INPACT

Project Title: Integrated plant protection as an answer for climate change
Project N°: 2021-1-CZ01-KA220-VET-000025827

Survey on digital use

Summary report

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Content

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Introduction

Throughout history, agricultural production has undergone many changes which have influenced the general human advancement. Seemingly, the exceptional population growth in the last century brought unfortunate consequences in the form of a demand for quality food supply in increasing quantities. Crop production is severely affected by climate change and extreme weather conditions. Agricultural insect pests are also affected by the environmental changes, but as they adapt well to different conditions of global warming, it is expected that their geographical range expands. Their number increases by overwintering or invasion by mitigatory pests, and leads to insect-transmitted plant diseases and reduced effect of pesticides. As a result, the risk of crop loss is highly increasing, causing economic issues and challenges to human food security. As the pest problem exacerbates, adaptive pest management strategies need to be developed.[1]

INPACT project focuses on sustainable crop protection as this sector is affected by restricted information flow and by climate change. The consortium will develop new training materials to facilitate environmentally-friendly production in the sector. The general objective of the project is to provide information on effective control measures against current and emerging crop pests, as effective pest control is one of the most crucial factors for farmers, directly affecting cost structure, profit accessibility, and food safety. On one hand, the INPACT project will contribute to increasing the knowledge of the target group of environmentally-friendly plant protection methods in order to reduce their use of pesticides. The involvement of relevant experts in this relatively new topic will ensure that current technologies and environmentally-friendly best practices will be selected and used to create training materials to help farmers and advisors devise strategies for protection against invasive pests. For this reason, the project aims: to survey the needs of the target group on which content and tools could support the better understanding of plant protection issues; and to develop online learning materials which include practical information on integrated pest management in the fruit and vegetable sector, and to specify stakeholders and professional bodies targeted in the project on national and international levels.

The **specific objectives** of the project are as follows

- To contribute to the development of knowledge in the target groups regarding environmentally-friendly plant protection methods in order to reduce the use of pesticides:
- To provide access to information to wider target groups, particularly those isolated during the lockdown.

[1] Skendži´c, S.; Zovko, M.; Živkovi´c, I.P.; Leši´c, V.; Lemi´c, D. The Impact of Climate Change on Agricultural Insect Pests. Insects 2021, 12, 440. https://doi.org/10.3390/insects12050440

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- To help reduce pesticide use, and encourage the application of new technologies and protection against invasive pests as tools to mitigate the negative effects of climate change.
- To raise awareness of the climate change impact on emerging pests of various crops and the dual role of farmers decision in this sector that is both is affected and affects the environment.

Consortium

The INPACT project partners are from Czech Republic, Bulgaria, Romania, Hungary, Poland and Greece. They have a wide range of expertise in the field of agriculture, plant protection and environment protection.

The Project leader is CZU (CZ) is an educational institution and a top specialist in plant protection.

AU (BG) is a university in Bulgaria in the area of agricultural and life sciences.

Civitas (RO) is a foundation that cooperates with local communities, farmers, and small producers from the region.

MAICh (GR) is an intergovernmental organisation providing postgraduate (MSc) education, and VE trainings to young agronomists and farmers using tailor-made curricula in agriculture.

ARID (PL) is an association working in the area of modern agriculture that cooperates with several agricultural and scientific organisations.

TREBAG (HU) is an SME that runs trainings and also develops various kinds of training materials. It has many years of experience researching and producing materials in the field of agriculture and conducting surveys and research.

KUJ (HU) is the most practice-based company in the consortium. Its staff consists of highly experienced and qualified agricultural professionals, who have not only taught integrated plant protection and advised decision-makers in agriculture related topics for decades, but also are active producers and farmers.

Project results

INPACT project will have 3 main results:

- PR1: Survey on the digital literacy and needs of the target groups
- PR2: Training material on plant protection with n novel approaches and emerging pests - that negatively affect crop yields
- PR3: Online platform and digital training material

This report covers the second subtask of PR1 (PR1/A2): Stakeholder analysis

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Aims of the survey

The aim of the survey is to identify areas where the special knowledge produced by the project will be transferred and to choose the most appropriate way of the knowledge transfer.

Together with the stakeholder analysis (PR1/A2) this survey is the common ground for the further developments of training materials and visual tools.

Based on PR1 a general curriculum will be developed but each partner country will have the opportunity to complete it with country-specific topics. For this reason the questionnaire (shown in the next – Methodology – section) was created.

Methodology

In order to analyse the needs of farmers in all the partners' countries, the consortium has conducted a survey using a Google Forms questionnaire. The main goal was to get all the relevant information about the farmers to develop the best suited material for them.

Eight general and ten country-specific questions were asked in order to identify the most important problems and required content for the curriculum. Seven questions were asked about the visual tools they can use for the knowledge transfer. The respondents could choose between multiple choice and free text. The template of the questionnaire is in Attachment 1.

First, and foremost we had to find out which type of pests affect their crops the most and what is their current approach in combating them. Knowing the extreme environmental conditions that the given countries face due to climate change is important to exclude materials that would not work in the new condition, and substitute them with those which may have been efficient only in other countries before. Knowing what information farmers seek is significant from the point of usefulness and success, but it is a waste of time and energy if the state of digital literacy is not considered, and the material cannot be reached due to their lack of computer skills.

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Results

1. General

1.1. Number of answers

In all countries the minimum number of responses was achieved. In total 121 completed questionnaires were collected (Table 1), allowing a comprehensive and detailed picture of the present situation in terms of plant protection to be determined.

Country	Number of answers
Czech Republic (CZ)	18
Bulgaria (BG)	13
Romania (RO)	24
Hungary (HU)	24
Poland (PL)	20
Greece (GR)	22
Total	**121**

Table 1. Number of answers

1.2. Age distribution

When developing the curriculum, all age groups have to be taken into consideration, as they are well represented. Creating a material that meets the needs and expectations of so many people might be a challenge, but the writers of the booklet believe that every material should be accessible to all ages.

