Identifying sector needs to increase resource use efficiency

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OPERA

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OPERA consortium members

	OPERA Consortium partners	Short name
1	Wageningen Environmental Research (Alterra), The Netherlands	WENR
2	Stellenbosch University (SU), South Africa	SU
3	Evenor Tech (Evenor), Spain	Evenor
4	Instituto de Recursos Naturales y Agrobiologia de Sevilla (IRNAS – CSIC), Spain	IRNAS
5	French National Institute for Agricultural Research (INRA – EMMAH), France	INRA
6	University of Florence (UNIFI – DISPAA), Italy	UNIFI
7	Council for Agricultural Research and Economics (CREA) – Research Centre for Policies and Bioeconomy (CREA-PB), Italy	CREA
8	Institute of Technology and Life Sciences (ITP), Poland	ITP

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Summary

The EU project OPERA is based on a transdisciplinary approach to ensure the joint learning and co-development with all relevant stakeholders throughout the project, by identifying the needs and demands of the users, as well as the preferred combinations of information technologies and service models. Each case study partner selected the particular stakeholders based on the document “guidelines for analysis and selection of stakeholders”. The approach follows a snowball sampling design, where identified and contacted stakeholders are asked to identify further stakeholders, starting with the case study partners. A total of 123 stakeholders from different sectors were identified and selected to participate in the questionnaires elaborated by identifying the needs and demands. Regarding options to increase the competitiveness of farms, different actions were selected for the cases studies. Improving the marketing strategy of the products was selected in France and farmers in South Africa; however, this action was less important for Poland. Improving the sustainability of the production process was selected in Poland, farmers in South Africa and in the Netherlands. The increase in professionalism of management was selected in Italy, bulk suppliers from South Africa and Spain. The options preferred by the stakeholders to increase the water efficiency were “improvement of the field infrastructure” in all cases studies, “irrigation strategy” in Poland, France, South Africa, Italy and Spain. In the Netherlands, only in dry areas and dry seasons limitations in the use of water are currently encountered. In the results obtained from questions about an irrigation advice tool, the stakeholders identified cost and benefits to be important in Poland, France, Italy, Spain and the Netherlands, as well as the prediction of water demand in Italy and the Netherlands. Each case study reported that the cost of sensors or advice tools could be a limitation to implement new technologies. Each case study showed additional singularity requirements for advice tools (advice in alternative crops in Italy and the Netherlands, irrigation strategy in Spain) but the farmers from South Africa were very satisfied with the information they receive from the Water Users’ Association regarding water availability for the season, restrictions and other regional information. The results of the user needs assessment are taken into account in the development of ICT methodologies to be tested in the case studies, and form the basis of the remainder of activities in work packages 1 and 4 within OPERA.

1 Introduction

The EU project OPERA has, as main objective, the application of the best combination of advances and technologies from remote sensing, soil moisture monitoring, plant responses and forecasting to bring them rapidly towards implementation and commercialization in the form of innovative service models.

OPERA is based on a transdisciplinary approach to ensure the joint learning and co-development with all relevant stakeholders throughout the project, by identifying the needs and demands of the users (farmers, farmer associations, extension services, water management organizations and policy makers, among others), as well as the preferred combinations of information technologies (sensors, models, remote sensing) and service models. The application of this kind of approach enables notable social and scientific outcomes and benefits with interest to both scientists and practitioners (Scholz and Steiner, 2015; FAO, 2017).

The transdisciplinary approach of the OPERA project needs an appropriate and accurate identification of stakeholders from the outset of the project, including a good understanding of them, their roles and the interactions among them, since the overall legitimacy of the participative process and the extent to which outcomes are broadly accepted depends on how participants are selected, and how well they represent the broad stakeholder environment (Dougill et al., 2006; Prell et al., 2009).

Stakeholders are defined as anyone who can affect, or is affected by, a decision (after Freeman, 1984); they might be individuals or formal organisations and may span a range of interests and sectors (Leventon et al., 2014).

“GUIDELINES FOR ANALYSIS AND SELECTION OF STAKEHOLDERS” was developed (see Annex 1), following the results of Dougill et. al, 2006; FAO, 2017; Leventon et. al,2014; Miah et. al, 2015; Njoroge et.al, 2015; Prell et. al, 2009 and Scholz et. al, 2015. The guidelines allowed identifying key stakeholders for every case study and could be invited to the first workshop.

Since each case study in the OPERA project is developed in a different geographical location, under different language, cultural and socioeconomic particular traits, a deeper understanding of the soil threat and its context is held by each case study partner, so each of the partners will undertake the particular stakeholder selection for its case study. To this aim, the guidelines provide a flexible protocol to be implemented by the case study partner according to their own needs and capabilities, also providing certain degree of harmonisation between case study sites by providing key principles to follow in each site.

The guidelines were based on previous experiences and results as well as the report developed by Leventon et al. (2014), which was designed and tested to provide input to a range of transdisciplinary research projects. The process is designed to be implemented by partners with little previous experience in social research, and in a range of case study contexts.

The stakeholder analysis and selection will help for the case studies going forwards in completing the workshops and deliverables under WP1 and requirements for the development of WP4 (stakeholders as service users). It should also feed into WP2 (evaluation of method functionalities) and WP3 (Field operational works: monitoring and demonstration activities).

In addition, the surveys template was design and sent to partners, allowing to compile the information homogenously (see Annex 1).

2 The stakeholder and institutional analysis process

In order to promote an efficient and effective interdisciplinary research foundation, the stakeholder and institutional analysis was designed for the case study partners to lead the analysis for their own study areas. Most of the case study partners have long-term, on-going collaborations with a number of stakeholders in the case study areas. Indeed, many partners would consider and would be considered by others, as stakeholders themselves. By leading the identification process, partners were able to build on their existing knowledge of other actors. We also wanted to position them as stakeholders from the beginning in order to include the researchers within the participatory approach of OPERA (rather than as outsiders), in order to promote more effective knowledge exchange and interdisciplinary (Mitton et al., 2007). Positioning the researcher as a stakeholder helps to facilitate communication by not positioning the researcher as a more powerful actor, and instead positioning all participants as collaborators. We designed the process so that partners were encouraged to both disseminate information about the OPERA project and to make contact with stakeholders that they had not previously had contact with. This approach also made sense from a practical perspective, in that case study partners were all located fairly close to their study sites and spoke the language. In order to design a process that could be easily implemented by case study partners, preliminary consultations were held.

2.1 The approach

Each case study builds on pre-existing experience and local research specialization, and the case study partners have different backgrounds regarding previous engagement with stakeholders and social science research methods. In fact, most of the case study partners have already long- or medium-term collaborations with a number of stakeholders in the case study areas. By the application of the present approach, partners will be able to build on their existing knowledge and, in addition, it will help to disseminate information about the OPERA project and to make contact with stakeholders that they had not previously had contact with.

The approach follows a snowball sampling design (Leventon et al., 2014), where identified and contacted stakeholders are asked to identify further stakeholders, starting with the case study partners (Figure 1).

Figure 1: The snowball sampling concept

The process was designed around a two-part questionnaire. Stakeholder analysis and selection: step by step (Table 1). Part 1 of the questionnaire was designed to collect characteristic information about identified stakeholders while part 2 was dedicated to the identification of further stakeholders that they already knew of, including those with whom they were not already in contact. Further stakeholders, influence and interests can be, indeed, explored in more detail along the project lifespan. Project partners were encouraged to include in their sample some stakeholders with which they had not had previous contact. Stakeholder diversity is important also for identifying potential customers and their needs.

Table 1. Steps for the stakeholder identification, according to the snowball sampling method.

Step 1:	Fill out the Part 2 of the Questionnaire. For each stakeholder you identify, please fill out a new Questionnaire (Part 1 only).
Step 2:	From the group of stakeholders that you identified, select 6 to contact and formally guide them through Part 2 of their Questionnaire.
Step 3:	Based on their answers to Part 2, please fill out a new Questionnaire (Part 1 only) for each of the stakeholders they identify.
Step 4:	If more stakeholders are needed, repeat Step 2.

2.2 Stakeholders and Institutions in the Case Study Sites

In this section, we present the outcomes of the stakeholder and institutional analysis process. For each case study, we present a brief description of the crops, and of the general administrative levels present in the area; detailed information presented in graphics is available in Annex 2. We then present the identified stakeholders, highlighting how they fit to the administrative structures and key sectors. Each case study overview includes a table of the identified stakeholders, and of policies that were identified during the analysis process. Recommendations are made for each site as to further stakeholders that they may wish to consider in order to fully represent administrative levels and key sectors. Recommendations are also made (where relevant) as to how partners may choose to select which stakeholders (or which representatives of a stakeholder) to invite to on-going stakeholder platforms under the OPERA project. Partners are also encouraged to look at the summaries of other case studies in order to consider a broader range of stakeholders and policies.

1. Case Study 1: Poland

The case study in Poland is situated in kujawsko-pomorskie (eng. kuyavian-pomeranian) province. The first demonstration area is located in Zglowiaczka river catchment on the small productive field and the second one (added to the project in 2018) is located in the Upper Notec river catchment on the big productive field. Vegetables are cultivated as well as irrigated on both fields. The pilot areas are situated in the southern part of the province. This is the region of intensive agricultural crop production but even in the average year it suffers significant rainfall water deficits. The main problems: water scarcity in the growing season, use of clean long-renewable deep groundwater resources for irrigation, low efficiency of water use for irrigation, lack of irrigation decision support system for farmers based on current crop water needs and weather forecasts.

The workshop carried out for the Institute of Technology and Life Sciences (ITP) from Poland was held in Minikowo, Poland at 27/11/2017. A total of 38 stakeholders participated. Table 2 shows the list of institutions in the workshop.

Table 2. List of institutions assisted to the workshop in Poland.

Institution	Sector	Institution	Sector
Starostwo Powiatowe w Toruniu	governmental administration	Powiatowy Zespól Doradztawa Roinczego, Wloclawek	governmental, agricultural advisory service
G's Polska Sp. Z o.o.	private, farmer	Urzad Wojewódzki w Bydgoszczy, Wydzial Infrastruktury I Rolnictwa	governmental, administration
Kujawsko-Pomorski Osrodek Doradztwa Rolniczego, Minikow	governmental, agricultural advisory service	Powiatowy Zespot Doradztwa Rolniczego, Bydgoszc	governmental, agricultural advisory service
Powiatowy Zespot Doradztwa Rolniczego, Lipno	governmental, agricultural advisory service	Geofabryka	private, SME, environment and agriculture services
S'potka Wodna w Nakle 7nd Notecia	administration, farmers association	Uniwersytet Technologiczno-Przyrodniczy w Bydgoszczy (University of Technology and Life Sciences)	research
Kujawsko-Pomorski Osrodek Doradztwa Rolniczego, Minikowo – Przysiek	governmental, water management authority	County Agricultural Advisory Team in Radziejów	governmental, agricultural advisory service
County Agricultural Advisory Team in Chełmża	governmental, agricultural advisory service	County Agricultural Advisory Team in Nakło	governmental, agricultural advisory service
Stacja Doświadczalna Oceny Odmian (Experimental Station of Plants Varieties Assessment)	state entity, evaluation of plants varieties	Uniwersytet Warmińsko-Mazurski w Olsztynie (University of Warmia and Mazury)	research
Instytut Technologiczno-Przyrodniczy w Falentach, Kujawsko-Pomorski Ośrodek Bawdawczy w Bydgoszczy (Institute of Technology and Life Sciences at Falenty, Kuyavian-Pomeranian Research Centre in Bydgoszcz)	research		

2. Case Study 2: France

The Crau region is located in the vicinity of Marseilles, at the intersection of Rhone River valley, and the Mediterranean seashore. The entire area is a natural steppe as soils are very thin and consist mainly of pebbles that prevent soil tillage, while climate is very dry with no natural hydrographical network and a violent wind (Mistral). As a consequence of these natural handicaps, intensive agriculture (cereals, vine, orchards…) is not possible, and it has long remained a "desert" between rich intensively cultivated regions such as Rhône River valley and the Aix-en-Provence sedimentary basin. It has thus been used for extensive cattle (sheep) breeding since the Neolithic and Antiquity. The region is one of the very few steppe areas in Europe, with many endemic species of patrimonial and ecological significance protected by different European and national regulations under various statuses

Part of this steppe area was converted to grasslands by irrigation with water brought from the Durance River since the 16th century, so that soils were thickened by silt input and became more fertile. High quality productions (the "Foin de Crau", the only hay with an AOP label[1], sheep breeding of "Mérinos d'Arles" and "Agneau de Sisteron" lamb IGP[2]) rely on these grasslands irrigated by water from the Durance's river. By bringing water in a plain with no surface hydrographical system, man has shaped the landscape since the 16th century. The Durance hydrographic regime has always been irregular, and the supply of irrigation water suffered from many shortages, which generated many conflicts until the Serre-Ponçon dam was built, in the 1960s. Nowadays, Durance waters, through the gravity irrigation system of the Crau grasslands, are the major source of water percolating towards the aquifer. They contribute to over 75% the Crau's groundwater recharge and thus supply drinking water to approximately 290 000 people as well as to the large industries established at the south of the area.

A meeting gathering different stakeholders was organized on February 2nd 2018. 9 participants were present covering different sectors (aquifer management, irrigation association, irrigation water provider, nature protection, farmers (hay producer only)). The goal of the meeting was to identify expectations in terms of decision tools based on the different developments made in the project:

- Use of remote sensing (Sentinel);
- Use of crop models as STICS, Aquacrop.

3. Case Study 3: Italy

In view of changing weather patterns and water scarcity, irrigated agriculture must be supported by offering a higher flexibility to switch to other water saving crops and/or a better operational forecasting of actual water demands and water availability.

