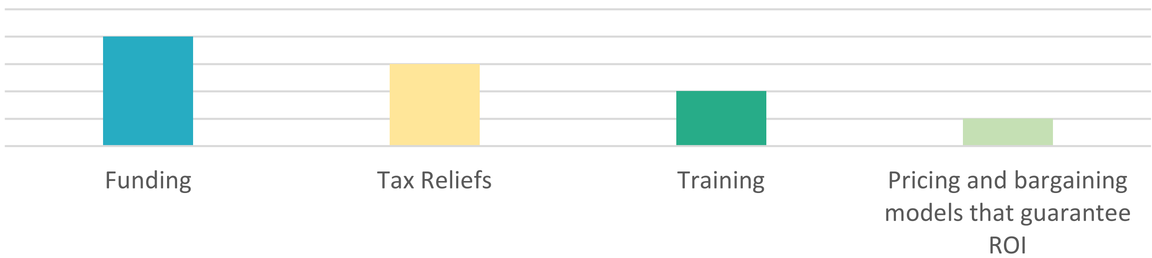

Figure 88: Incentives which could encourage EU farmers to adopt IPM and INM technologies and strategies

4.1.5.3. *Training*

The third part of this section has investigated the perceptions of the participants regarding the training activities and what it would be suitable for the activities of PestNu. In the first question (Q52), the participants were asked to declare their interest to cooperate or to get advice from the research providers of the consortium for the AOPs and DSTs used in PestNu.

55% of responders have declared their positive interest to cooperate or to get advice from the research providers of the project and 45% has replied 'No' (Figure 88).

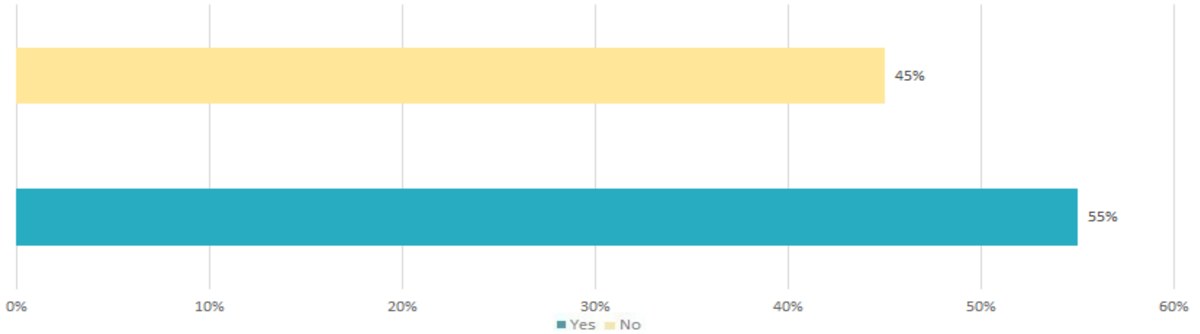

Figure 89: Interest in cooperating or in getting advice from the research providers of the consortium for the AOPs and DSTs used in PestNu

After that, the participants were asked (Q53) to declare their interest to get trained in the use of DSTs and AOPs. 63% has declared their interest to get trained in both, 18% only in DST and 19% only in AOPs. From their responses a strong interest in such training activities arises, which means that the partnership of the project must organize training activities regionally (Figure 89).

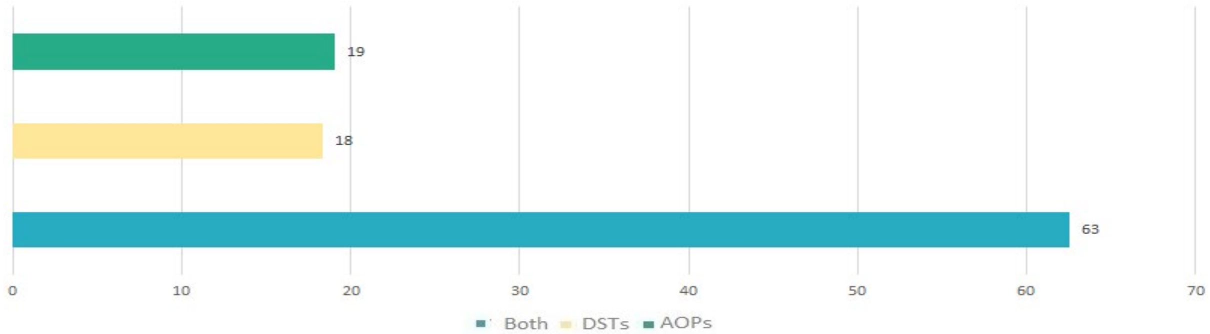

Figure 91: Interest to get trained regionally on the use of DSTs and AOPs

Another important aspect in order to organize successful training activities was to address the kind of the training, which would better fit to these technologies and practices. Five options have been given to the participants, asking them to select as many as they want. The options were the following:

1. On line demonstration workshops
2. On site demonstration workshops
3. On line training sessions
4. Face to face training sessions
5. E-learning platform