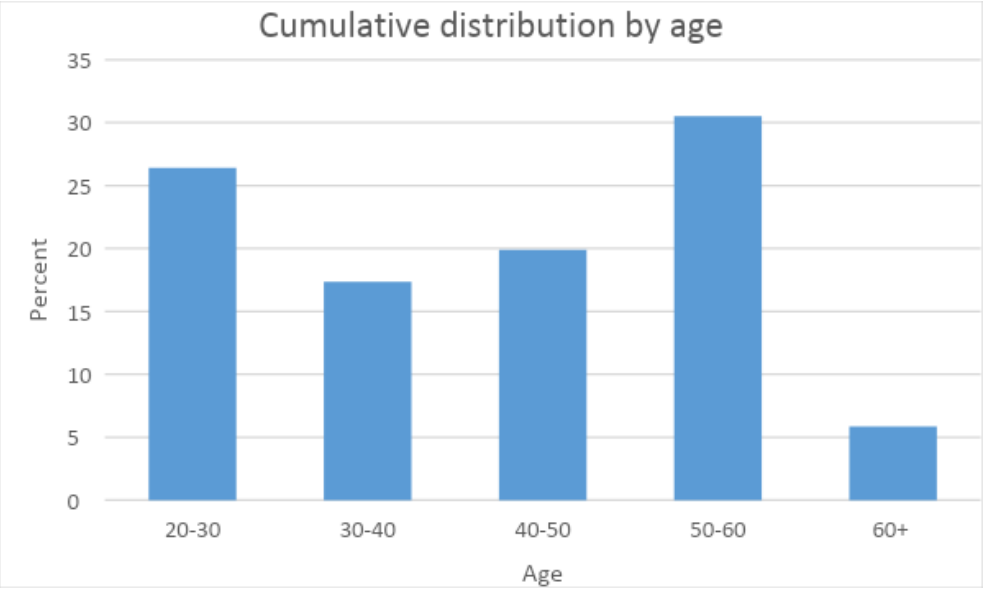

Figure 1. Cumulative age distribution of respondents

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The following table summarises the age group of the largest number of respondents per country

Country	Age group with largest number of respondents
Czech Republic (CZ)	20-30
Bulgaria (BG)	20-30
Romania (RO)	30-40, 50-60
Hungary (HU)	50-60
Poland (PL)	40-50
Greece (GR)	50-60

Table 2. Age group of largest number of respondents

1.3. Experience of the respondents

We investigated how many years of professional experience the respondents possess as well as the size of the agricultural enterprise in which they had gained this experience.

Similarly to the even distribution of respondents' age, their professional experience also showed even distribution (Figure 2). That means, the curriculum should focus on farmers who have a lot of experience and also on those who have little.

In Figure 3 the size of the farm is shown. Most of the respondents don't work on farms, but among those who do, small-sized, perhaps family-run farms predominate. This suggests that farmers who are working alone, and not large professional enterprises belong to the main target group.

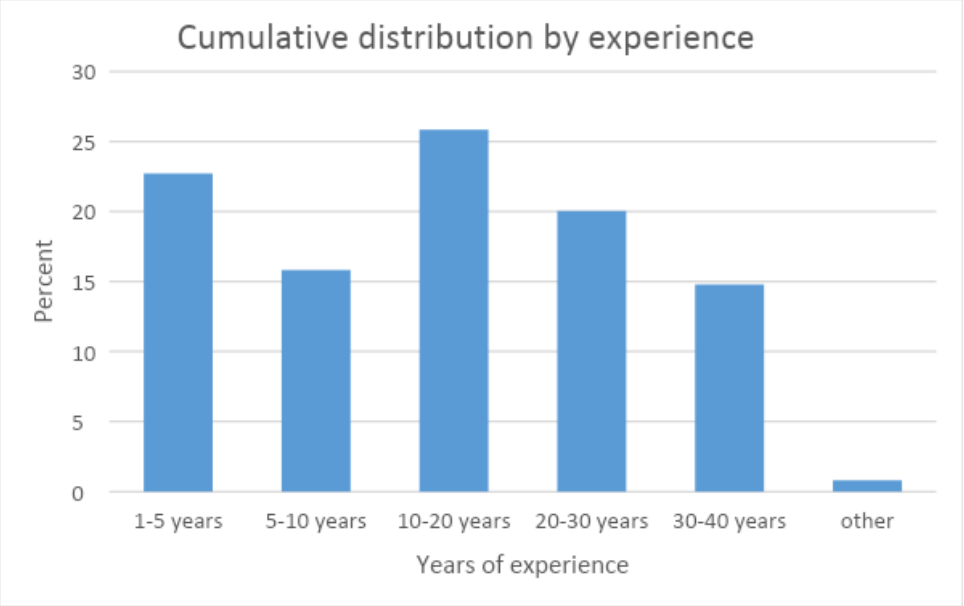

Figure 2: Experience of respondents

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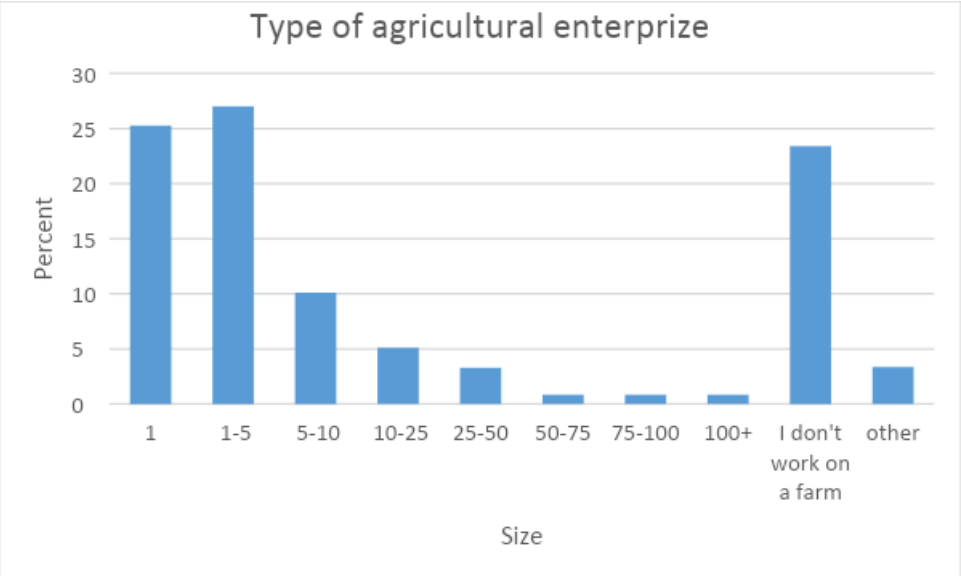

Figure 3: Size of farm

1.4. General topics

In the next part of the questionnaire the general topics of interests of the respondents was assessed.