The case study is located in Campania, Italy (around Naples), were the main cultivated crops are silage maize, wheat, tomato and other vegetables (i.e. pepper, beans). Here water use optimization implies a decision-making process under significant hydroclimatic uncertainty.

Key investigation during the project includes adaptation potential and end-user needs, optimal approaches for dynamic forecasting of crop water requirements based on sequential assimilation of remote sensing observations and numerical weather predictions in a crop growth model.

The main contribution to OPERA of Italian case study is to emphasize the role of reclamation consortia for raising awareness and develop tools for optimum water management under climate variability and uncertainties in the Mediterranean.

Key stakeholders involved are farmers, regional government, land and water reclamation authorities, farmer associations, local policy makers and legislators.

Workshop venue: the workshop was held at the Consorzio Generale di Bonfica del Bacino Inferiore del Volturno, which is the main authority for land reclamation and irrigation of the study area (see Annex 3)).

Total participants were 14 (Table 3).

[1] AOP (appellation d'origine protégée) Protected origin destination
[2] IGP (Indication géographique protégée) Protected geographic indication

Table 3. List of institutions assisted to the Italian workshop.

Institution	Sector	Institution	Sector
UNIFI	Research	CONSBIV	Irrigation/land reclamation
Individual	Farmer	COLDIRETTI	Farmer association
CONFAGRICOLTURA	Farmer association	ARIESPACE	Private sector SME
University of Napoli	Research and High Education		

4. Case Study 4: South Africa

Farmers in the Western Cape of South Africa, particularly the Breede River valley, are up to 7 times more water efficient than growers of the same crops in other parts of the world . The increasingly dry summers over the past few decades, particularly the last decade, have forced farmers in the Province to adapt in order to remain profitable or grow their businesses. They've had to test and adopt a variety of irrigation techniques and farm management tools to boost their water efficiency.

In an effort to support farmers to become as efficient as possible, the Western Cape Government partnered with Dutch firm eLEAF, Hortgro and the Integrated Application Promotion Programme for the European Space Agency to develop an open access online platform, using satellite and weather information, to monitor vineyards and orchards in terms of crop growth, crop water-use and leaf nitrogen content. The platform, called FruitLook, has been online since January 2012 and covers approximately 200 000 hectares (105 000 ha of wine grapes, 12 500 ha of table grapes, 30 500 ha of deciduous fruit, 12 000 ha of citrus and 21 000 ha of stone fruit).

This case study focuses on the irrigation practices and uptake of technology (field-based measurements as well as information technology such as Fruitlook) by farmers in Breede River Valley, particularly the area around Robertson. Although traditionally known for vineyards, peaches and apricots, farmers are diversifying and planting increasing amounts of citrus. Through in-depth interviews, this case study will gather important information regarding:

- Main types of irrigation used.
- What factors and technology farmers and advisors consider and use in their irrigation scheduling.
- Whether farmers and advisors use satellite and/or weather information services already available to them; as well as their eagerness to adopt new technologies.
- What they are willing to pay for satellite services and what they would like to see in such products.
- What they changed in their irrigation practices and scheduling in order to get through the drought of the past season, during which they only received 50% of their water allocations.

In-depth interviews structured around these questions will allow the researchers in South Africa to gather information on extreme water efficient farming and the use of on-farm and satellite information systems to support decision-making. This information will be relevant to all other OPERA countries where farmers have only in recent years been forced to think about water-efficient irrigation techniques.

Further to this, technical analyses will be done to determine the accuracy of the existing Fruitlook programme by comparing evapotranspiration values from weather data, with that of the programme. Daily soil probe data for one block on approximately 10 farms will be obtained to further see whether the remote sensing programme could have added value for the farmers. With all this data, the researchers will be able to determine the water use of the entire valley, providing meaningful information to government regarding the farmers' water requirements.

A decision was made to hold individual interviews with stakeholders, rather than a workshop, for the South African case study. The reasons for this decision include:

1. From previous experience the researchers know that workshops are generally poorly attended by farmers. They have too many other commitments and do not like this type of environment. Getting them all in one room at the same time is also difficult, given different harvesting times of their crops.
2. Similarly, we have found that in such workshops, one or two people would dominate discussions (even in small groups), while the opinions of the majority of attendees are not documented.
3. The researchers wanted to use the interviews for both completion of the questionnaires, as well as information gathering for the other work packages for which much more detail is required. It made sense to gather all the necessary information from each farmer during one meeting, rather than to meet them at a workshop and see them again later to collect more information.
4. The approach followed allowed the researchers to build good, personal relationships with each of the stakeholders interviewed, which is useful should we require further information from them in the future.

Interviews were held between 15 May 2018 and 15 June 2018. A total of 4 agricultural advisors (viticulturists/soil scientists) and 23 farmers were interviewed (Table 4). All interviewees work in the Breede River Valley around the town of Robertson, stretching towards Worcester, Ashton, Bonnievale and McGregor (Figure 2).

Table 4. List of institutions participated in South Africa.

Institution	Sector	Institution	Sector
Voorspoed	Farmer (owner)	Van Loveren	Farmer (co-owner)
Mont Blois & Sunshine	Farmer (owner)	Buitehof	Farmer (owner)
Die Eike	Farmer (owner)	Graham Beck	Farmer (farm manager)
Vinefera	Farmer (director)	Viljoensdrift	Farmer (owner)
Vinkrivier	Farmer (farm manager)	Excelsior	Farmer (owner)
VinPro	Viticulturist (advisory)	Robertson Cellar	Viticulturist (advisory)
Keisershof	Farmer (co-owner)	Arabella	Farmer (owner)
Goedverwacht	Farmer (owner)	De Wetshof	Farmer (farm manager)
Klipbos	Farmer (owner)	Bo-Langverwacht	Farmer (owner)
Esperance	Farmer (owner)	La Maison	Farmer (owner)
Prospect	Farmer (owner)	Zevenbergen	Farmer (owner)
Roodezandt Cellar	Viticulturist (advisory)	Le Chasseur	Farmer (owner)
Retreat	Farmer (co-owner)	Fritz & Louise Breytenback	Farmer (owner)
Elim	Agricultural advisor		

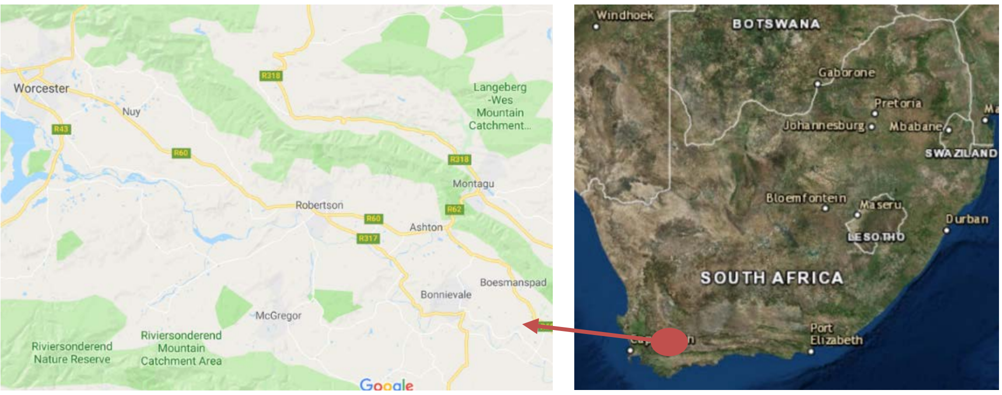

Figure 2. Area of study in South Africa

5. Case Study 5: Spain

Agriculture in the Mediterranean regions is facing serious problems related with present drought and the general scarcity of water resources, resulting to an increasing water demand. Such difficulties are to be aggravated due to the future predicted severe water scarcity in the Mediterranean area. Olive crop has been selected as a case study since it is a strategic economic sector representing 24% of the value of the agricultural production in the Andalusia area, covering a surface of around 1.5 million ha (about 17% of the region total surface, covering the 60% of the national surface dedicated to olive crops and 30% of the European surface), providing around 40% of the global olive oil production and around 20% of the global table olive production. It is, in addition, an important source of wealth and employment (it supports more than 22 million wages annually), element for social and territorial cohesion, a relevant agro-system of high environmental value and configurator of the Andalusian territory and culture.

The Spanish case study is focused on the Andalusian olive crop, covering a gradient of climate and crop management. Although some facilities and advice services are available in this area, the present solutions have not been properly brought into practice, thus desirable results continue to be reached. OPERA will have impact the Andalusian olive sector by: i) Identifying the concrete local barriers that had prevented the transfer of research results into the farmer and water manager practice; ii) Defining, adapting and applying regulated deficit irrigation (RDI) in the Andalusian olive orchards, aiming a sustainable balance between water savings and olive production; ii) Using those methods upscaled to the territory (by the use of earth observation technologies, territorial analysis and modelling) and tested through OPERA to define goals and advice for policy makers; iii) Creating a self-updating, scalable, user-friendly computing tool to be used by farmers, irrigation organizations and policy makers.

Workshop venue: Seville's Casa de la Ciencia Museum is an open space for the popularization of science and educational and cultural fun for everyone. It belongs to the Spanish National Research Council (CSIC) (see Annex 3) (Table 5).

Table 5. List of institutions assisted to the Spanish workshop.

Institution	Sector	Institution	Sector
Universidad de Sevilla	Research sector	Consejería de Agricultura, Pesca y Desarrollo Rural	Regional government
Evenor-Tech	Private sector	Agencia Andaluza del Conocimiento	Regional government
Galpagro	Land user and advisory services	Confederación Hidrográfica del Guadalquivir	Regional government
EBD-CSIC	Research sector	CSIC-Andalucía	Research sector
IFAPA	Research sector	JRC-ITPS Sevilla	Research sector
IRNAS-CSIC	Research sector	AREDA	Land user and advisory services
CENTA	Research sector	TEPRO	Land user and advisory services
FERAGUA	Irrigation association	ASAJA-Sevilla	Land user and advisory services
Internacional Olivarera	Land user, private sector		

6. Case Study 6: the Netherlands

The case study in the Netherlands is focussed on the use of weather forecasts in predicting the water availability in the root zone. Since weather forecasts are uncertain, as given by the 51 ECMWF ensemble forecasts, there is also uncertainty in the predicted water availability. In the less arid region of North-Europe it is common practice to have mobile irrigation (overhead sprinkling) systems. Farmers have to decide when and where these need to be put in practice. Weather forecasts, predicted crop water availability, and additional information via sensors (local or remote) could provide the farmer additional information in optimizing his/her irrigation decisions.

In the Netherlands it was decided to have 1-to-1 interviews rather than a workshop, for similar reasons as listed above for the South-Africa case. The Alterra partner have conducted 5 surveys among stakeholders from research, water board and farming practice. Three stakeholders participated in Survey 1: a representative of an innovative farmer (frontrunner), a representative of a waterboard and a representative of research (Table 6). Water availability for irrigation in the Netherlands in the past was not often an issue. However, with changing climate we do experience more drought periods, and locally water boards temporarily forbid farmers to use surface water and groundwater for irrigation. When this will occur more often in the near future, there will be a need for better tuning water supply, water availability and water need.

Table 6. List of institutions assisted to the Dutch workshop.

Institution	Sector	Institution	Sector
Water board Aa en Maas	Private sector	WUR Plant Research	Research
Livestock research	Research	Vandenborneaardappelen	Farmer

3 Results and conclusions from exercises

For each case study the results will be summarized in the following subsections. References to graphs refer to the graphs listed in Annex 2.

1. Case Study 1: Poland

The results show that the main actions to increase the competitiveness of farms could be "Renewal of existing production processes", "Improving the sustainability of the production process" and "Introduction of innovative processes". In addition, the less important were "The product innovation" and "Improving the marketing strategy of the product" (Figure 7).

According to the question 2, the stakeholders valuated 3 sentences and the results showed that sentence "If I heard about new technology, I would look for ways to experiment with it" was the most valued. This result is related to the previous question, the stakeholders are open to use new technologies that allow introducing innovative processes, improve the sustainability and renewal the existing production processes (Figure 8).

In question 3, the stakeholders evaluated the preference between improvements:

A1: Improving easy access to the information.
A2: Ensuring coherent data and data reporting.
A3: Improving delivery efficiency.
A4: Improving private and public awareness.
A5: Assuring economic sustainability.

The results show us that "Improving easy access to the information" was not selected as an improvement and the stakeholders preferred ensuring coherent data and data reporting, improving delivery efficiency and assuring economic sustainability.

Table 7. Results of preferences (Poland)

	9	7	5	3	1	3	5	7	9	
A	Absolute preference	Very strong preference	Strong preference	Weak preference	Indifference	Weak preference	Strong preference	Very strong preference	Absolute preference	B
Options										Options
A1	2	1	0	1	3	2	6	0	0	A2
	0	0	1	1	1	3	3	5	0	A3
	1	0	1	1	2	3	1	3	2	A4
	0	1	1	0	3	2	6	1	0	A5
A2	2	1	3	2	5	0	0	1	0	A3
	1	2	0	2	2	2	1	1	3	A4
	0	1	4	2	3	1	1	2	0	A5
A3	1	3	1	3	2	2	1	0	1	A4
	0	1	2	3	3	2	3	0	0	A5
A4	0	1	2	3	3	1	1	1	2	A5

The stakeholders identified limitations, economics and administration to improve water efficiency. The main economic limitations were the high prices of sensors and the availability of a catalogue of the best technical and organizational solutions. Also, the main administrative limitations were the complexity and the time of obtaining water intake permit (Figure 9).