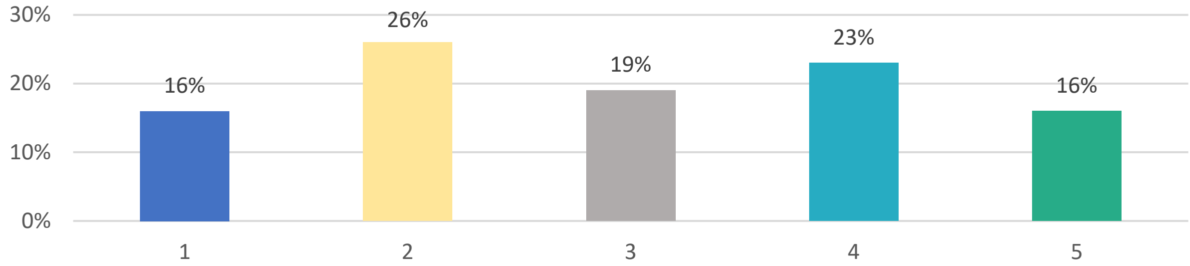

Figure 92: Training activity type

26% prefer 'on site demonstration workshops', 23% 'Face to Face training sessions', 19% 'On line training sessions' and only 16% prefer 'On line demonstration workshops' and 'E-learning platform'. The results indicate a strong preference on the training activities with physical presence (Figure 90).

4.1.5.4. Networking

The fourth part of this section aimed in investigating the networking activities of the participants. The participants were asked, in an open question (Q55), to indicate the networks, associations, platforms, etc. they are part of. The majority of them participate in Unions of farmers, in relevant Networks, Chambers of Agriculture, Forums, Federations of Producers and Producers organizations.

Subsequently, they were asked (Q56) to declare how often they attend on networking events, meetings or workshops at an annual basis and most of them have replied 1 to 2 times per year (51%) (Figure 91). Afterwards, they were asked if they believe that the networks they participated provide enough information for AOPs & DSTs (Q57). 58% has replied 'No' and 42% 'Yes' (Figure 92). The participants who had replied 'No' were asked (Q58) to indicate if this should be a service provided by the networks they participate. 96% has replied 'Yes' indicating a possible service for this kind of organizations (Figure 93).