Figure 4 shows the overall type of the production in the partner countries. This is mainly crop, fruit and vegetable production, while a lower number of respondents a few respondents are working with greenhouses, and some are engaged with animal husbandry.

In the partner countries, respondents are mostly concerned about the damage caused by insects (Figure 5). Fungi are also a major threat, while viruses, bacteria and the other pathogens (potato beetle, invasive weed borers) are perceived to be less of a problem.

We asked the respondents what types of pest control they use (Figure 6) and, in parallel, which they would like to be informed (Figure 7). They mainly use cultural control (e.g. crop rotation, tillage, etc.) and chemical control. But they are also very interested in biological (e.g. using predators, parasitoids, inducers of plant defence, etc.) and mechanical (e.g. traps, etc.) control methods. The curriculum will include the mentioned topics.

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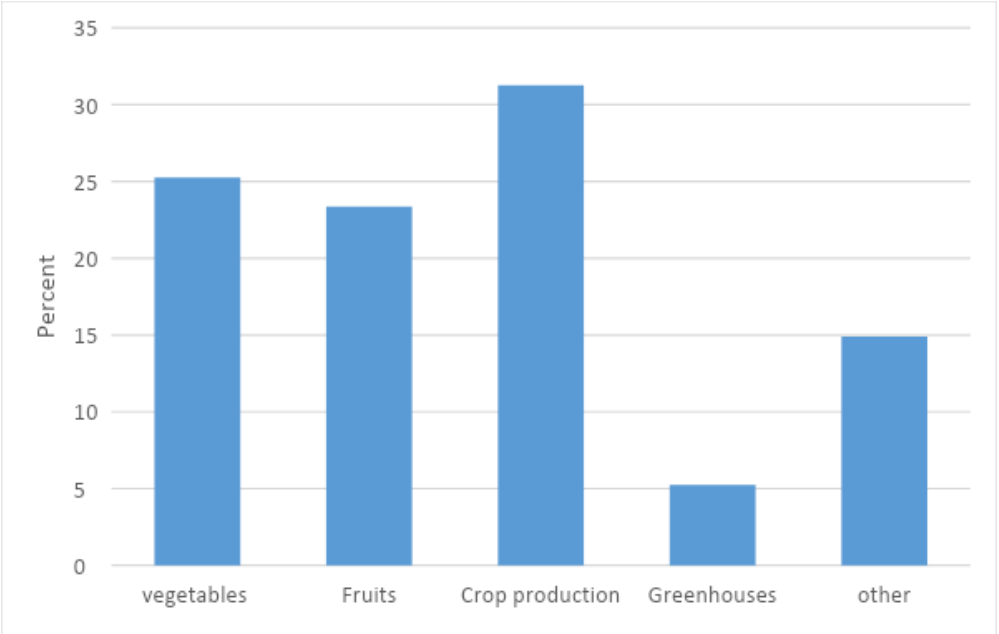