In addition, limitations for adopting alternative crops/varieties were identified by the stakeholders. The most was the uncertainity of prediction on market demands as well as the knowledge/advice on suitable alternative crops in relation with plant physiological requirements, soil and climate characteristics. The stakeholders identified a lack of specific information on water, fertilizer and cultivation requirements for alternative crops or varieties or lack of sufficient training. In addition, the high prices of irrigation equipment necessary to obtain production every year from varieties tolerant to drought could be the main cost limitation. According to the prediction on market demands, there are different analysis from agricultural advisory centers not used by farmers and they use internet, newspaper, bulletins and other sources (Figure 10).

According to the valuation of the relevance as limitation to adopt alternative crops or varieties from farmers and producers specifically, the results did not showe difference between knowledge on suitable alternative crops, costs and uncertainity of prediction on market demands (Figure 11).

The options preferred by the stakeholders to increase the water efficiency were improvement of the field infrastructure and improvement of the irrigation strategy. However, the option "changes in the crop or variety selection" had 7 votes in highly preferred and 9 in preferred values (Figure 12).

The stakholders selected the preferred options that advice tools should include from the proposal list. The results showed a high preference in advice on alternatice crops or varieties and prediction of water demand along the irrigation season. Others options most valued were the advice on costs and benefits associated to improvement of the field infrastructure such as preferred option and the advide on costs associated to energy used for irrigation (Figure 13).

At the end, the stakeholders valuated known advice tools (Table 8).

Table 8. Current tools valuated in Polish workshop

Name	Main benefits	Main problems
Weather forecast	Current information Easy access	Low accuracy Incorrectness of the forecast
Agricultural Advisory Centre	Information about new products	
Brochures	Current information	Have to reach and read
Internet	Easy access Availability	Tendentiousness of information
Conferences	Possibility of discussions and questions	
Dynamic program of vegetables farming	Cultivation as much as one can sell without surplus	Weather

2. Case Study 2: France

The questionnaires were adapted to the French case study and the stakeholders completed the questions in online format. Although the questions and the format have some differences according to the others case studies, the mean is the same.

The stakeholders selected what are the improvements that could be made to increase profitability on their farms. The results showed that the most important improvement was "Better sell the products", followed for improve the use of water. The improvement "Have access to additional water resources" highlights too as an important value (Figure 14).

The second question is related to three sentences and the stakeholders had to selecte the most important for them. The sentences were "I am attracted by new technologies", "I am one of the first to adapt new technologies in my close environment" and "I am reluctant to use new technologies". The most selected was "I am attracted by new technologies" (Figure 15).

The options that allow a better use of water irrigation were evaluated by the stakeholders. The results of questionnaires showed two main options "Optimization of irrigation dates and doses" and "Improvement of irrigation infrastructure" (Figure 16)

The most important characteristics of an irrigation pilot service for the stakeholders were "affordable cost" such as the main characteristic followed by "Direct access to the information", "Ease use of information" and "Regularity in the delivery of information" (Figure 17). However, the stakeholders identified the obstacles to implementing an irrigation control system such as "costs" (too expensive), "lack of confidence in recommendations" and "limitation of the use of the service due to administrative decisions on the use of water" (Figure 18). The stakeholders highlight 4 barriers to the implementation of irrigation control systems: financial aid, support, information and producers in association or group (Figure 19).

3. Case Study 3: Italy

The stakeholders identified that the main actions that could be important to increase the competitiveness is "Product improvement" followed by "Increasing professionalism of management", while renewal of "existing production processes" and "organizational innovation" seem to have less importance for the stakeholders (Figure 20).

Respect to the valuation of sentences, the stakeholders did not express a clear preference but, even if on average they do not like to experiment with new technologies, they declare to be normally the first to adopt them (Figure 21).

According to question 3, the stakeholders evaluate preferences between improvements.

A1: Improving easy access to the information.

A2: Ensuring coherent data and data reporting.

A3: Improving delivery efficiency.

A4: Improving private and public awareness.

A5: Assuring economic sustainability.

The results show that in many cases there is not a preference among the proposed options (Table 9). The table also shows that "improving private and public awareness" and "assuring economic sustainability" are the most preferred options. Nevertheless, these results should be further processed with a specific methodology.

Table 9. Results of preferences in Italy

	9	7	5	3	1	3	5	7	9	
A Options	Absolute preference	Very strong preference	Strong preference	Weak preference	Indifference	Weak preference	Strong preference	Very strong preference	Absolute preference	B Options
A1	1		6	3	10	2	5			A2
		1	2	4	8	8	3	1		A3
			4	4	9	3	7			A4
			2	1	10	3	9	2		A5
A2		3	1	3	8		8	4		A3
	1		2	2	7	2	4	9		A4
			2		10	1	7	3	4	A5
A3		1	2	1	8		4	5	6	A4
		1	2		8	3	1	10	2	A5
A4			1		10		6	9	1	A5

The majority of stakeholder do not have preferences between the proposed factors limiting the improvement of water use efficiency probably because they give the same importance to economic (cost) and administrative/legal limitations (Figure 22).

The results show also that farmers are not very flexible to change to alternative crops, and the main limitations is economic cost but also the uncertainty of prediction on market demands (Figure 23).

Besides the main limitations for adopting alternative crops, the results showed that the costs and the uncertainty of prediction on marked demands are the main limitation (Figure 24).

According to the identified preferred tools for prediction on market demands are: Supply chain agreements, agreement with the big distribution, marketing agreements, product labelling and traceability, producer associations (Figure 25). As well as, the stakeholders preferred improvement of the irrigation strategy and of field infrastructure, but also changes in the crop/variety versus the increase on the crop density. In addition, the preferred options that an advice tool should include are "costs/benefits associated to improvement of the field infrastructure", "prediction of water demand along irrigation season" and "advice on alternative crops/varieties" also (Figure 26).

4. Case Study 4: South Africa

The results showed that innovative processes, product improvement, training and sustainability are most important to the interviewees to increase their competitiveness. However, answers to all questions, ranged from 0 (not applicable) to 7, which shows that all categories are somewhat relevant for the farmers. It was clear at the end of the interviews those cellars and those farmers with their own production facilities (pack houses, cellars) have different opinions in what could increase their competitiveness, then those farmers who sell their products in bulk to cellars or exporters.

A separate analysis showed priorities for increasing competitiveness differ between those farms with their own cellars or brands (labels) and the farms selling their produce in bulk (no production facilities). The researchers are of the opinion that this separate analysis is a more accurate result. For the farms with their own labels, expanding their farms/area under production, organisational innovation and marketing are the most important factors (Figure 27). Innovation and sustainability are also important to these farmers. For the bulk suppliers, product improvement, training for their staff and sustainability are the most important (Figure 28).

The table below summarises some key comments made by interviewees with regards to the nine categories.

Table 10. Comments regard to the nine categories (South Africa).

Renewal of existing production processes	Those farmers with cellars and pack houses regarded this as important. It was emphasised that keeping machinery in the cellar has a big impact on the amount of juice that can be extracted from the grapes; pack houses give farmers a competitive advantage over those who have to sell everything to cooperative pack houses; and many said that continuous upgrading is essential to stay ahead in the market.
Introduction of innovative processes	Farmers described their efforts to constantly try to improve irrigation, fertiliser and equipment to farm optimally. The point was also raised this is expensive and not affordable/profitable for all farms.
Product innovation	Farmers are looking at new clones and cultivars to improve production.
Product improvement	Most farmers agreed that it is important to always try to improve the product they deliver to the market and they are continuously looking at ways to achieve this.
Increasing professionalism of staff	All farmers offer training to their farm workers and believe that this is important. Training is also required by industry standards (e.g. Wieta, Siza). However, some raised the point that the application of what they learned is often lacking.
Increasing size of farm/area under production	Most farmers mentioned that economy of scale is important and that they would like to expand, but that water is the limiting factor. It was also mentioned that there's a "tipping point" at which it makes more financial sense to farm more intensively than to acquire more land.
Organisational innovation	Farmers who ranked this high mentioned the need to "think outside the box" and "try new things" in order to move forward.
Improving marketing strategy of product	This was very important to all farmers with their own cellars or labels, and not at all important to the bulk suppliers who depend on exporters for marketing (they have no control over it).
Improving the sustainability of production	Most farmers rated sustainability very high, particularly ensuring the soils stay healthy.

Interviewees were asked whether they see themselves as risk-averse, risk-neutral or risk-seeking. The majority of people answered that they are risk-neutral, noting that they prefer to take "calculated risks" (Figure 29). In addition, farmers and advisors asked about their desire to experiment with new technologies. They generally indicated that they like new technology, with all three variables scoring on average between 4 and 5 out of 7. Most farmers indicated that they like to try new technologies, but "only if it works", or that they "first want to check what others do" (particularly what the large farmers do), or that the new technology "has to warrant the cost" (Figure 30).

According to the water efficiency, as briefly mentioned in the introduction, farmers struggled to answer questions relating to how they can improve their efficiency, as most of them have done all they can, consider themselves highly efficient and won't change anything further. Not all farmers answered these questions as they do not have limitations for becoming more efficient, having already done all they could.

The cost of infrastructure and the need for dams were most mentioned as limitations to improve efficiency (Figure 31).

Three farmers mentioned how the lack of private storage dams leads to inefficiency. Reasons include:

- "If we didn't have a dam, we would have to over-irrigate to get our allocation otherwise it flows into the ocean"
- "People have the fear that 'if I don't use it, I'll lose it'. People will then rather use their water out of fear that it will be taken away."

- Due to old laws, existing dams are too shallow, “this means that there’s high evaporation because the dam is shallow. We’re a water-scarce country and need deep dams with lower losses.”

Eight farmers mentioned the lack of private dams for winter storage water as a major issue when asked what they would change in the area. Although not mentioned during the water efficiency part of the interview, their concerns about not having dams to store winter water is directly related to efficient and effective use of water and therefore these comments were included in this question’s analysis.

Most farmers were of the opinion that improving field infrastructure and adapting their irrigation strategies are the best ways to improve efficiency. Seven farmers mentioned the value of adding mulch to their vineyards, and particularly orchards, but also mentioned the cost implications makes this a difficult option. Cost implications are also the reason for farmers who said that improving infrastructure is not helpful (Figure 32).

According to the crop preference, vineyards, apricots and peaches are traditional to this area, although wine grapes are the predominant crop. Over the past few years there has been significant diversification in the area, the main reasons being a good international market (favourable exchange rate for export), as well as stretching the season – and thereby labour use, water use, and importantly the cash flow for the farmers. Citrus (lemons, naartjies, clementines) is particularly popular, with most farms now having at least a small amount (e.g. around 5 ha) of citrus. Other crops include blueberries, pomegranates and prunes. However, farmers overwhelmingly answered that they are unlikely to switch crops based on climate change predictions. Most farmers consider vineyards to be the best suited crop for the area, being the most water-efficient. Water availability is seen by most in light of the other crops that need more water (fruit), not vineyards. Climate change does not play a big role in farmers’ decisions about the crops they are planting and will plant in the foreseeable future – they plant according to market needs and will rather try new cultivars and clones of wine grapes than to switch crops (Figure 33).

Most farmers see water availability as the key limiting factor for the type of crops they can plant. There is also a strong emphasis on the current (foreseeable future) market demands and profitability as being a limiting factor to planting new crops, much more so than an uncertainty about the predictability in the market. Infrastructure as a limiting factor relates to the fact that most farms are historically designed (pump houses and irrigation) for vineyards, with a bit of orchards. To change crops might mean that all infrastructure would need to be changed too, which would be too expensive (Figure 34 and 35).

According to current advice tools, 85% (22 out of 26) of farmers and consultants interviewed said that they have heard about Fruitlook (free remote sensing product that provides 20 x 20m resolution images for most of the Western Cape; data provide are biomass index, leaf area index, evaporation deficit, actual evaporation and plant nitrogen levels) and some have played around with it a bit, but only 3 farmers and 2 advisors have actually used the programme.

No one had any knowledge of other similar products available. Three farmers indicated that they would like to have drones that provide these types of images, but the technology is not at a suitable standard in South Africa yet. Farmers who use iLeaf (programme linked to weather station that, with a subscription, clients get 10-day weather forecasts, hourly humidity, ET_0, rainfall and wind data; the programme also contains climate modelling to predict risk for diseases, as well as reports on cold units, dew and frost risk, amongst others) are mostly interested in the weather forecast (rain and wind) to plan for spraying.

There are no incentives related to water in South Africa (farmers receive their allocation and pay a set price). The cost of different irrigation options (drip vs micro) is known to the farmers, they do not need this in an advice tool.

Farmers are not keen on receiving additional information to what they already have for their farms. 17 persons interviewed use continuous logging soil probes according to which they adapt their irrigation scheduling (in combination with using experience and instinct). An additional three use Neutron moisture meters, with only five not using this technology, relying on topsoil samples and visual plant physiology only. It was clear from the interviews that the farmers trust their probe information and do not see the need for receiving much more information than this. The probe data (after approximately three years) give farmers an accurate understanding of the crops' water use patterns and thereby the accuracy of their scheduling. It was quite clear that farmers would prefer personal advice from consultants rather than to rely on an advice tool or modelling product.

With regards to climate data, eight interviewees reported to receive climate data (forecasts, humidity, wind, ET_0 etc) either from their own weather stations or from the cellar, or from chemical representatives. The rest rely on weather websites and are happy with this approach. The needs for climate modelling products are thus not high – farmers are mainly interested in wind and precipitation forecasts (Figure 36).

Crop-related information, as well as information on alternative varieties, are received at open days, information sessions or from consultants and representatives. Farmers do not see the need to have these in an advice tool.

All farmers were very satisfied with the information they receive from the Water Users' Association regarding water availability for the season, restrictions and other regional information. About half of the farmers did indicate that it would be nice to receive dam levels and other water-related information on an advice tool.