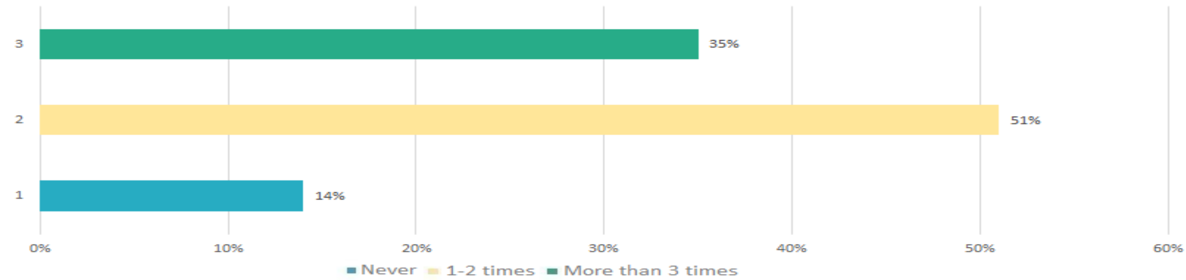

Figure 93: Frequency of attending networking events

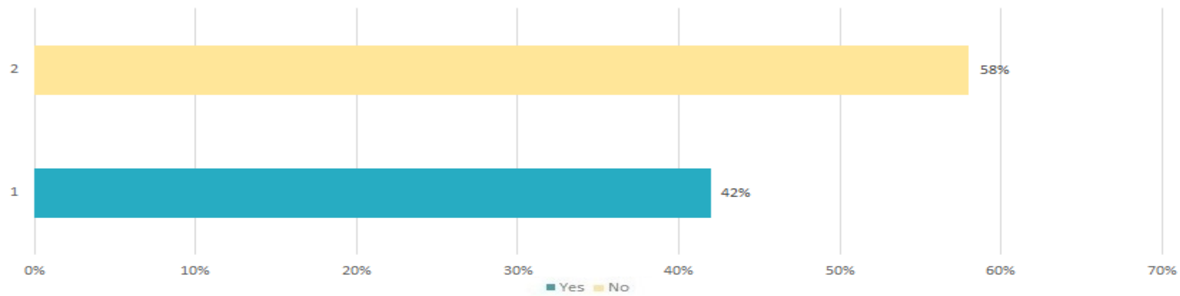

Figure 94: Information provided from networks for AOPs & DSTs

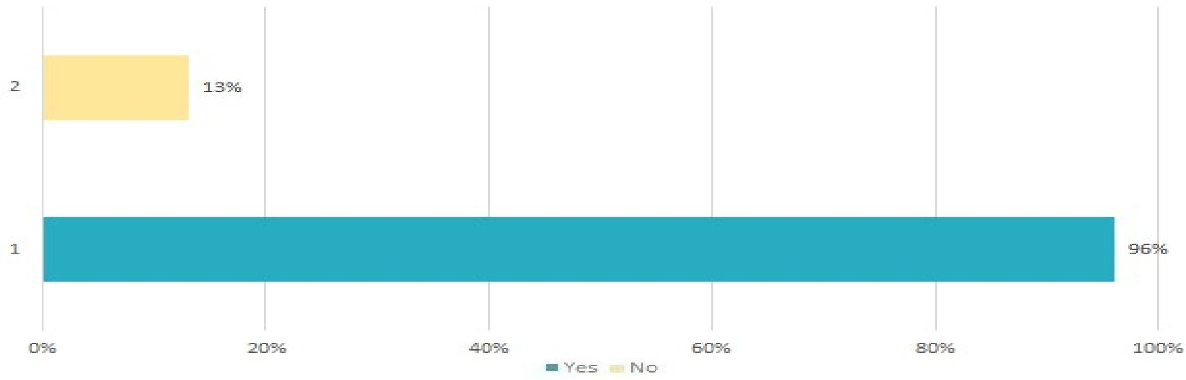

Figure 95: Services provided by networking organizations

4.1.5.5. Standards

The fifth part of this section has investigated the awareness of the existing standards, such as ISO 22005, ISO 17989, ISO 15903:2002, ISO 15003, National etc. (Q59). 83% said that they do not know any standard and only 17% said yes, indicating an extremely low level of awareness for standards (Figure 94).

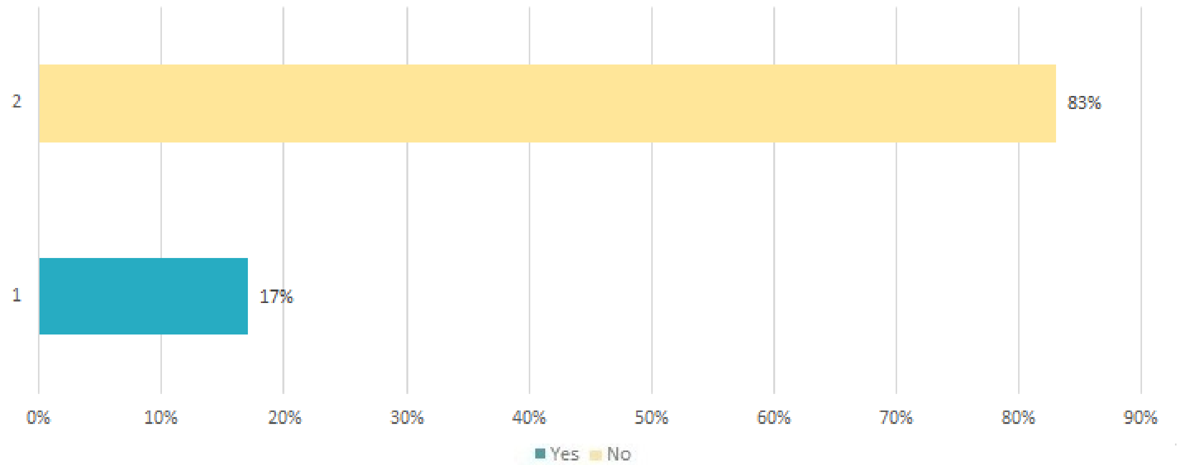

Figure 96: Awareness for the standards

The participants who have responded 'Yes' were asked to indicate the standards they know providing the list below.

- ÖNORM Standards
- ISO 22005
- ISO 17989
- ISO 15003
- ISO 22517
- ISO 9001
- GLOBAL CAP/GRASP
- AGRO 201, 202
- IFS
- BRC

- ISO 14001
- FSSC 22000
- ISO 45001

Following, the participants were asked (Q61) to indicate which Standards they find more useful in the production lifecycle and they have indicated all the above. Next, the participants were asked (Q62) to mention the main role and benefits of standards providing the following opinions.

- Specific guidelines to produce food for people and animals.
- Quality assurance.
- Standardization of processes.
- Common line and policy for producers, control of processes, post-harvest control conditionsand public / consumer protection.
- Confirmation to the end user that the product is safe.
- Fairness, transparency and competitiveness against third countries.
- Continuous improvement.
- Management of the resources use.
- Food safety and health
- Better management of the activities developed by companies and producers
- Business audits according to standards provide opportunities to highlight shortcomings in the business and to act.
- Better control and follow-up.

In the last question the participants were asked (Q63) to indicate gaps or issues that must be standardized in their sector and the following suggestions have been proposed.
Standards for the

- Precision agriculture
- Use of sensors
- Information technology
- Health and fertility of soils

The questionnaire was finalized by asking the participants if they want to receive information about PestNu project activities and results (Q64). 56% has declared ‘Yes’ and 44% ‘No’. The participants who had responded ‘Yes’ 199 in total, provided their email address to receive relevant information.

5. Conclusions & Recommendations

While the scope and core objective of T1.1is to collect information from the Farm to Fork practitioners regarding their perceptions, needs, drivers and barriers concerning AOP and DSTs and to produce a comprehensive report for the sector which will translate the user requirements for real case situations into systemic ones, providing efficient support for users along the Farm to Fork chain, this section aims to provide the main conclusions and recommendations with regard to the increase of the awareness, the level of information and the penetration of the AOPs and DSTs.

This section contains two parts. The first one contains a list of conclusions arising from the results of survey and the second one a list with recommendations which will help partnership to plan the future activities of the project to as much as possible impactful actions. Even though, the recommendations serve as theoretical suggestions and not as technical feedback, they can be exploited to the project's technical work tasks, offering a motivation for some components to be designed and refined.