Figure 4: Production type

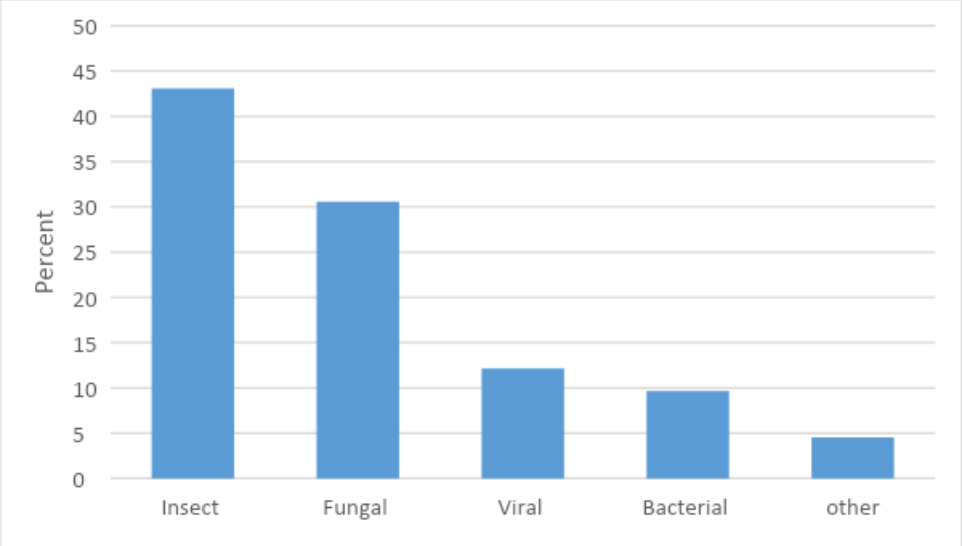

Figure 5: Type of pests causing concern

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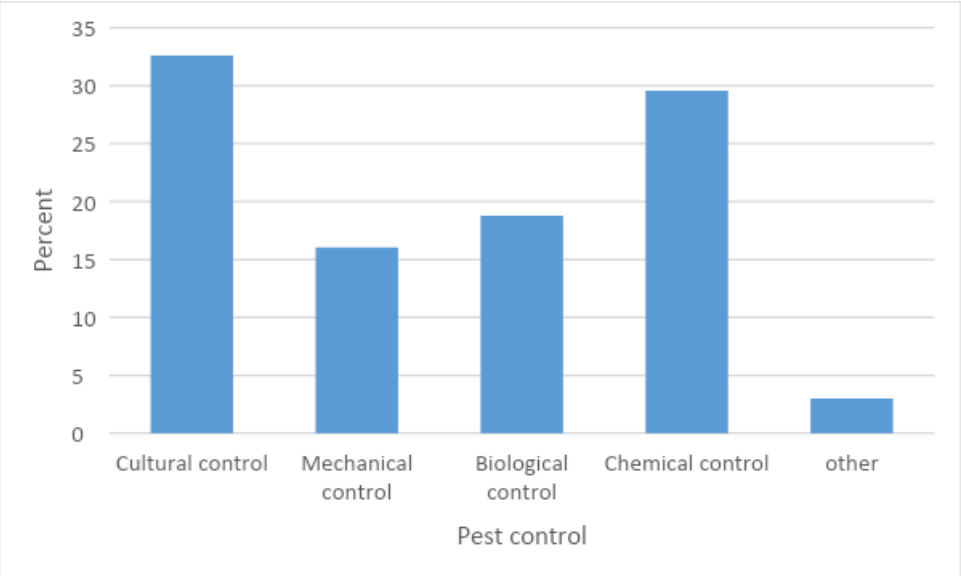

Figure 6: Type of pest control in use

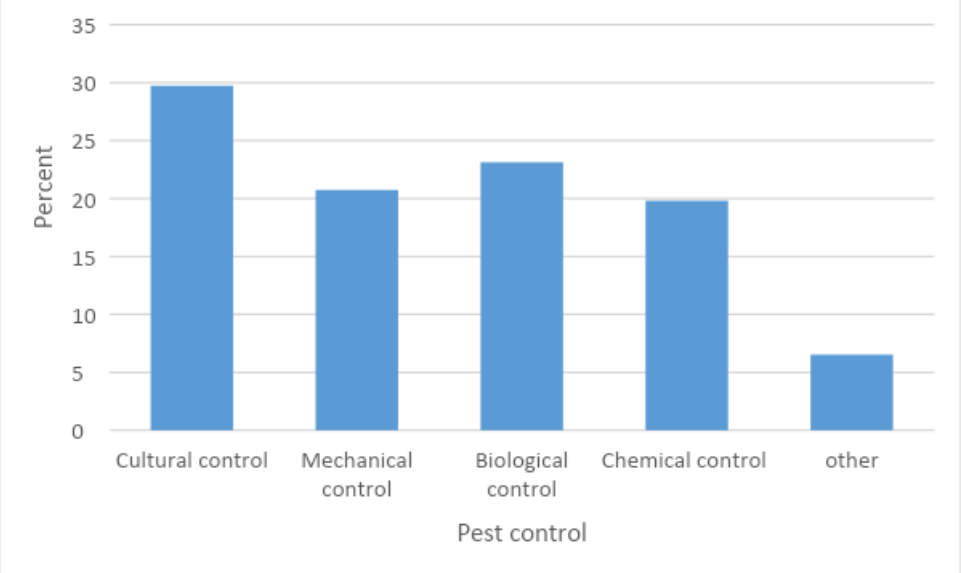

Figure 7: Type of pest control for information

The respondents were asked if there are types of pest control specific to their counties. Below is shown the cumulated list of these methods from all the partner countries:

- Biological control:
  - *Mycorrhiza* fungi to fight root pathogens predominantly,
  - Using biological foliar fertilisers for general enhancement of plant health state and defence,
  - Mixed cultivation that enhance biodiversity in order to increase natural populations that combat pests and microorganisms (provide ecosystem services),
  - Beneficial organisms

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- Plant associations
- Spaying with Greenman Agro products
- Biofungicides
- Colour and sex pheromone insect traps
- The use of *Trichogramma* against *Lepidoptera* insect pests
- The collection and use of forecasting and monitoring data

- Other:
  - Planting African marigolds as a mean to deter aphids (repellent)
  - Eggshell, coffee grounds, ash, are recommended as barriers against gastropods

- Physical methods
  - Hoeing
  - Manually picking potato beetles and snails
  - Pruning in the orchard
  - Plant propagation maintaining proper hygiene measures

In general, the importance of integrated pest management (IPM) was highlighted.

1.5. Digital literacy

The digital skills were also evaluated, which platforms they are familiar with and they use (see Figure 8), as well as the degree of usage and frequency (Figure 9). Respondents were asked to rate their digital skills on a 5-scale measure (Figure 10).

It can be argued that farmers and agricultural professionals are active users of digital tools, most of them being daily internet users, and it is unlikely that they would have any problems using a new platform. Although, they did not rate their digital skills as excellent, but we assume that by this they mean that they are users, not programmers. Finding a suitable means for information delivery might be a challenge, as the least used digital tool is the online learning platform.

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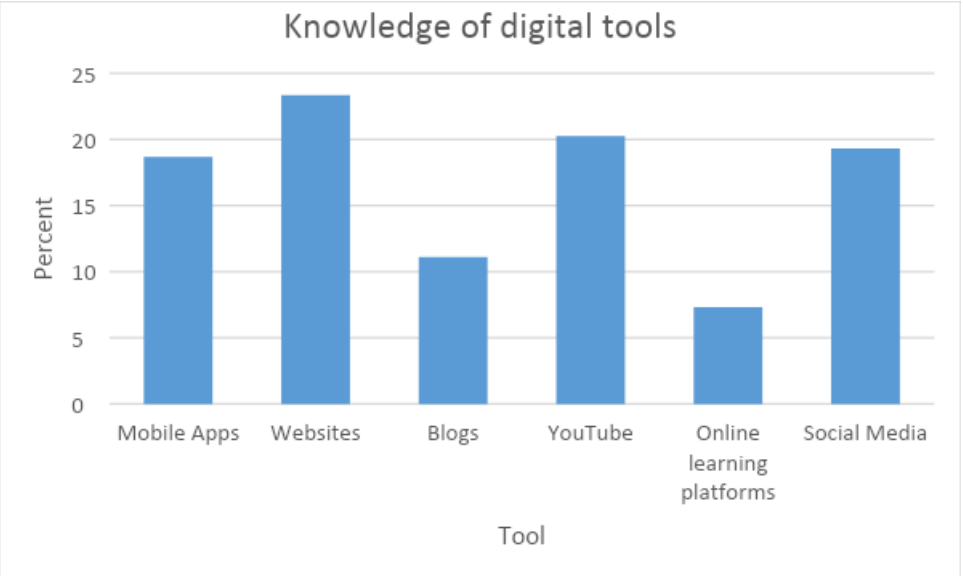