5. Case Study 5: Spain

The results show that the main actions could be important to increase the competitiveness is "Organizational innovation" followed by "Product improvement" and "Increasing professionalism of management" (Figure 37)

With respect to the question 2, the answer from the stakeholders highlight, they did not like to experiment with new technologies. The stakeholders commented that the innacuracy of market demands and the high costs for implementing new techonologies are very important risks. (Figure 38)

With respect to question 3, the stakeholders evaluate preferences between improvements.

A1: Improving easy access to the information

A2: Ensuring coherent data and data reporting.

A3: Improving delivery efficiency.

A4: Improving private and public awareness.

A5: Assuring economic sustainability.

The results show us that the more values selected was A4 vs A1, A3 vs A1 and A5 vs A1 (Table 11). The improvement in easy access to information is not priority for our stakeholders. Between the others improvements the results don't show preferences.

Table 11. Results of preferences (Spain)

	9	7	5	3	1	3	5	7	9	
A	Absolute pref	Very strong pr	Strong prefere	Weak prefere	Indifference	Weak prefere	Strong prefere	Very strong pr	Absolute pref	B
Options										Options
A1	1					2	1	2	2	A2
			2		3	1	1		1	A3
			1			4	2	1		A4
				1	1		2	1	3	A5
A2	2	1	1	1	1			1	1	A3
	1		2	2	2			1		A4
	1		1	1	1	1		2	1	A5
A3			2		2	2		1	1	A4
		1		1		2	1	2	1	A5
A4			2	1	1		1	1	2	A5

The majority of stakeholder answered that Costs and Administration were the main limitations for improving water efficiency (Expensive products, investment cost, lack of agility by the administration, little promotion of advisory services by public administration, etc.) (Figure 39).

With respect to the main limitations for adopting alternative crops, the results showed that the costs and the uncertainty of prediction on marked demands (Figure 40). In this sense, the tools preferred for prediction on market demands are:

Local market
Infodays
Regional Administration of Agriculture
Workshops
Private and sectorial meetings
Consumer surveys

The results show also the flexibility of farmers to change to alternative crops (median: 2.43) (Figure 41). Also, the main limitations to adopt alternatives crops are costs and uncertainty of prediction on market demands (similar results of stakeholders group).

The stakeholders preferred improvement of the field infrastructure, irrigation strategy and change in the crop selection versus the increase on the crop density (Figure 42). In addition, the preferred options that an advice tool should include are "costs/benefits associated to improvement of the field infrastructure" and "the irrigation strategy" also (Figure 43).

The current tools used for stakeholders have many benefits and problems. The summaries of characteristics are represented in Table 12.

Table 12. Current tools evaluated in the Spanish workshop.

Name	Main benefits	Disadvantages
Direct consulting of climate forecasts (AEMET)	Free, easy, updated information	Large-scale, inaccuracy, complicated to interpret for irrigation
Estimations through data from Agro-Climate Stations	Free, availability, friendly, more accurate	No prediction, not tell when, how or how much to irrigate, maintenance
Own sensors	Quality and specific data	Need to interpret
Drones	Precision data	High cost
Satellite images	Cheaper than drones	The availability of data is conditioned.

6. Case Study 6: the Netherlands

According to the reactions it could be important to increase the competitiveness, and the stakeholders indicated that it is important to improve the sustainability of the production process (Figure 44). In addition, according to the valuation of sentences, the stakeholders answered that they like to experiment with new technologies and look for ways to experiment with it (Figure 45).

Respects to question 3, the stakeholders evaluate preferences between improvements.

A1: Improving easy access to the information
A2: Ensuring coherent data and data reporting.
A3: Improving delivery efficiency.
A4: Improving private and public awareness.
A5: Assuring economic sustainability.

The results did not show differences between improvements (Table 13). Also, there are no striking economic and administrative limitations for improvements of the water efficiency on irrigation (Figure 46). In the Netherlands, most of the time, there is enough water and humidity to have good soils and moisture levels. It is only required in some dry periods in the year.

Table 13. Results of preferences (the Netherlands)

	9	7	5	3	1	3	5	7	9	
A	Absolute preference	Very strong preference	Strong preference	Weak preference	Indifference	Weak preference	Strong preference	Very strong preference	Absolute preference	B
Options										Options
A1							3			A2
			1		1	1				A3
			2	1						A4
					2	1				A5
A2		1	1	1						A3
				2		1				A4
			1		1	1				A5
A3				2			1			A4
						2	1			A5
A4				2			1			A5

Investments, when growing high value crops are cost efficient. The frontrunner farmer who is part of the survey points out those measures will lead to increased production and decreased water use. So, he reaches double positive effects. Good systems are quite expensive, especially to cover all production fields. For most crops the growing patterns change every year due to alternate cropping systems. Therefore, drip irrigation is too expensive. Most farmers do not invest in smart irrigation systems. They use the overhead sprinkling irrigation quite frequently to avoid risks of droughts. Administrative burdens are not limiting very much the decision to invest in improving the irrigation. But it is relevant in dry areas, where the availability of ground water is limited. Farmers are not allowed to use this groundwater for irrigation and do not easily get permissions. Positive is that provinces are interested in supporting precision farming, to develop regulations to stimulate investments. So, farmers may find support for more sustainable practices and investments.

Respondents are interested in alternative cropping. There is already quite some knowledge about alternative crops. The limitations are merely coming from economic factors and market uncertainties (Figure 47). Most farmers are conservative regarding their farming system; it is a big step to grow new crops. Farmers have contracts with a cooperation. It is not so easy to change productions and value chains. And there is much demand for regular products, so the push for other practices is missing. Most growers think that adaptation of varieties will lead to decrease of production on the short term. Most limiting probably is the uncertainty on required investments versus the prices and the risks that are higher in an initial stage of growing a new crop. Farmers change their practice only when there are urgencies.

There is not much investment of farmers in knowledge development. Plant breeding is focussing in the context of plant diseases. The growers do not struggle with limitations on water and nutrients, so they do not demand for other crops or varieties. The urgency is missing. The frontrunner farmer, a potato farmer, is not interested in other crops, but in other varieties of potatoes, which are better resistant to droughts and wet circumstances. The market uncertainty is the most important aspect. Market demand is leading for decisions on production of certain crops or varieties. But the market asks for the products that the growers actually are delivering. There are yet not many problems in growing them or with their quality. Quality is most important factor for the market. The market demand doesn't lead to limitation in the of use of water; the more use of water, the better results. The less use of water, the more risks of bad quality products. To create a new market, the infrastructure and the production chain needs to be developed. This will take time and it is seen as a risk.

For the respondents, the most preferred option is to improve the irrigation systems on field level (Figure 48). The capacity of irrigation is limited, because the majority of the farmers do have only 1 or two overhead sprinkling installations, which cannot be used for all parcels. Next to that, the technique of the nozzle is not perfect. Farmers are often too late, because they wait for the rain, which may not arrive.

Next to this option, changes in crops or in varieties are being pointed out as preferred options for improvement, to make them more resistant against wet and drought circumstances. For 2 of the 5 respondents also the improvement of the field infrastructure is seen as a preferred option.

The most preferred options for an advice tool focus on the following aspects (Figure 49):

- Prediction of water demand along the irrigation season
- Advice on costs/benefits associated to improvement of the irrigation strategy
- Advice on alternative crops/varieties

There is a growing interest to irrigate more optimal, by using different techniques and combinations of data regarding specific sensors to measure the moisture of the soil, to use remote sensing, to make use of better weather forecasts information systems and predictions. It is clear that the investment costs for famers in technology in relation to expected prices and income, are relevant for the decision to invest in new technologies and information. Big data is entering arable farming. A combination of information will increasingly determine farmers decisions about irrigation. One farmer is already experimenting with robots who are able to make optimal decisions in farming practices.

Next to that, there is a clear interest in the development of alternative varieties and/or in new crops, who are more resistant towards specific dry or wet circumstances, for example due to climate change. Another need is being articulated, namely the relative efficiency of certain crops or varieties compared to other crops, other varieties, in various production areas. Farmers would like to improve and optimize their production in terms of quality and sustainability and would like to show it to buyers and consumers.

These innovative practices need exploration and testing. Therefore, incentives and funding are relevant. Advice on incentives is not mentioned a lot, but the innovative farmer is very keen in seeking support in knowledge, advice and finance.

Famers have already a good overview of the costs of irrigation. A frontrunner farmer who invested in new technologies such as the use of sensors and weather predictions pays 150 euro per hectare per year. He saves 50% of the amount of water and he realises a 12% higher yield with precision irrigation. Another respondent mentions that there is no clear and convincing insight in the revenues of measures.

Some respondents are interested in improving the field infrastructure, to arrive to more optimally growing structures and irrigation systems. Some respondents are interested in the costs of the use of energy, because it is a relevant cost. Farmers will irrigate less because of the energy costs; they won't take any risks that crops might have to low water inputs. So energy will not be the main issue for tool or service development.

Next to the suggested tools and services, the concept of the water footprint did come forward in two of the interviews. The farmer mentioned that all his buyers of potatoes make demands on sustainability and efficient use of water for crop growing. But, these companies are not eager to pay higher prices or to support in the investments of farmers. A researcher mentioned that the relevance of the water footprint is known but does not lead to more sustainable investments and practices.

In the Netherlands an irrigation tool has been developed by Wageningen University and Research, the water board and the farmers organisation; www.beregeningssignaal.nl; This tool is built on data and maps of the soil (1:50000), for some crops (maize, grass, potato, sugar beet and spinach), evaporation, soil texture, level of ground water and crop rotation schemes. The tool use weather forecasts (3-5 days) and historic weather information. The tool gives advices on irrigation to arable and dairy farmers. Also economic advice will be given, for example on irrigation of meadows for a higher yield of grass or purchase of feed for cattle. Actually, the tool has 150 users, who pay 200 euro per year. The tool needs 1000 members to be cost effective.

Another tool is www.akkerweb.nl. Akkerweb compiles all the information in one central geo-platform. Within Akkerweb, the 'crop rotation application', set up using geo-data, forms the foundation for all the functionalities that provide an added value for farm operations, such as fertilisation and crop protection. Akkerweb consists of basic information of soils, weather forecast, with information on lot level.

4 Evaluation of the workshops and interviews

The number of participants was different between case studies, but the information obtained was very interesting. For example, the Netherlands case study only had 5 stakeholders, however, the information compiled show us that the are no remarkable economic and administrative limitations for improvements of the water efficiency on irrigation. Only in dry areas could these limitations be important. From a general point of view, the stakeholders highlight the market uncertainty such as the main limitations for adopting alternative crops or varieties.

The flexibility implementing the methodology for identifying and compiling the information by stakeholders, such as France case study, allows to identify single barriers or limitations according to the country. For example, if we analyse all data compiled about the actions that could be important to increase the competitiveness, the results show us that the main actions are "product improvement" and "increasing professionalism of management" (course, stage, study visits). This result is similar with Italy and Spain, so, a general strategy in this action could not be accepted by the rest of countries, is better applying the actions according to the local/national needs.

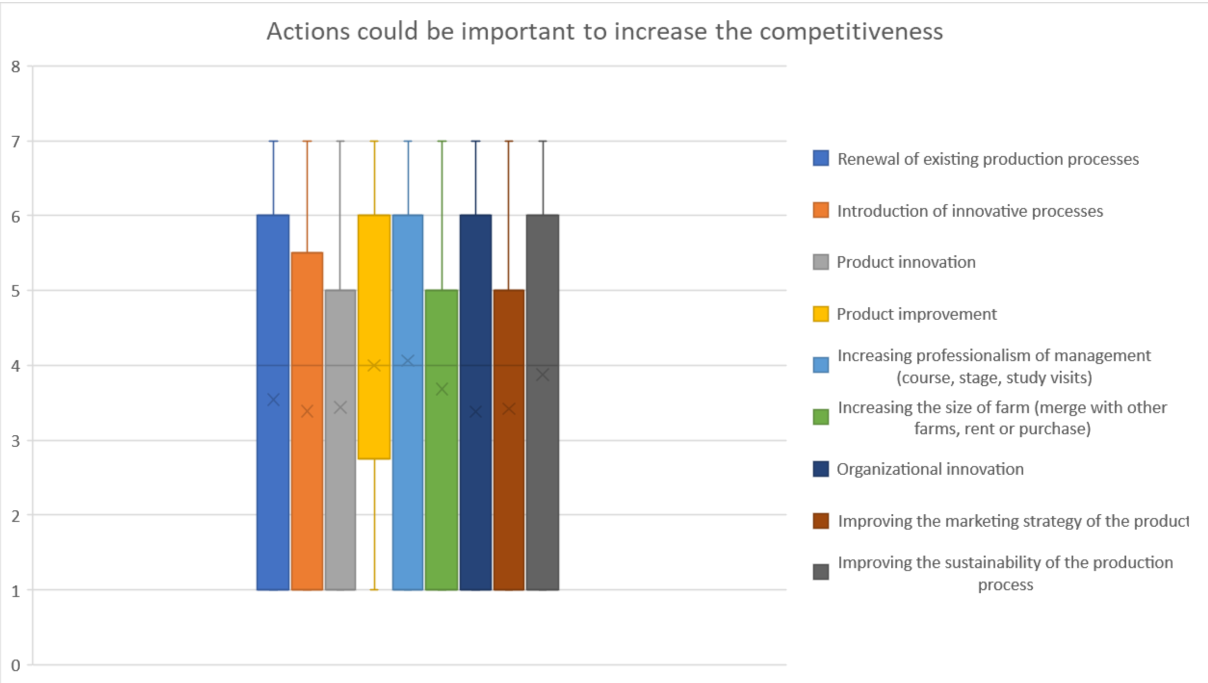

Figure 3. Results of all data from question "Actions could be important to increase the competitiveness"

Surprisingly, the stakeholders from the Netherlands and Spain answered that they "do not like" use new technologies. This answer is contradictory to the rest of case studies like use new technologies and looking for ways to experiment with it.