5.1. Main Conclusions

Pesticide use, loss of nutrients and Farm to Fork EU Strategy

- The reduction on the dependence on hazardous pesticides use, of the loss of nutrients from fertilizers and of the environmental footprint are considered as very important. Among the practitioners' groups, Agronomists consider them as more important when Farmers' group gives less importance in these issues, but still quite high. The distribution among countries reveals similar level of importance for all countries.
- The participants declare moderate awareness of the F2F. Among the practitioners groups, the Farmers are less aware of theF2F Strategy and at countries level, the UK indicates the lowest levels of awareness. Concerning the achievement of the F2F targets, they are considered moderately feasible with a quite high percentage of Farmers to declare unawareness of their feasibility, indicating a gap in farmers information about the F2F EU Strategy.

Agro-ecological & Organic Practices

- A good level of awareness of the various AOPs is indicated among the practitioners groups, while their demonstration in real case scenarios and their penetration in the participating countries are considered as moderate. The lowest awareness levels are observed in the Farmers group, and the highest in the Agronomists group. Among the consortium countries, Austria performs better, and this is probably correlated to the highest percentage of Organic Farming the country holds within Europe. The UK presents the lowest score of awareness of the AOPs.
- The most preferable sources for receiving relevant information are the 'Websites of relevant public organizations such as Ministries of Agriculture, National Agricultural Organizations, etc.' and the 'Agriculture Universities & Research Centres'.

- The estimation of the participants for how common are the AOPs is that they are moderately common in their countries. Regarding practitioners' groups, they have similar estimation and at country level, Austria ranks first, while Cyprus and the UK show the lowest estimations. The participants have shown a willingness to adopt AOPs in their facilities.
- The estimation of the participants about the existence of appropriate solutions for the nutrient loss and the reduction of hazardous pesticides and fertilizers was moderate. Among the existence of solutions for the reduction of nutrient loss and for the substitution of hazardous pesticides and fertilizers, for the reduction of nutrient loss, the participants believe that there are more solutions. The participants have declared that these solutions have moderately tested in real case scenarios. No significant differences were observed among practitioners' groups and countries.
- A positive behaviour from the side of the local suppliers to promote the biopesticides and the biofertilizers has been observed while the use of biofertilizers or biopesticides by practitioners was average. It seems that in Austria and Spain the local suppliers are performing better.
- Almost the half of the farmers of the survey have used biopesticides and biofertilizers with Austria and Spain to achieve the best scores. An extended list of such products has been used. Regarding the characteristics they take under consideration, price ranks first, followed by safety and effectiveness. The majority of those who haven't used biopesticides and biofertilizers up to now, are declaring quite positive for future use.
- A quite low level of knowledge and familiarity with existing guidelines and regulations were observed. Lack of appropriate information, lack of specific standards and guidelines and lack of well-structured and organized national, mainly, legislation are indicated as the main reasons for this gap.

Digital & Space-based Technologies

- A quite low level of awareness of the DSTs has been observed, lower than the awareness of AOPs. Among the practitioners' groups, Agronomists present the highest awareness and the Farmers the lowest. At countries' level, Spain performs better and Austria gives the lowest awareness. Their demonstration in real case scenarios is estimated as moderate while their penetration in the participating countries is considered low.
- The participants estimate that the DST saren't very common in their countries. Regarding practitioners' groups, they have similar estimations while at country level, Spain and Sweden have the highest scores and Austria the lowest. The participants have indicated a quite low level of DST use while they have declared that if the use of DSTs was taking place in a more organized and collective way, they would have adopted them easier.
- A quite user-friendly data visualization for the existing DSTs was declared while a high level of awareness of the issue of cyber-attacks was observed.
- The usefulness of the three examined DSTs-the in-situ and real-time UVC nutrient analyzers, the AI robotic traps and the autonomous mobile robots - was evaluated as positive. Among the three the in-situ and real-time UVC nutrient analyzers have got the highest score, which means that they seem more attractive and useful to the practitioners. Similar estimation was observed among the practitioners groups and countries.

Impact of PestNu, Incentives, Networking & Standards

- The participants estimate that there is a moderate level of market demand regarding the PestNu technologies. The main reasons indicated for this, were the lack of liquidity, the lack of information for those practices which makes them unattractive, and their limited application. No great interest was observed for such investments.
- Cost seems to be the most important factor for the low adaptation of both DSTs and AOPs, followed by lack of information/training for the available technologies/practices &low familiarity with new technologies. Other reasons indicated from the participants were the age and the low educational level of the farmers, the structure of the agrifood sector, the lack of confidence to the effectiveness of these technologies and the high risk of these investments.
- Funding has been estimated as the most important incentive for the adaptation of both AOPs and DSTs followed by tax reliefs, training and pricing & bargaining models that guarantee a good ROI.
- A strong preference for training activities with physical presence and a low level of awareness of standards were also observed.

5.2. Main Recommendations

Recommendation 1: Communicate more effectively the Farm to Fork EU Strategy and its targets

Even though the practitioners groups consider the reduction on the dependence on hazardous pesticides use, of the loss of nutrients from fertilizers and the environmental footprint as very important, their awareness of the F2F EU Strategy is quite low, especially among the group of Farmers. Taking under consideration that this group will be affected more from the implementation of this strategy, it is of paramount importance to develop informative activities to increase the level of awareness. The activities must be targeted and oriented to specific groups, at regional level and at local languages.