Figure 8: Knowledge and use of digital tools

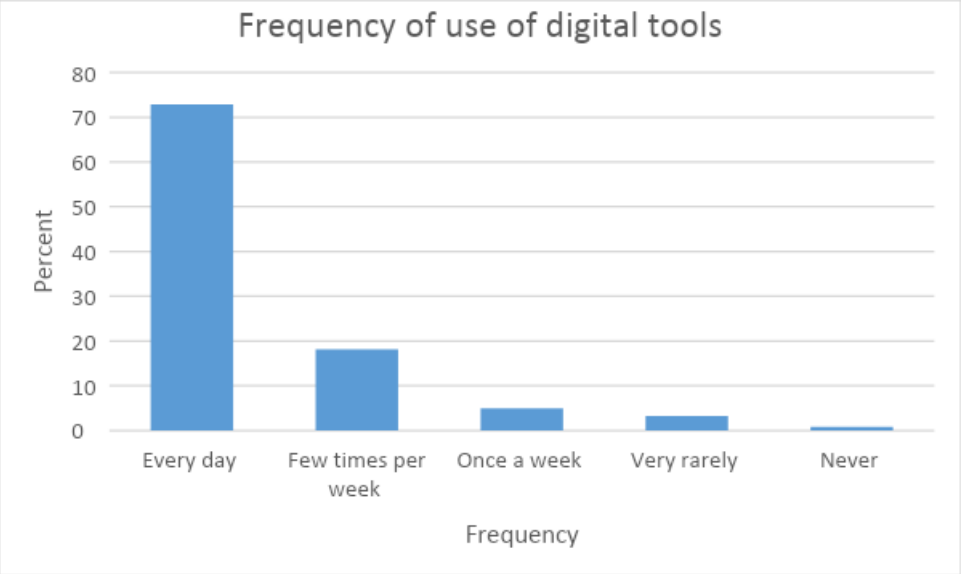

Figure 9: Frequency of use of digital tools

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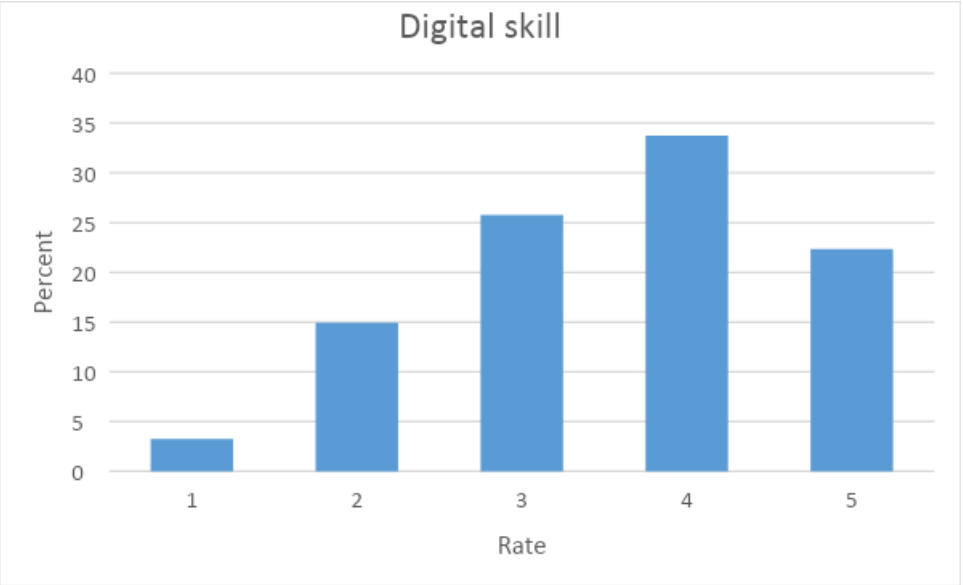

Figure 10: Digital skill

1.6. Knowledge transfer

The means used to obtain plant protection knowledge and the most interesting topics were examined.

The first part of the questionnaire concerned the current situation: how they currently access information on plant protection (see Figure 11) and what agricultural training/information is available in their country (Figure 12). It can be seen that farmers and agricultural professionals both use the internet extensively as a source of information and also participate in online training courses. This, together with face-to-face trainings where they can participate with their colleagues, are probably the best means to transfer knowledge.