The strategy adopted by South Africa partner provided a lot of useful information about the needs or requirements of stakeholders. For example, the market needs are the most important driver and they prefer to try new varieties and clones of wine grapes than to switch crops irrespective of climate change scenarios that may arise. According to the questions about current advice tools, this was adapted to the category of stakeholders and local circumstances. For example, farmers are acutely aware of irrigation costs, as well as electricity costs per irrigation type (there is only one electricity service provider in South Africa). Some questions were also combined into one, for example information relating to water restrictions, distribution and demand predictions, as farmer currently receive all this from their Water Users' Association (WUA).

5 Other information

Difficulties encountered:

The availability of time for some users means that meetings (workshops) must be organized in a single day. Also, particular care should be addressed to the timing of agricultural field operations in order to have farmers' presence.

Changes made concerning the procedure suggested in the workshop guidelines:

Due to the availability of some of the participants in Spanish workshop, the groups classified before the workshop had to be modified due to the absence of some participants. However, a proportion according to the objectives of the project was maintained.

The French case study made the questionnaires by internet allowing to the stakeholders complete the exercises in their available time.

How was the interest and participation of the different stakeholder groups in the workshop?

All the attendees showed a good level of motivation and interest in the Spanish workshop. Only representatives of CSIC-Andalusia and the Guadalquivir Hydrographic Confederation remained during the opening ceremony for reasons of agenda.

All the attendees, in the Italian workshop, showed a good level of motivation and interest but not everyone agreed with the level of proposed innovation. In this respect, it emerged that different stakeholders' groups were interested into different aspects. CONSBIV interest is more oriented to the water management at territorial level including water saving, cost recovery and water consumption monitoring. Farmers seemed to be more interested in economic saving and in the value of agricultural production. Finally, SME was interested to the development of an ICT based solution to be useful for both mentioned stakeholders groups.

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Annex 1 Guide cover and surveys template

OPERA

WP1: Guidelines for analysis and selection of stakeholders

GUIDELINES FOR ANALYSIS AND SELECTION OF STAKEHOLDERS

Operationalizing the increase of water use efficiency and resilience in irrigation

OPERA

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Version: final

Figure 4. Guide cover

OPERA WP1: Guidelines for analysis and selection of stakeholders

Sheet content:

1. Actions could be important to increase the competitiveness
2. Valuation of sentences
3. Preferences on improvements

1. Actions could be important to increase the competitiveness

1 = Unimportant; 4 = Not so important; 7 = Very important.

	Value
Renewal of existing production processes	
Introduction of innovative processes	
Product innovation	
Product improvement	
Increasing professionalism of management (course, stage, study visits)	
Increasing the size of farm (merge with other farms, rent or purchase)	
Organizational innovation	
Improving the marketing strategy of the product	
Improving the sustainability of the production process	

2. Valuation of sentences

1 = Unimportant; 4 = Not so important; 7 = Very important.

	Value
"If I heard about a new technology, I would look for ways to experiment with it"	
"Among my peers, I am usually the first to try out new technologies"	
"I like to experiment with new technologies"	

3. Preferences on improvements

A1: Improving easy access to the information
A2: Ensuring coherent data and data reporting.
A3: Improving delivery efficiency.
A4: Improving private and public awareness.
A5: Assuring economic sustainability.

	9	7	5	3	1	3	5	7	9	
A Options	Abs olute prefe rence	Very stron g prefe rence	Stro ng prefe rence	Wea k prefe rence	Indiff erenc e	Wea k prefe rence	Stro ng prefe rence	Very stron g prefe rence	Abs olute prefe rence	**B Options**
A1										**A2**
										A3
										A4
										A5
A2										**A3**
										A4
										A5
A3										**A4**
										A5
A4										**A5**

Figure 5. Survey 1 template

WP1: Guidelines for analysis and selection of stakeholders

Survey 2. Identification of barriers and needs. User requirements

Sheet content: *click on the titles to go to the different survey sections*

1. Main limitations for improving water efficiency on irrigation
2. Main limitations for adopting alternative crops/varieties
3. Preferred options to increase water efficiency on irrigation
4. Preferred options that an advice tool should include
5. Valuation of known advice tools

1. Main limitations for improving water efficiency on irrigation

	Completely disagree	Disagree	Neutral	Agree	Completely agree	
	1	2	3	4	5	
Economic (costs)				x		*Identified limitations on incentives to invest in improvements*
						Notes: Knowledge
Administrative/legal limitations			x			*Identified limitations on water uptake/ water uptake rights*
						Notes:

2. Main limitations for adopting alternative crops/varieties

	Completely disagree	Disagree	Neutral	Agree	Completely agree	
	1	2	3	4	5	
Knowledge/advice on suitable alternative crops/varieties in relation with plant physiological requirements, soil and climate		x				*Identified limitations on knowledge or advice on suitable alternative crops/ varietie*
						Notes:
Economic (costs)			x			*Identified economic limitations on flexibility to adopt alternative crops/varieties*
						Notes:
Uncertainty of prediction on market demands				x		*Identified limitations related with uncertainty of prediction on market demands*
						Notes:
						Identified preferred tools for prediction on market demands
						Notes:
Only for farmers/producers:						

Figure 6. Survey 2 template

Annex 2 Graphs

Case Study Poland

Figure 7. Actions could be important to increase the competitiveness

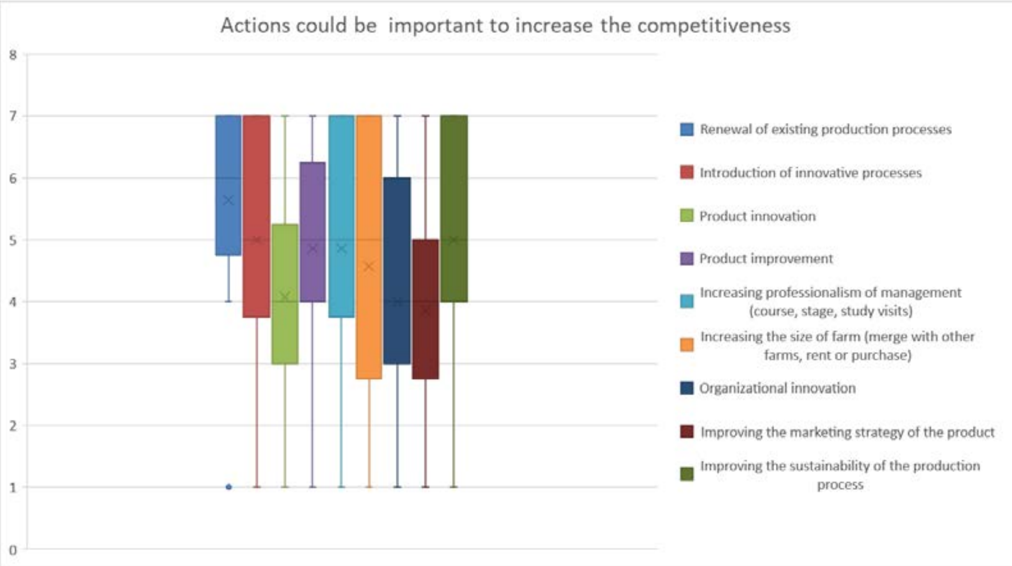


Figure 8. Valuation of sentences

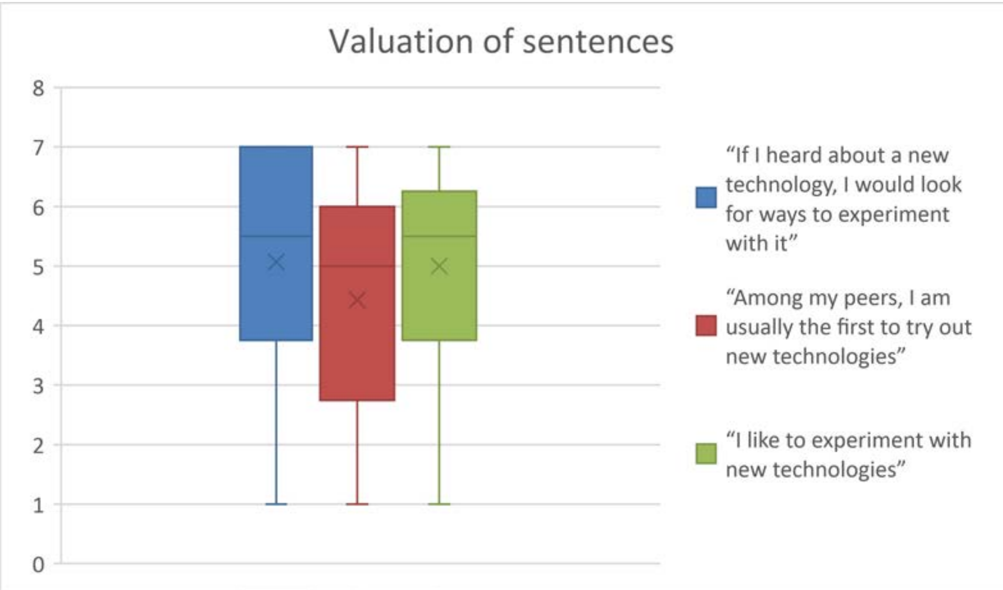


Figure 9. Main limitations for improving water efficiency on irrigation

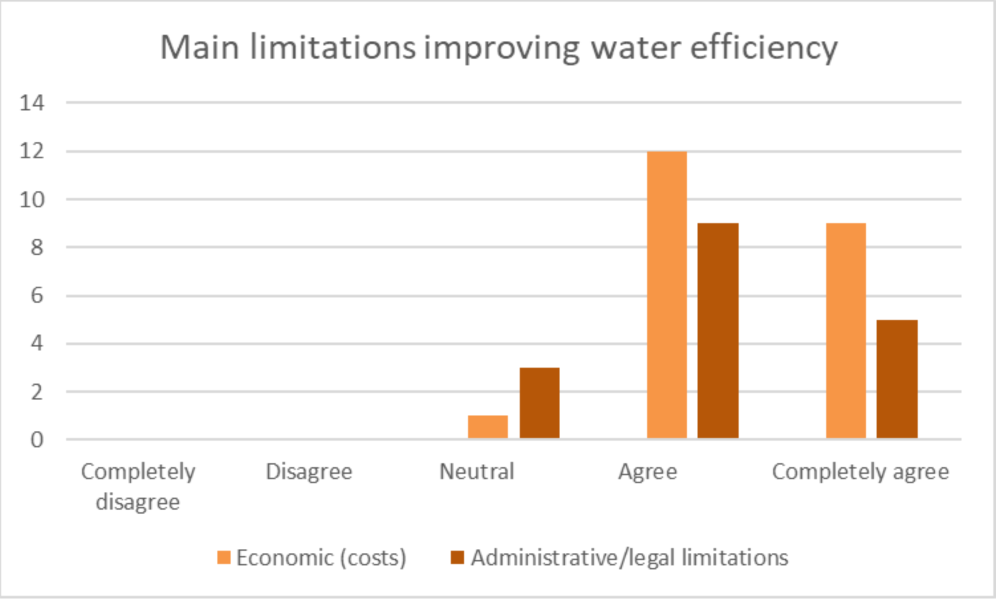


Figure 10. Main limitations for adopting alternative crops/varieties

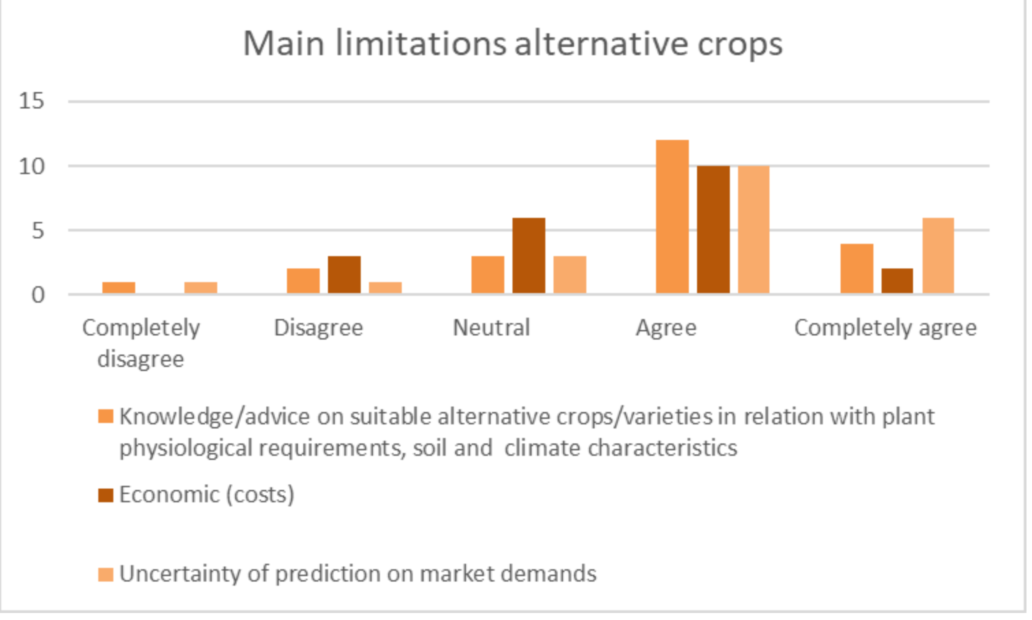


Figure 11. Only for farmers and producers: Order according to their relevance (1st to 3rd) as limitation to adopt alternative crops/varieties:

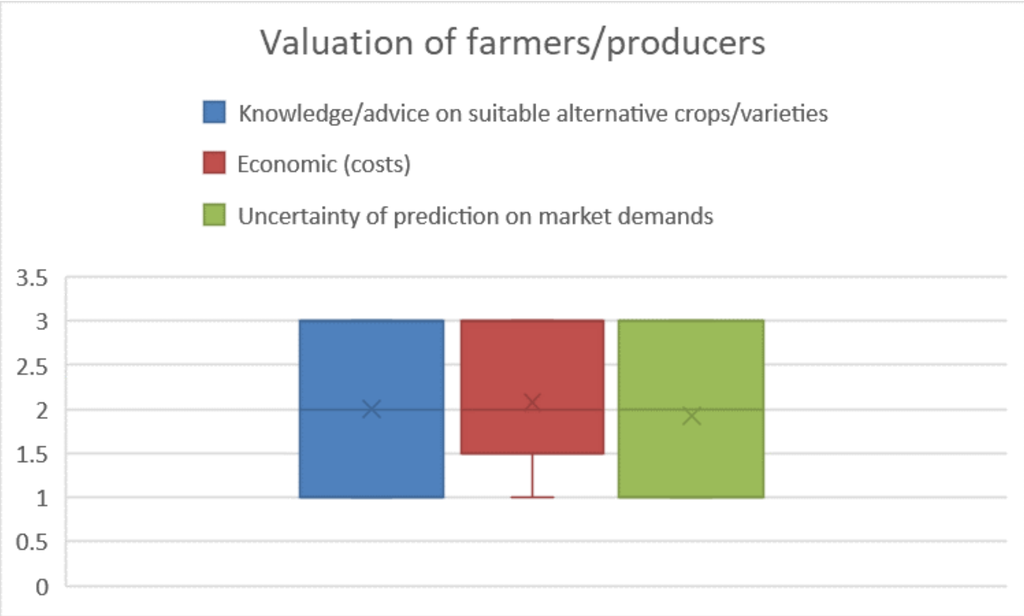


Figure 12. Preferred options to increase water efficiency on irrigation

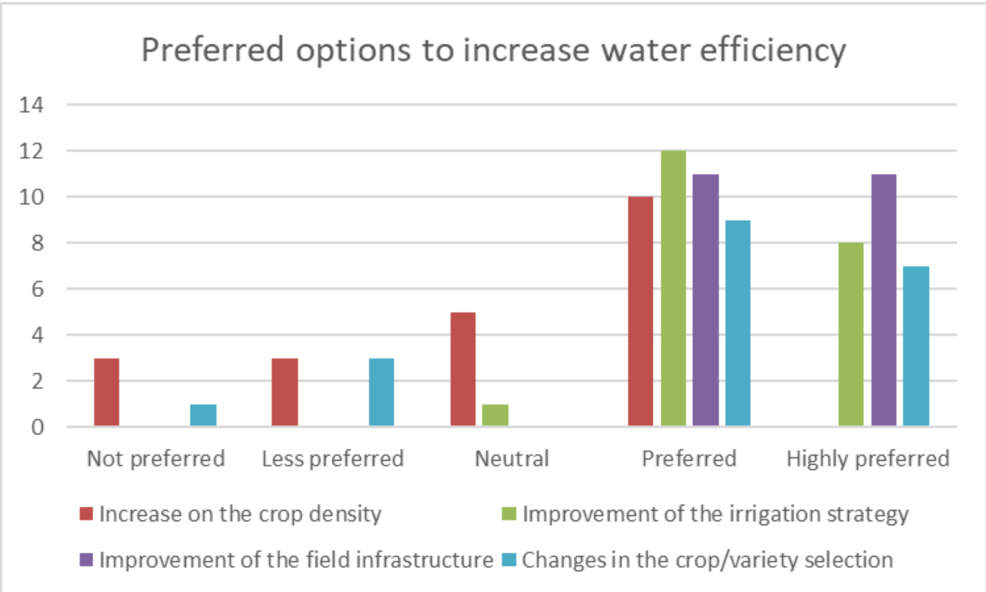
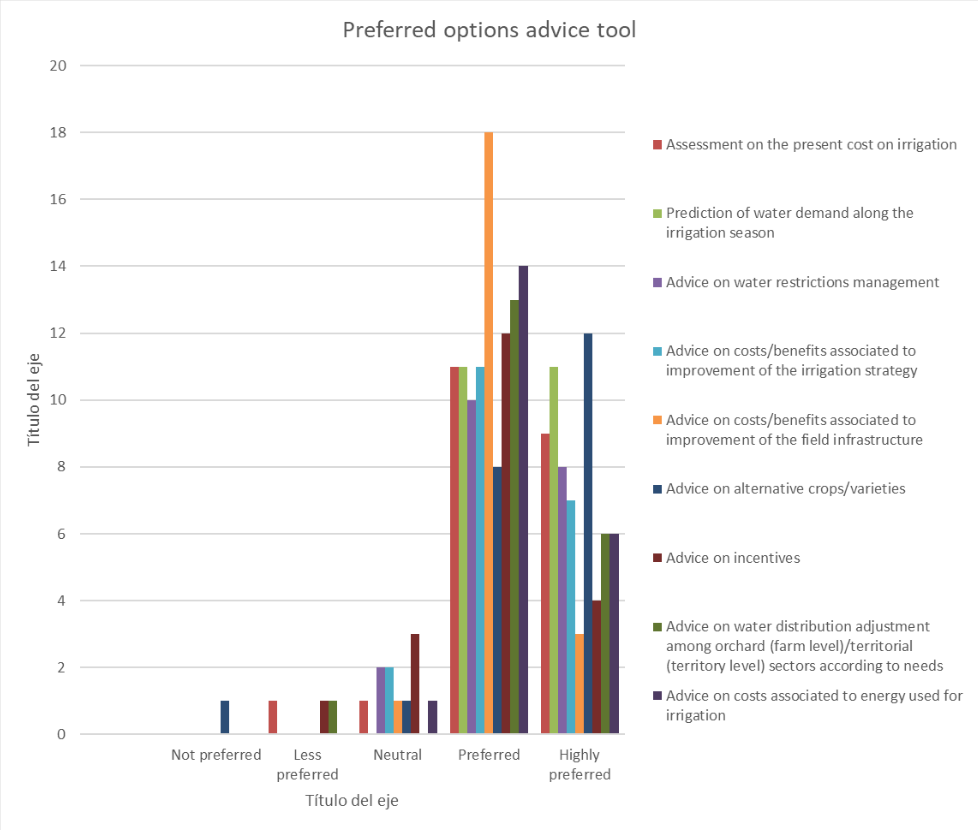


Figure 13. Preferred options that an advice tool should include



Case Study France

Figure 14. What improvements could be made to increase profitability on your farm