It is also important to raise the awareness of the Agronomists as well, since they are the main advisors of the farmers. Finally, the relevant organizations (Ministries, Farmers Unions and Associations, Cooperatives, etc.) have to develop appropriate communication channels to provide the relevant required information to the farmers, in an easily understandable language.

Recommendation 2: Promote the development of supporting services

To achieve the targets of the F2F EU Strategy it is necessary to provide to the Farm to Fork practitioners supporting services, which will guide and assist them in all their new activities. The supporting services have to include supporting material such guidelines, best practices, codes etc. which will facilitate the exploitation of the new practices and technologies, information points to disseminate and communicate news concerning AOPs and DSTs, advice spots which will help farmers mainly to the implementation of new AOPs and DSTs and training activities. The services have to be targeted and oriented to specific groups.

Recommendation 3: Demonstrate the use of AOPs and DSTs in real conditions

The existing AOPs and DSTs are quite known to the Farm to Fork practitioners but an increase in their engagement and adoption is needed. The analysis reveals that the demonstration of these practices and technologies is limited and therefore is necessary to encourage the organization of demonstration activities which will clearly show the effectiveness of them in the field. Cost, safety and effectiveness have to be important parts of the demonstration activities.

Recommendation 4: Develop viable and realistic business models for the DSTs

Usually, the DSTs include technologies or products which are expensive, highly sophisticated or need a specific expertise to be used. These elements make their adoption from the Farmers unattractive and therefore, there is need for the development of viable and realistic business models for their exploitation. The common use from Farmers groups, the renting frameworks under the auspices of Unions or Cooperatives, the licencing models, etc. have to be examined and proposed to the Farm to Fork practitioners as possible scenarios of exploitation.

Recommendation 5: Encourage the direct knowledge sharing

A great majority of the participants have expressed their strong willingness to participate in training and demonstration activities. Therefore, it is important to organize this kind of activities, mainly face to face, which will increase the familiarity of the Farm to Fork practitioners with the AOPs and DSTs, their knowledge for the reduction in the dependence on hazardous pesticide use and the loss of nutrients from fertilizers and their awareness for the practical use of the AOPs and DSTs. The knowledge sharing activities must be targeted in the various groups of the Agri-food chain (Farmers, Agronomist, suppliers, etc.) at regional level and at local languages.

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7. Annex 1: Questionnaire

Welcome note

Dear participant, welcome to our survey!

The survey lasts about 15 minutes. There are no right or wrong answers, this is about your views. All data is anonymised, and your privacy is guaranteed.
Thank you for helping us gather relevant information!

PestNu is an acronym of a H2020 European Green Deal project which brings systemic solutions under circular economy along the farm-to-fork food production chain, using cutting edge Digital and Space-based Technologies (DST) combined with Agro-ecological and Organic practices (AOP) for reducing the dependence on hazardous pesticides, reducing the losses of nutrients from fertilisers, towards zero pollution of water, soil and air and ultimately fertiliser use.

PestNU consortium (20 partners from 9 different EU countries) targets within 36-months duration to deploy, upscale, field-test and demonstrate novel DST (eg. robots, sensors, Earth Observation mission systems etc) combined with AOP (eg. automated recycling system of agricultural wastes, biofertilisers, biopesticides etc) in novel circular economy food production systems, such as aquaponics and circular horticulture systems as closed/semi-closed hydroponic greenhouses, and in open-field vegetable cultivation, under different conditions, soils and crops (tomato, cucumber, pepper).

In this context a questionnaire was developed to probe the opinions of the practitioners. The responses from the survey will guide us to plan the future the project activities.

We are very interested to hear your insights concerning the reduction of pesticides and fertilizer use and the loss of nutrients. This will support our understanding of your needs and will contribute to the successful project implementation.

Do you have any questions or comments? You can contact us: Project Coordinator, Dr Ria Pechlivani/CERTH (*riapechl@iti.gr*) or Survey Studies Leader, DrFoteini Salta/SEVT (*fotsal@sevt.gr*).

Informed Consent form for survey

By ticking the consent boxes below, I participate in this activity voluntarily. I understand that my participation will involve providing multiple-choice or written responses to a survey, where I will be invited to offer my views about agricultural needs for new technologies.

I understand the following:
• I have read the information explaining the project and understand how this research activity will collect and process my responses, and my personal data if I choose to provide it.
• I will be asked to provide professional or personal views and that the record of my involvement in the research will be kept confidential.
• I have the right to ask questions about my project participation and receive clear answers before making any decision.
• I may refuse to answer any questions I do not wish to discuss. I am free to end my participation at any time.