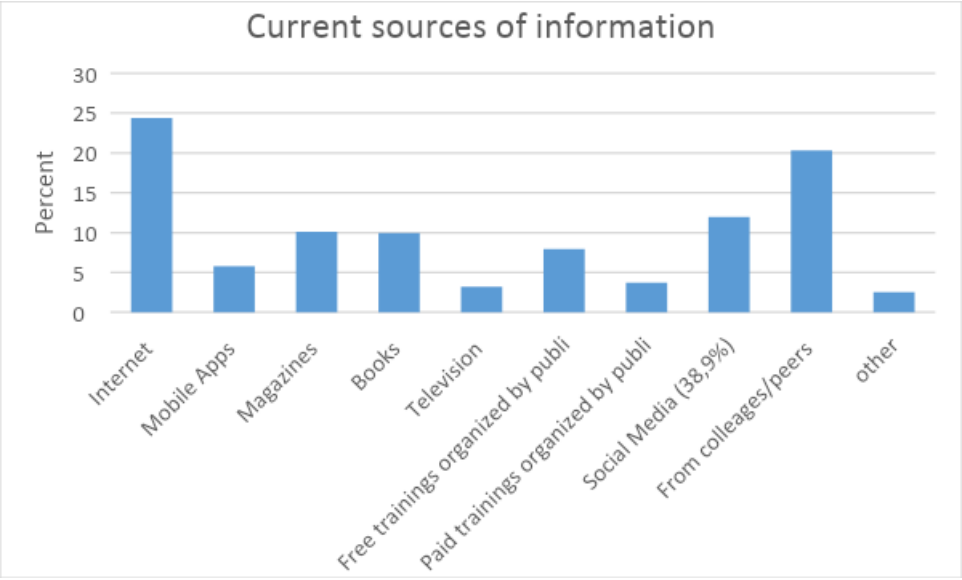

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Figure 11: Sources of information

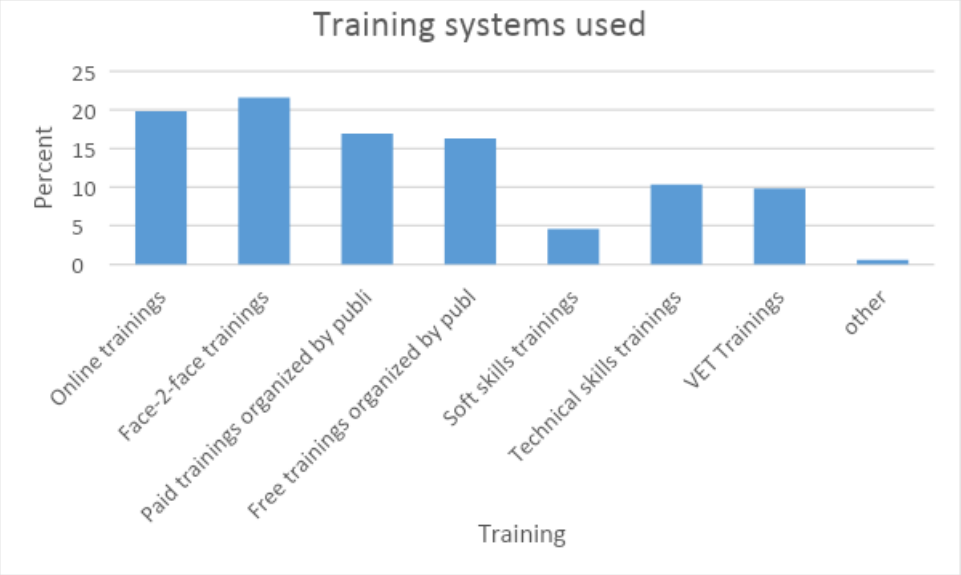

Figure 12: Agricultural trainings

In the second part of the questionnaire, the needs for training materials were examined, and the topics that respondents considered the most important to learn more about (Figure 13) and which tools they would prefer as a source of information (Figure 14). It can be clearly seen that they prefer learning about environmentally friendly good practices for pest control, and the most preferred tool is video.

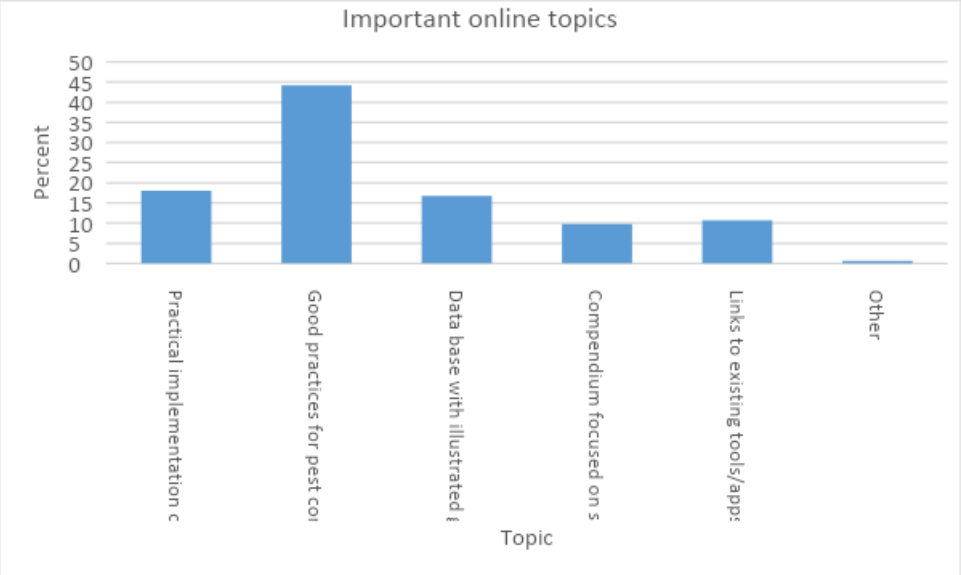

Figure 13: Important topics

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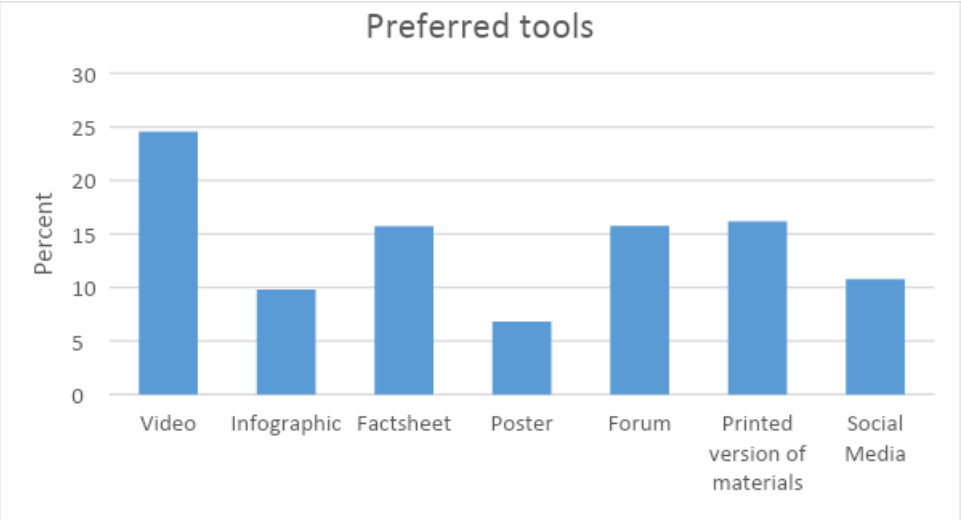

Figure 14: Preferred tools

1.7. Summary

The answers to the questions allow the following general conclusions about the curriculum to be drawn.