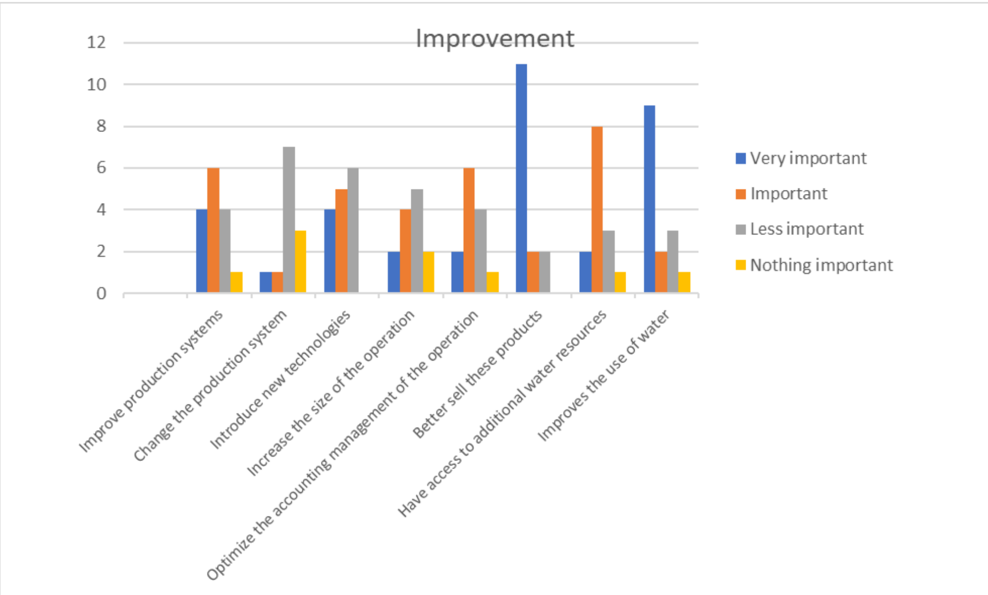


Figure 15. Sentences selected by stakeholders

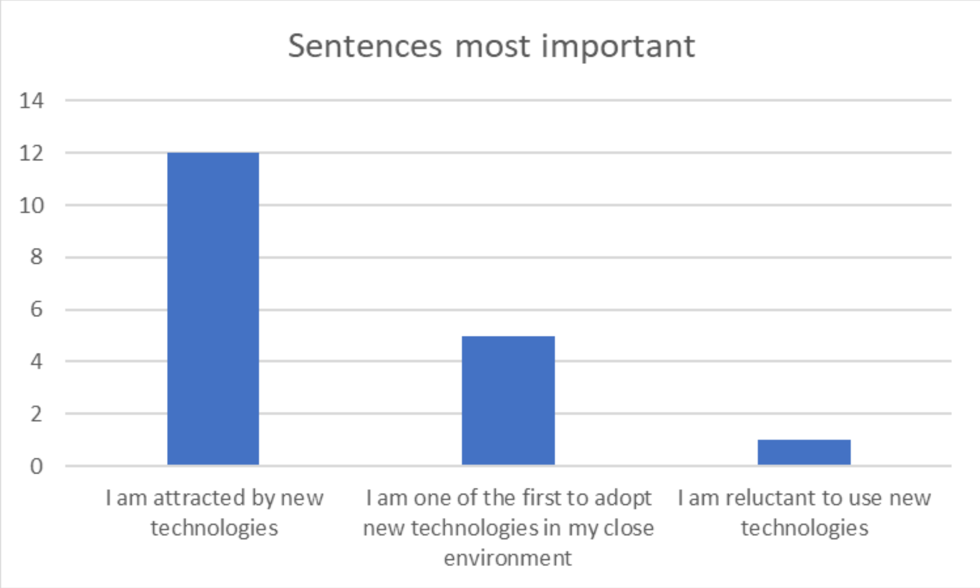


Figure 16. Options that allow a better use of irrigation water

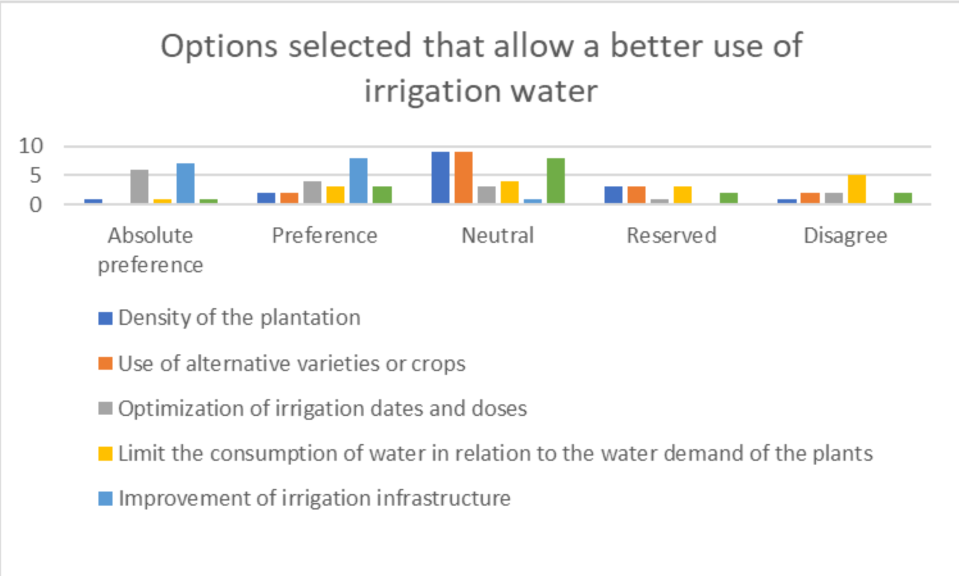


Figure 17. Important characteristics selected by stakeholders

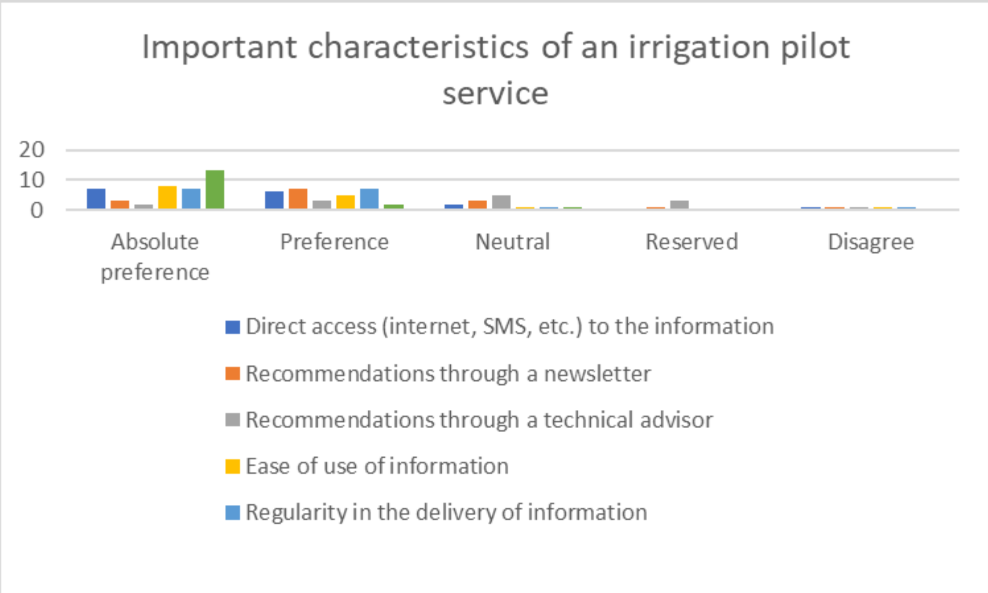


Figure 18. Obstacles identified to implementing an irrigation control system

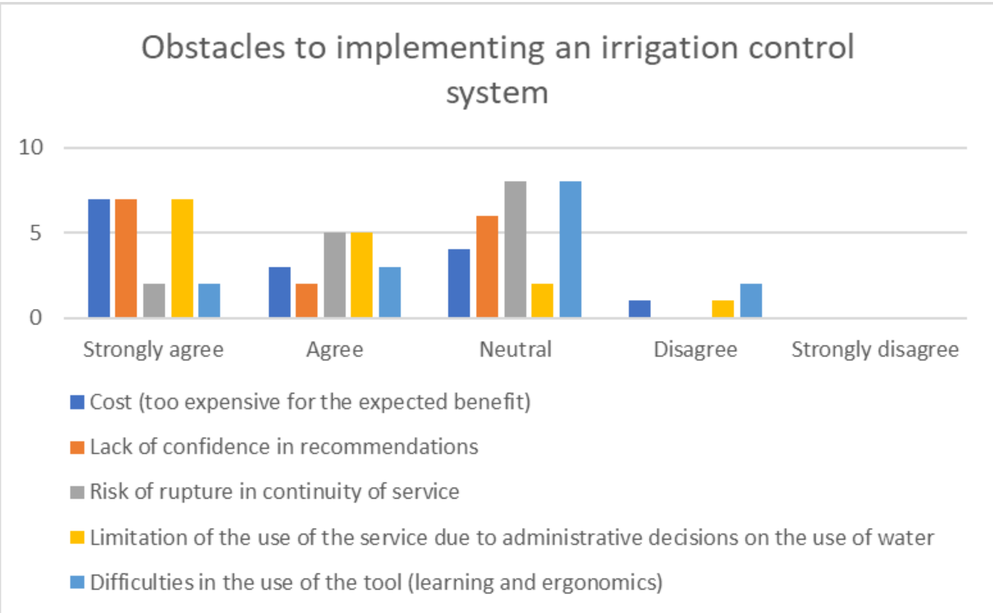
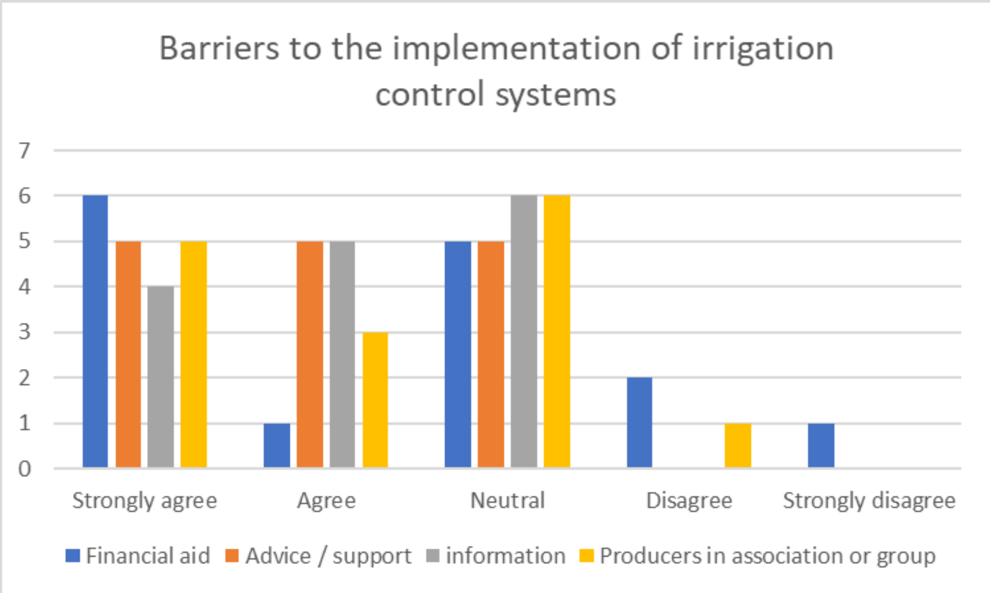


Figure 19. Barriers identified to the implementation of irrigation control systems