• My responses to this survey are recorded and digital copies will be kept in secure folders. Any physical copies which are made of my responses will be safely stored by the PESTNu team and will be destroyed when they are no longer needed or five years after the project comes to an end (whichever is sooner).
• If the information I provide is used for the writing of a piece of work to be delivered to the European Commission, or scientific research paper, the consortium will remove my name from that information so that my identity and experiences remain confidential (unless attribution is required and I have consented to it).
• I have been made aware of my rights regarding my personal data and how to exercise them.
• I have been given the contact details of the research team and I have been informed that I am free to contact:

Q1. My participation is voluntary. I have not been pressured or coerced in any way to provide answers to this survey.
Yes
No

Q2. I agree that my responses to this survey can be used by the PestNu Consortium for their work in the project, and my responses can be used for scientific research papers
Yes
No

Introductory Data

Q3. Practitioners: Please specify
Farmers
Farmers' agents (e.g. farmers' associations/co-operations, agrifood wholesalers, supermarkets, grocery stores, etc)
Agricultural suppliers and services (eg. stores that sell pesticides, fertilisers, plants etc)
Agronomists or related professions

Q4. Country
Greece
Italy
Spain
Sweden
Portugal
Ireland
Cyprus
Austria
UK
Other

General

Q5. How important is it for you the reduction onthe dependence on hazardous pesticides use besides their high efficacy compared to alternative organic methods (pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or the environment)?

1 (Not at all important)
2
3
4
5 (Extremely important)

Q6. How important is for you the reduction of the loss of nutrients from fertilizers, thereby reducing the need for chemical fertilisers?

1 (Not at all important)
2
3
4
5 (Extremely important)

Q7. How important is it for you the reduction the environmental footprint (CO_2 emissions)?

1 (Not at all important)
2
3
4
5 (Extremely important)

Q8. How aware are you of the targets of the Farm 2 Fork EU strategy for sustainable safe, nutritious and healthy food production?

1 (Not at all aware)
2
3
4
5 (Extremely aware)

Q9. How feasible do you consider the target set by Farm2Fork for reducing the overall use and risk of chemical pesticides by 50% and the use of more hazardous pesticides by 50% by 2030?

1 (Not at all feasible)
2
3
4
5 (Extremely feasible)
I don't Know

Q10. If you have selected 1 or 2, please indicate the reasons you consider the reduction not feasible.

……

Q11. How feasible do you consider the target set by Farm2Fork for Reducing nutrient losses by 50%, which will reduce the use of fertilizers by at least 20% by 2030?
1 (Not at all feasible)
2
3
4
5 (Extremely feasible)
I don't Know

Q12 If you have selected 1 or 2, please indicate the reasons you consider the reduction not feasible.
……

Agro-ecological and Organic Practises (AOPs)

<u>Agroecological practices</u>: Biofertilizers, natural pesticides and promotion of natural enemies, crop choice, crop variety and rotations, irrigation and drainage, intercropping and relay intercropping, agroforestry with timber, fruit, or nut trees, allelopathic plants, direct seeding into living cover crops or mulch, and integration of semi-natural landscape elements at field and farm or their management at landscape scale, etc.

<u>Organic farming practices</u>: The use of chemical synthetical pesticides and fertilizers is prohibited. The practices advocate healthy products free from components that may harm humans and nature and include but are not limited to industrial pesticides, fertilizers, clones, GMOs, chemical medications, hormones, growth-boosters, etc.

In the PestNu project, Agro-ecological and Organic Practises listed below will be further deployed, upscaled, field-tested and demonstrated:

- *Automated self-controlled system for microalgae based biofertilizer production*
- *Microalgae biofertilizer based on recycled drainage wastewaters*
- *Biopesticide with nutritional effect produced by recycled materials from agrofood Industries*
- *Integrated Fertilization/Nutritional programs*

Q13. How aware are you ofAgro-ecological and organic practices (AOP) in general?
1 (Not at all aware)
2
3
4
5 (Extremely aware)

Q14. If you have selected 4 or 5, do you think that AOPs have been tested enough thoroughly in real case scenarios?

1 (Not at all demonstrated)
2
3
4
5 (Extremely demonstrated)
I don't Know

Q15. Please indicate the sources you want to receive information for the Agro-ecological and organic practices:

- Websites of relevant public organizations (Ministries of Agriculture and Agrofood, National Agricultural organizations for the protection and insurance of agricultural activity, etc)
- Websites of Farmers Unions & Agricultural Co-operations
- Agriculture Universities & Research Centres
- Agronomists & Agricultural Suppliers workshops on-site
- Agro- Digital Advisory Platforms by registration
- No I don't want to get informed for new AOPs

Q16. How common are the agro-ecological and organic practices (AOP) in your country?

1 (Not at all common)
2
3
4
5 (Extremely common)
I don't Know

Q17. How likely would it be for you to adopt AOP on your facilities?

1 (Not at all likely)
2
3
4
5 (Completely likely)
Not Applicable

Q18. Would it be more likely to adopt agro-ecological practices if they were applied to a higher extent by others in your region?

Yes
No
Not Applicable

Q19. Do you think that there are appropriate solutions for the reduction ofnutrient loss?