The material should focus on integrated plant protection, where biological control is of primary importance. It is essential to develop an integrated farming system that preserves biological diversity and natural resources, but also ensures profitability and produces high-quality, healthy products. Instead of chemical control methods, environmentally-friendly biological, physical, or other non-chemical methods should be preferred – which can be equally effective as chemical interventions. Within this topic, the transfer of and learning about good practices is of great significance.

The most problematic pests are insects and fungi, and the two most favoured control measures to eliminate them are cultural control and chemical control. It is delightful that most farmers are open regarding learning about other types of pest control, cultural control and biological control are the preferred means of defence. These intentions align with the European Union's ambitions and environmentally friendly practices.

The impacts of climate change are perceptible in the partner countries in forms of rising global temperature, heat waves, flooding, intense storms and droughts. Global warming has complex effect on the insects as well: it impacts their diversity, distribution and development; moreover, they are likely to expand their geographic distribution. This means, that if farmers need to face with multiple negative consequences of climate change like lower and poorer quality yields, risking significant economic losses, as well as human food security. Although the mentioned changes are drastic and unflattering, especially when one wants to build new strategies alone. As the problems are identical, so can be the solution. As the territories are located relatively close to each other the extreme environmental

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conditions are similar to each other. All the partner countries develop a material about the best practices in their countries on pest control with the request of the questionnaire in mind, and translate the product to the national languages to be more accessible for everyone.

The digital literacy and skills of the farmers and agricultural experts will enable them to process the online learning material delivered via digital tools. However, we have to choose the tool with care, as they have a strong preference for video content.
The depth of the curriculum should take into consideration the differences in the age and the professional experience of the users.

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2. Country-specific problems

In agriculture, some general problems affect entire regions, while others are unique to a particular country. We will include these topics in the curriculum, and each participant will have the opportunity to supplement the curriculum according to each nation's requirements. In the survey, participants were asked about their experiences of climate change. The responses are presented below by country.

2.1. Czech Republic

The visible examples of climate change in the Czech Republic can be seen as drought, dry years, and flooded fields after rain. These phenomena have negative effects on pest control. The application of preventive products is often delayed due to reduced access to flooded fields, and subsequently the effect of the product is not optimal. Pests are becoming more and more resistant and there are new species for which there are no current protection measures available. In warm weather, beetles thrive; their population grows like never before. Plants are more prone to damage, lower yields, poorer quality.

The effects of climate change can be seen on the crops. Blooming trees are affected by frost as abrupt weather changes occur more frequently in the spring. The growing season is becoming shorter year by year, which leads to lower durability, lower yields and poorer quality of the harvest. The absence of water gives rise to drought, which in a moderate length promotes the crops to be more susceptible to damage, and can prove catastrophic as no crop succeeds in prolonged drought.

Respondents' farms were most affected by:

- Air pollution: 50%
- Water pollution: 33,3%
- Soil pollution: 38,9%
- Extreme temperature fluctuations: 5,6%

Most of the farmers assume that their farming practices have an effect on climate change. The majority of those surveyed believe that the following practices can mitigate the effects of climate change:

- Supplying organic matter to the soil,
- Minimal tillage,
- Varied sowing procedures,
- Insertion of catch crops,
- The inclusion of airborne nitrogen crops.

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2.2. Bulgaria

Climate change affects farms in Bulgaria with extreme temperatures and drought. The unpredictable weather causes difficulties with the plant protection and reduces the effectiveness of chemical treatments. One visible difference is that fruits are damaged by sunburn. Because of the ever-changing weather the immunity of crops is decreasing, which leads to changes in timing of sowing and transplanting.

Respondents' farms were most affected by:

- Air pollution: 25%
- Water pollution: 25%

50% of farmers did not perceive any effects of pollution on their farms.

Farmers in Bulgaria could not name any applied farming practices that might mitigate the effects of climate change.

2.3. Romania

Climate change has a serious effect on Romanian farms. Farmers experience extreme temperatures, and natural phenomena in connection with the abruptly changing weather. These are: drought, flood, hail, and mild winters. Air pollution is a different category from the examples listed, but it is also notable.

New problems resulting from climate change include a serious reduction in the ability to control pests. Novel and resilient insect pests have appeared lately, and the effectiveness of chemical plant protection measures is reduced by extreme weather conditions. Sometimes overwhelming outbreaks of fungi and mildew occur due to the increased humidity, so more frequent treatments are needed. It should be noted that previously cold winters killed many insect pests, but this season has become a lot milder, enabling many pests to overwinter. Aside from a higher abundance of known pests, there is an increasing number of emerging pests that were not present in this area before, and currently there are no best practices for how to protect the crops against these.
In short, climate change impacts crops in two ways: there is an increasing number of difficulties in planning and yield.

Respondents reported that their farms are mostly exposed to:

- Air pollution: 31%
- Water pollution: 34%
- Soil pollution: 29%
- Other pollution: 6%

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In Romania farmers definitely think that their practices have an effect on climate change, but opinion as to whether the effect is positive or negative is almost equal. They did not name any farming practices that might mitigate the effects of climate change. They stated that one of the most important challenges for farming is the induction of young people into the profession, and how to make farming a more attractive proposition.