1 (Zero Solutions)
2

3
4
5 (Multiple Solutions)
I don’t know

Q20. If you have selected 4 or 5, do you think that these solutions have been tested enough in real case scenarios?
1 (Not at all demonstrated)
2
3
4
5 (Extremely demonstrated)
I don’t know

Q21. Do you think that there are enough alternatives for the substitution of hazardous pesticides and fertilizers?
1 (Not at all alternatives)
2
3
4
5 (A lot of alternatives)
I don’t Know

Q22. If you have selected 4 or 5, do you think that these alternatives have been tested enough in real case scenarios?
1 (Not at all demonstrated)
2
3
4
5 (Extremely demonstrated)
I don’t know

Q23. Do your local agricultural suppliers and advisors promote the use of biopesticides and biofertilizers?
Yes
No
Sometimes

Q24. Have you ever used biofertilizers or biopesticides in your fields?
Yes
No
Not Applicable

Q25. If yes, what kind of biofertilizers or biopesticides have you used?

……

Q26. If yes, rank the main characteristics/features you are looking for in biofertilizers or biopesticides?

Efficiency

Price

Safety

Q27. If no, how likely would it be for you to make use of biofertilizers or biopesticides in near future?

1 (Not at all likely)
2
3
4
5 (Completely likely)

Q28.Do you think that there are appropriate guidelines, & regulations regarding the reduction of losses of nutrients, pesticides and fertilizer use implemented in the field?

1 (Zero Guidelines)

2

3

4

5 (Multiple Guidelines)

I don't Know

Q29. If you have selected 1 or 2, please indicate what main focuses may be missing

……

Q.30 Please indicate some of the guidelines & regulations that are familiar to you

Q31. Do you have any ethical concerns or worries about the use of agro-ecological and organic practices?

……

Digital and space-based technologies

Digital and space-based technologies are tools, systems, and methods for precision and smart agriculture eg. Geographical information systems, remote sensors for water and nutrient stress and insect detection, proximate sensors for soil (N concentration and pH) and crop conditions, robots both ground and aerial for monitoring yields, Decision Support Systems for *integrated pest and nutrient management, etc*

In the PestNu project, Digital and Space Technologies (DST) listed below will be further deployed, upscaled, field-tested, and demonstrated in aquaponics/greenhouses and open-filed vegetable cultivation:

- *Artificial Intelligence robotic trap for real-time insects monitoring and management*
- *Satellite-based monitoring systems of crops condition such as soil/plant nutrients (e.g. fertilizers) and pest plant inputs (e.g. herbicides, bactericides etc)*
- *Autonomous self-navigating robot for pesticide (insects, fungal diseases) monitoring and 3D spot spraying.*
- *In-situ & real-time UVC nutrient analysers (Nitrite/ Nitrate, Phosphate/ Ammonium).*

Q32. How aware are you ofthe use of digital and space-based technologies (DST) in agriculture in general?

1 (Not at all aware)
2
3
4
5 (Extremely aware)

Q33. If you have selected 4 or 5, do you think that DSTs have been tested enough in real case scenarios?

1 (Not at all demonstrated)
2
3
4
5 (Extremely demonstrated)
I don't Know

Q34. How common is the use of digital and space-based technologies in your country?

1 (Not at all common)
2
3
4
5 (Extremely common)
I don't Know

Q35. If it was initiated the use of DST through licensing, renting frameworks from Agriculture cooperatives or farmers' unions, would you apply them to your fields?

Yes
No
Not Applicable

Q36. Have you ever used precision agriculture technologies/tools such as robots, sensors, in-situ analysts, satellite data, etc?

Yes

No
Not Applicable

Q37. If no, how likely would it be for you to make use of some of them in near future?
1 (Very unlikely)
2
3
4
5 (Very likely)

Q.38 Please indicate how user-friendlyis the data visualization ofexisting precision agriculture digital and space-based commercial systems are (if you have used any)?
1 (Very Bad)
2
3
4
5 (Very Good)

Q.39 How important is it for you the protection of DST data from cyber-attacks?
1 (Not at all important)
2
3
4
5 (Extremely important)

Q.40 How useful do you find the use of AI robotic traps for real time pest monitoring and in reducing food losses in the future?
1 (Not at all useful)
2
3
4
5 (Extremely useful)

Q41. How useful do you find the use of autonomous mobile robots for pesticide monitoring spraying?
1 (Not at all useful)
2
3
4
5 (Extremely useful)

Q42. How useful do you find the use of in-situ and real-time UVC nutrient analyzers for the control of soil health?

1 (Not at all useful)
2
3
4
5 (Extremely useful)

Q.43 Do you have any ethical concerns or worries about the use of digital and space-based technologies for food production?
……

Impact of PestNu, Policies, Training/Networking & Standards

Impact of PestNu

Q44.During the PestNu project, the DSTs and AOPs will be initially tested at pre-pilot and pilot sites. Do you want to participate actively in the pre-pilot and pilot sites activities for co-design, training and policy making?
Yes (indicate your e-mail at the end of survey)
No

Q45. Do you think that there is market demand for innovations such as PestNu AOPs'?

1 (Not at all)
2
3
4
5 (Extremely high)

Q46. If you have selected 1 or 2, please indicate what main factors may be missing

……

Q47. Do you think that there is market demand for technologies such as PestNu DSTs'?

1 (Not at all)
2
3
4
5 (Extremely high)

Q48. If you have selected 1 or 2, please indicate what main factors may be missing
……

Q49. What is your willingness to invest inPestNu AOPs' and DSTs' market introduction?

I'm in no position to decide on investments
1 (None)
2
3
4
5 (High)

Incentives for the DST and AOP implementation

Q50. Which are the main factors that contribute to the low adoption of existing DSTs and AOPs?
Cost
Lack of information/training for the available technologies/practices
Low familiarity with new technologies
Other (Please indicate)

Q51. Which of the following incentives could encourage EU farmers to adopt Integrated Pest Management and Integrated Nutrient Management technologies and strategies, like PestNu DST and AOP innovations (rank from 1 to 4)?

- Tax reliefs
- Funding
- Training
- Pricing and bargaining models that guarantee ROI

Training

Q52. Are you interested in cooperating or getting advice from research providers (e.g. universities, research centers, etc.) for the AOPs and DSTs used in PestNu?
Yes (indicate your e-mail at the end of survey)
No

Q53. Are you interested to get trained regionally on the use of:
DST
AOP

Q54. Which kind of training do you think will be more effective for these technologies (more than one choice)
On line demonstration workshops
On site demonstration workshops
On line training sessions
Face to face training sessions
E-learning platform

Networking

Q55. Which networks, associations, platforms, projects etc. are you part of?

………

Q56. How often do you attend networking events, meetings or workshops in one year?

Never
1-2 times per year
More than 3 times per year

Q57. Do you think that these networks associations, platforms you participate provides you enough information for AOPs & DSTs

Yes
No
Not Applicable

Q58. If no, please indicate if this must be a service provided by them

Yes
No
Not Applicable

Standards

Q59. Are you aware of standards (ISO 22005, ISO 17989, ISO 15903:2002,ISO 15003, National etc)?

Yes

No

Q60. If yes, what standard do you know?

………

Q61. What standards do you find the most useful during your production lifecycle?

………

Q62. What is the main role and benefit of standards?

………

Q63. Are there any gaps or issues in your sector that you think should be standardized?

………

Personal Data Management

WHAT PERSONAL DATA WILL BE COLLECT FROM YOU?
With your consent, we will collect your e-mail address, if you consent to being contacted to receive information for the project and the training activities it will develop.

The Data controller is: Federation of Hellenic Food Industries (SEVT). 340, Kifissias Avenue 154 51 Neo Psychiko, Greece. Contact: DrFoteini Salta (*fotsal@sevt.gr*).

The purpose of processing will be to contact you with further information about the PestNu research project. The legal basis for this processing is your consent. Your personal details will be kept separately from your survey responses and will not be published. The survey responses will inform research reports from the PESTNU project, but any information made public will not identify and individual. The legal basis for this processing is your consent.

Personal data will only be shared within the PESTNu project partners working on this research and will not be publicly available.

These data will be destroyed when they are no longer needed, or five years after the end of the project (whichever is sooner).

WHAT ARE YOUR RIGHTS AS A DATA SUBJECT?
In accordance with principles of research ethics and EU data protection regulations, you have rights regarding how your personal data is processed. Here are your rights and how we can fulfil them:
-Rights to access personal data processed about you, and the right for these data to being a portable form – If you request access to personal data that we hold about you, we will provide you with these data in an easily accessible format.
-Right to rectify personal data held about you – If you think the personal data that we hold about you is in accurate or incomplete, you can correct or complete it.
-Right to restrict the processing of your personal data – If you want to restrict the way we process your personal data, you can request that we do so.
-Right to request your personal data is erased– If you want us to delete your personal data from our systems, you can request that we do so.
-Right to leave the research activity – If you wish to withdraw from participating in this survey, you can do so at any time without negative consequences and your personal data will not be processed.
-Right to complain to a supervisory authority – If you feel we have not adequately dealt with your requests, you can complain to the national data protection authority.
This survey is managed by The Federation of Hellenic Food Industries, and you can find information on the Hellenic Data Protection Authority here: *https://www.dpa.gr/en*
We aim to fulfill all requests. In accordance with data protection legislation, some requests may be rejected.

WHO SHOULD YOU CONTACT FOR MORE INFORMATION?
For more information:
-on the PestNu project, you should contact Dr Ria Pechlivani, PestNu Project Coordinator (*riapechl@iti.gr).*
-on this survey, you should contact DrFoteini Salta, Project Manager/SEVT (*fotsal@sevt.gr*).

-on the processing of your personal data, you should contact Dr Matthew Hall, Research Analyst/Trilateral Research (*matthew.hall@trilateralresearch.com*)

Would you like to receive information for the PestNu project activities and results?

Yes (Indicate your email address)

No

E-mail

………………………………………………………………………………………………..

End of Survey

Thank you for taking part in this survey and contributing to our understanding of what Farm to Fork practitioners think about digital and space-based technologies and agro-ecological and organic practices for reducing the pesticides use and nutrients loss.

Your input will be imperative for us to identify key elements and perceptions that should be considered during the implementation of our project.

Do you have any questions or comments? You can contact us: Project Coordinator, Dr Ria Pechlivani/CERTH (*riapechl@iti.gr*) or Survey studies Leader, DrFoteini Salta/SEVT (*fotsal@sevt.gr*).

Feel free to follow the PestNu social media accounts for more information!

- LinkedIn: *https://www.linkedin.com/company/76532558*

- Facebook: *https://www.facebook.com/PestNu/*

- Twitter: *https://twitter.com/PestNu_*

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