2.4. Hungary

Climate change affects farms in Hungary in many ways. The most important issue is drought, drying up soil. There is also a strong solar radiation, which means that many crops become sunburnt, with even light-loving plants requiring shading in the summer. In spring, frost damage is the most dominant problem. The vegetation period of traditional cultures has changed and there is no adequate research to develop resilient seeds. There is little financial help for farmers, and they are forced to invest in new tools and machines by themselves, without state help.

As the climate is changing, so are needs for pest control. Many new pests have appeared and there is no effective chemical or biological control against them. The new species are often resilient to the protection measures that farmers are familiar with. Drought has also decreased the efficiency of chemical treatments. In winter we can observe other kinds of difficulties. Due to mild winters, greater numbers of insects survive, causing more harm later on. Severely cold periods can still be experienced when without an ice net, orchard protection is difficult. Generally, traditional folk wisdom is less and less applicable, and more attention needs to be paid to local meteorological forecasts.

Farmers reported that climate change impacts crops by:

- Decreasing volume;
- Unpredictable quality due to volatile climatic conditions,
- Damaged production due to hail and wind,
- Increasing costs,
- reducing pollinators.

Respondents' farms were reportedly exposed to:

- Air pollution: 52%
- Water pollution: 28%
- Soil pollution: 20%

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In Hungary almost half of the farmers think that their practices have an effect on climate change. Most of those assume that their practices have a positive or hopefully positive effect.

The respondents reported many of their concerns via the survey. It seems that farmers in Hungary have problems meeting administrative requirements, there is a lack of organic farming courses and knowledge transfer in general is poor.

2.5. Poland

Climate change affects farms in Poland mostly by causing uneven rainfall distribution and timing leading to floods and drought. Due to these physical phenomena, there are lower and poorer quality yields, with later harvest later than usual. The plant protection products are less effective, while the number of pests has increased. Farmers feel that they are not able to implement plant protection measures in a timely manner.

Respondents reported that they experience the following factors impacting their farms. (They could choose more than one option, resulting in more than 100% in total.)

- Air pollution: 95%
- Water pollution: 70%
- Soil pollution: 40%

Polish farmers think that their farming has an effect on climate change and they tend to assume this effect is negative.

2.6. Greece

Greek respondents highlighted drought, increased temperature, hail, and greenhouse effects, as the visible results of climate change. Moreover, climate change also exerts negative effects on pest control as well. Plants are not adapted to the abrupt weather changes which cause abiotic stress in them leading to higher vulnerability. This means that more intensive treatments are required, but the timing of interventions is difficult due to the merging of formerly distinct seasons. Existing treatments are no longer effective: increased humidity means that fungal infections occur more frequently, requiring increased application of plant protective products. Lastly, it is impossible to protect against hail damage.

Climate change has a negative effect on the yield, on crop quality, and causes considerable crop losses. Extreme temperatures, particularly heat waves during the flowering period, can cause the entire absence of (tree-borne) fruits. Severe weather conditions, like heavy rain, hail, or strong winds during plant maturation and harvesting are also damaging and can result in the total loss of the crop. Higher temperatures and altered rainfall patterns

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necessitate irrigation of previously non-irrigated crops in summer or autumn. These circumstances facilitate the invasion of new weed species that infect arable crops and contribute to quantitative and qualitative crop losses.
Increased humidity leads to more frequent fungal infections, which requires the excessive application of plant protective products. Altered weather conditions This condition benefit various insect vectors of plant viruses, resulting in more widespread infections. Furthermore, stronger sunlight and higher temperatures causes the photodegradation of pesticides, which reduces their effectiveness in plant protection.

Respondents' farms were most exposed to:

- Air pollution: 33,3%
- Water pollution: 26,7%
- Soil pollution: 53,3%
- Other pollution: 33,3%

Most of the Greek farmers think that their practices have a positive effect on climate change, but only on a very limited scale. They believe that the practice of non-intensive farming according to the principles of sustainable cultivation (permaculture) is the least harmful to the ecosystem. To preserve sustainability, they recommend the use of cover crops and fallow land. They think that greater levels of awareness of agroecological methods are required.

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Attachments

Template of the survey

INPACT Project - Survey on the digital literacy and needs of the target groups

GENERAL

How old are you?

- o 20-30 years old
- o 30-40 years old
- o 40-50 years old
- o 50-60 years old
- o 60+

How many years of experience in agriculture do you have?

- o 1-5 years
- o 5-10 years
- o 10-20 years
- o 20-30 years
- o 30-40 years

How many employees does your farm have?

- o 1
- o 1-5
- o 5-10
- o 10-25
- o 25-50
- o 50-75
- o 75-100
- o More than 100
- o I don't work on a farm
- o Other:
- o 

Please select the type of production:

- o Vegetables
- o Fruits

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- o Crop production
- o Greenhouses
- o Other:

Which types of pest control do you currently use?

- o Cultural control (e.g. crop rotation, tillage,...)
- o Mechanical control (e.g. traps,...)
- o Biological control (e.g. predators, parasitoids, inducers of plant defence)
- o Chemical control
- o Other:

Which type of pathogen causes the most problems for your crops?

- o Insect
- o Fungal
- o Viral
- o Bacterial
- o Other:

Do you have any specific technological solutions for pest control?

For which kinds of pest control would you like to receive information and current best practices?

- o Cultural control (e.g. crop rotation, tillage...)
- o Mechanical control (e.g. traps...)
- o Biological control (e.g. predators, parasitoids, inducers of plant defence,...)
- o Chemical control
- o Other:

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- o 

COUNTRY SPECIFIC PROBLEMS

Has your farm been affected by climate change (drought, floods, temperature, hail, greenhouse effect) and if so, how?

How has climate change (drought, floods, temperature, hail, greenhouse effect) affected your ability to control pests?

Are you aware that your farm is affected by:

- o Air pollution
- o Water pollution
- o Soil pollution
- o Other:
- o 

How does the climate change impact your crops?

Do you believe your farming practices have an effect (positive or negative) on climate change?

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Other comments or proposals:

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