Case Study: Italy

Figure 20. Actions identified to increase the competitiveness

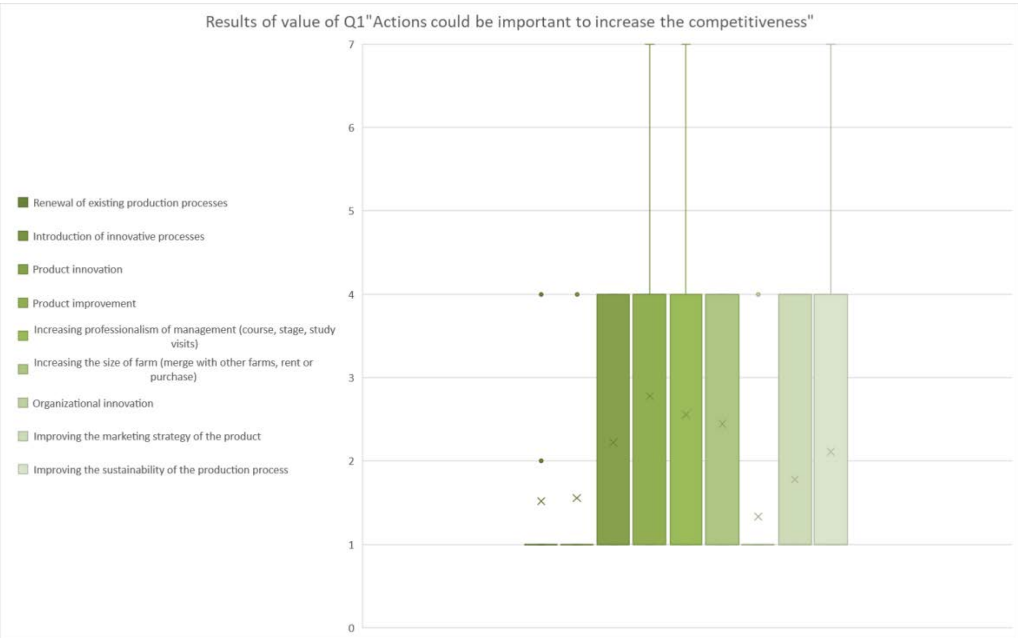


Figure 21. Valuation of sentences

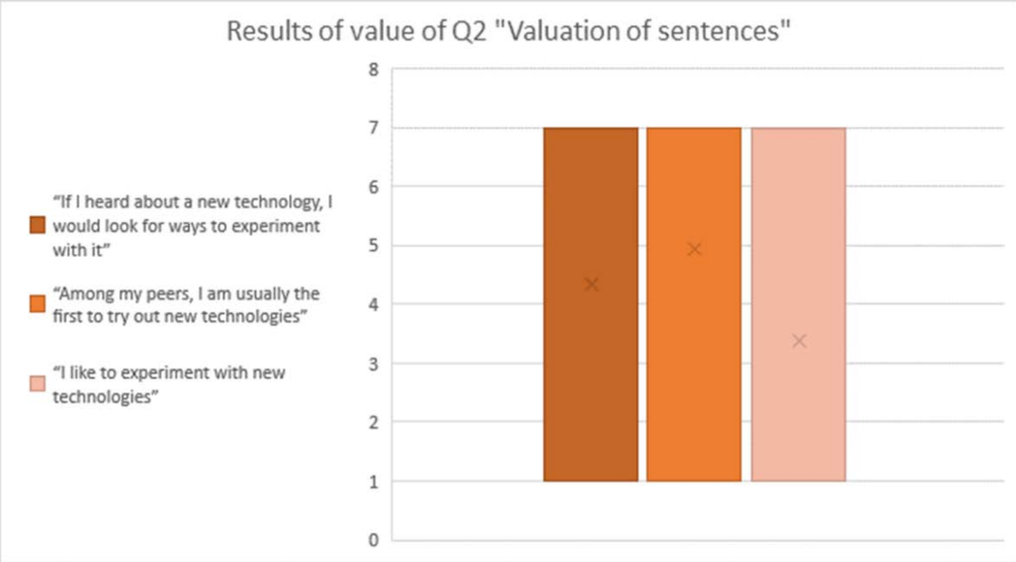


Figure 22. Limitations identified for improving water efficiency

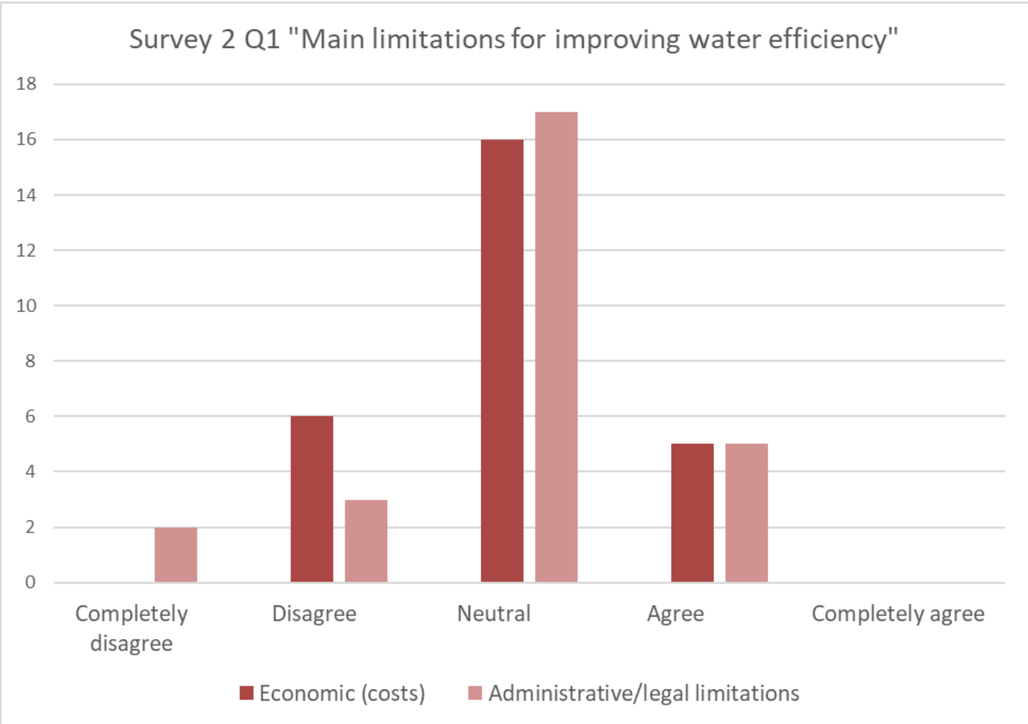


Figure 23. Valuation of farmers

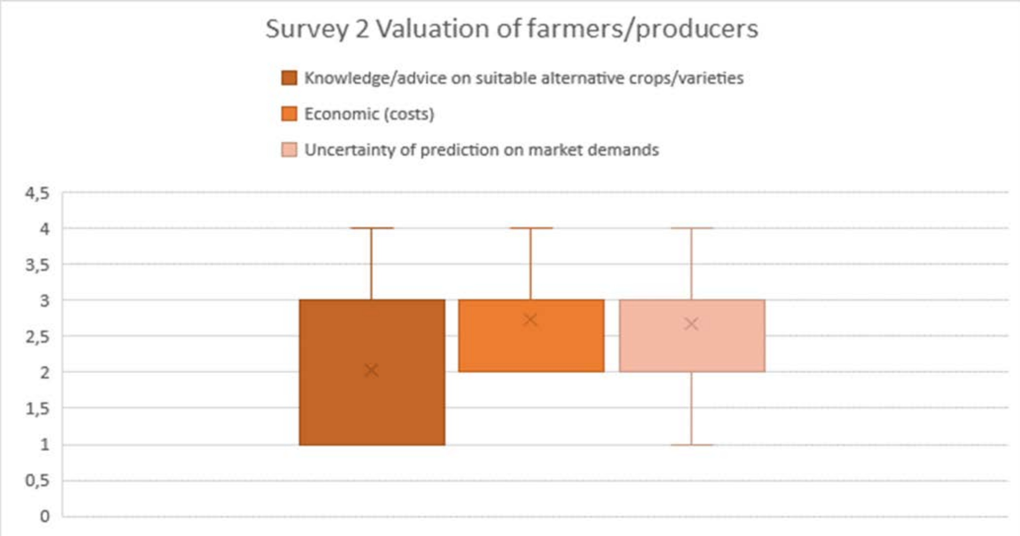


Figure 24. Limitations identified for adopting alternative crops/varieties

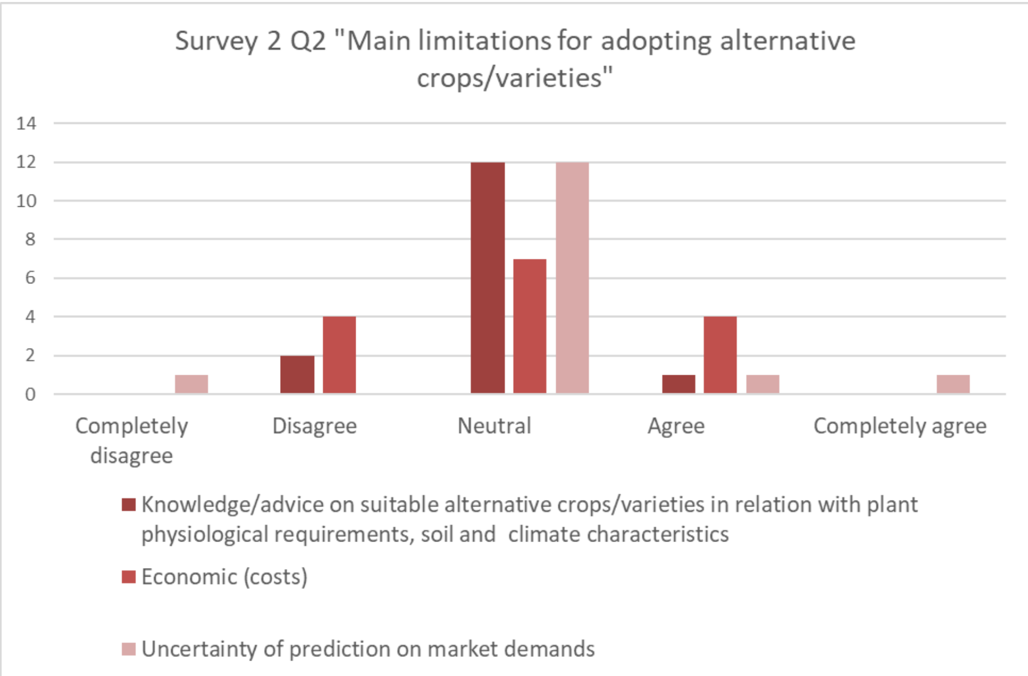


Figure 25. Preferred options to increase water efficiency on irrigation

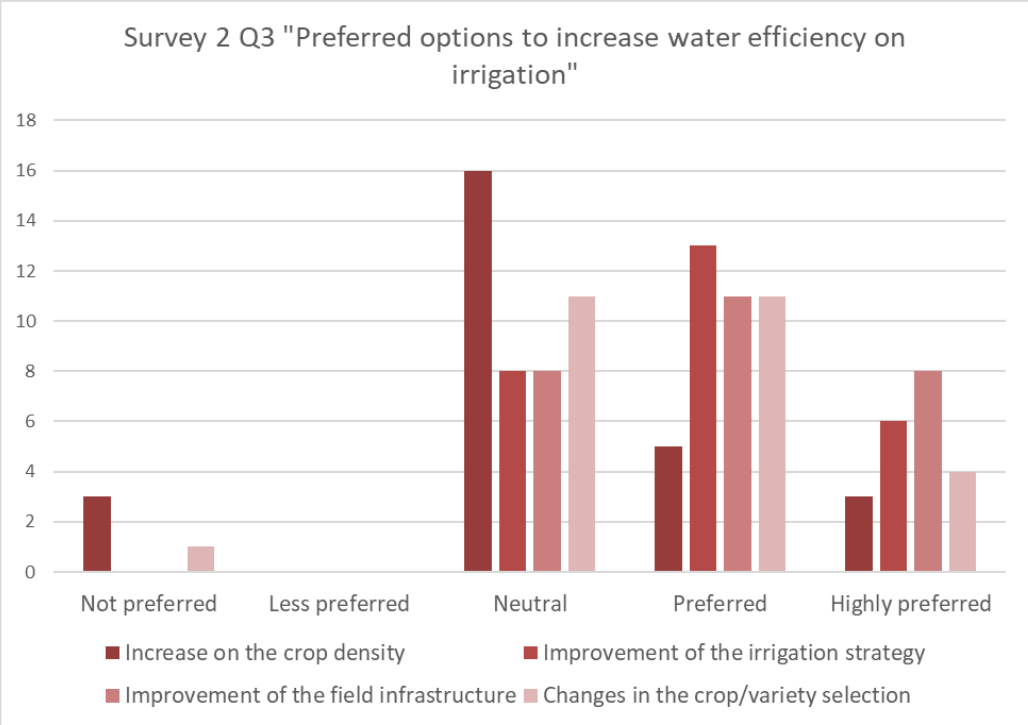
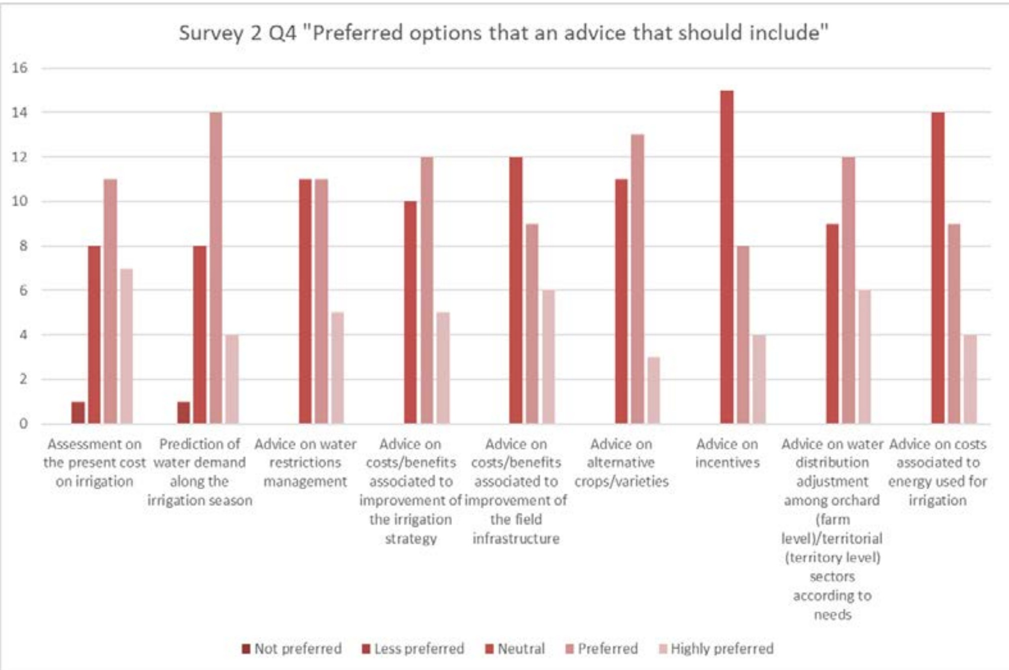


Figure 26. Preferred options that an advice tool should include



Case Study South Africa

Figure 27. Actions identified to increase the competitiveness (Cellars/own label)

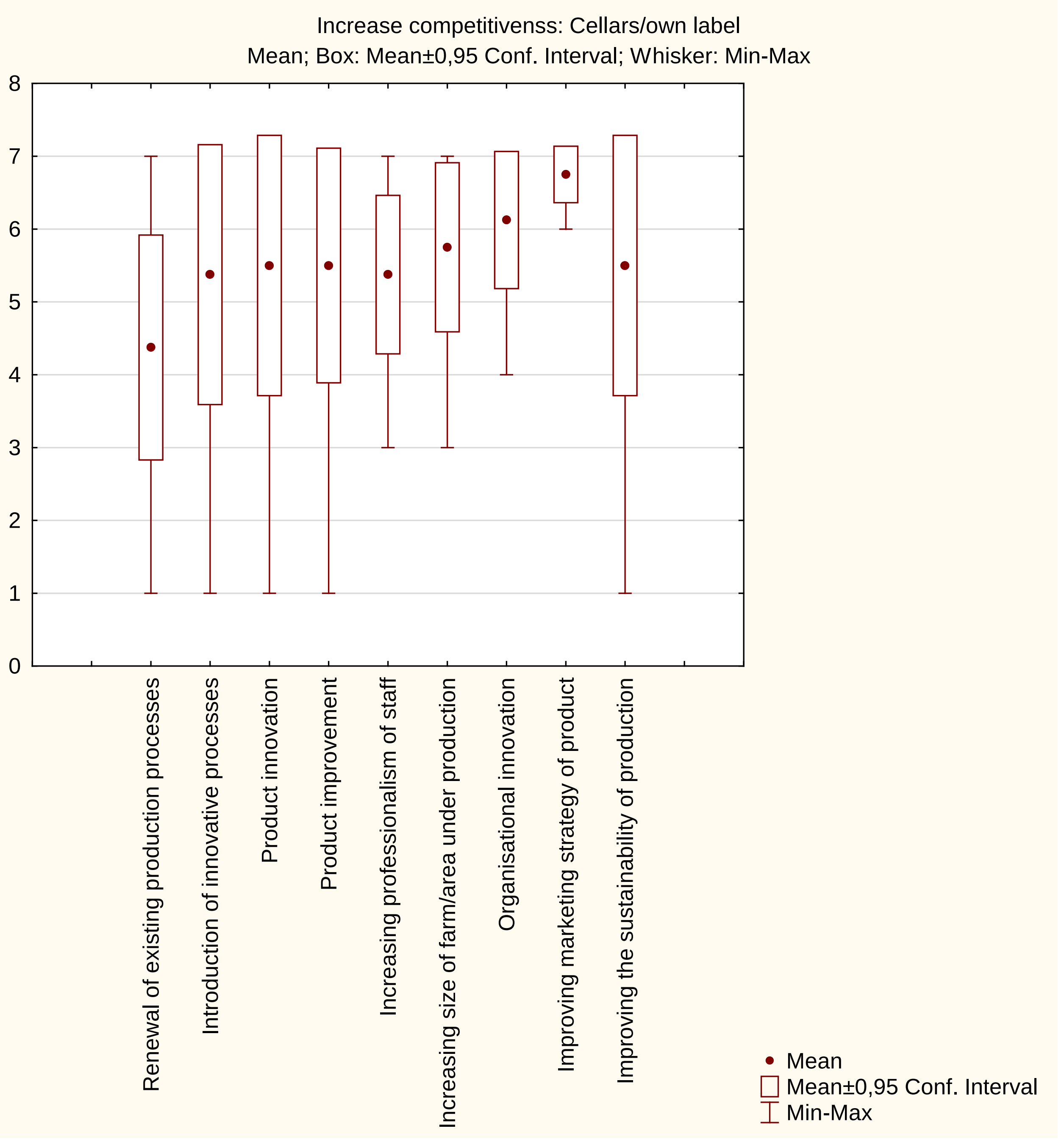


Figure 28. Actions identified to increase the competitiveness (Bulk suppliers)

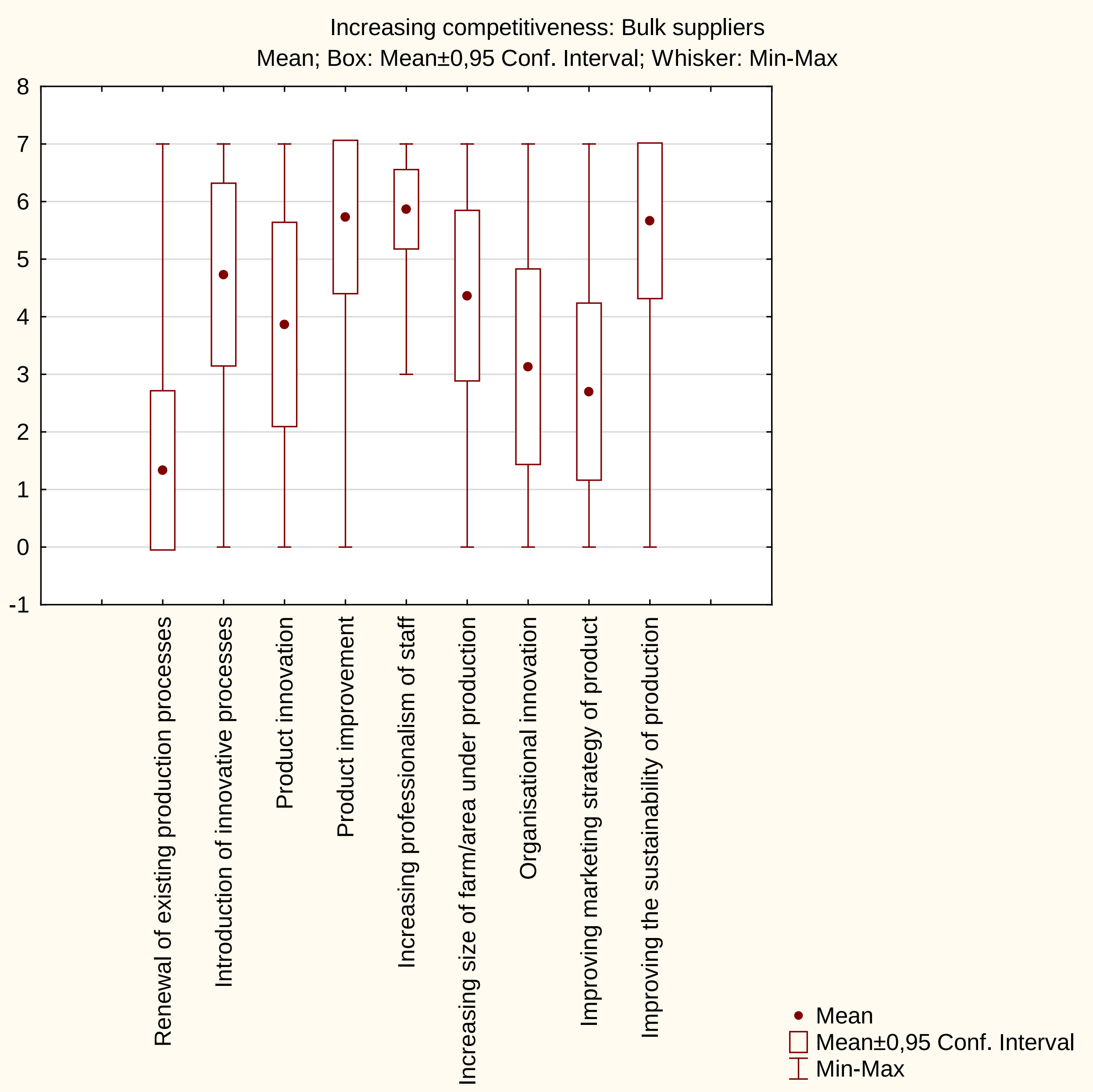


Figure 29. Valuation of risks

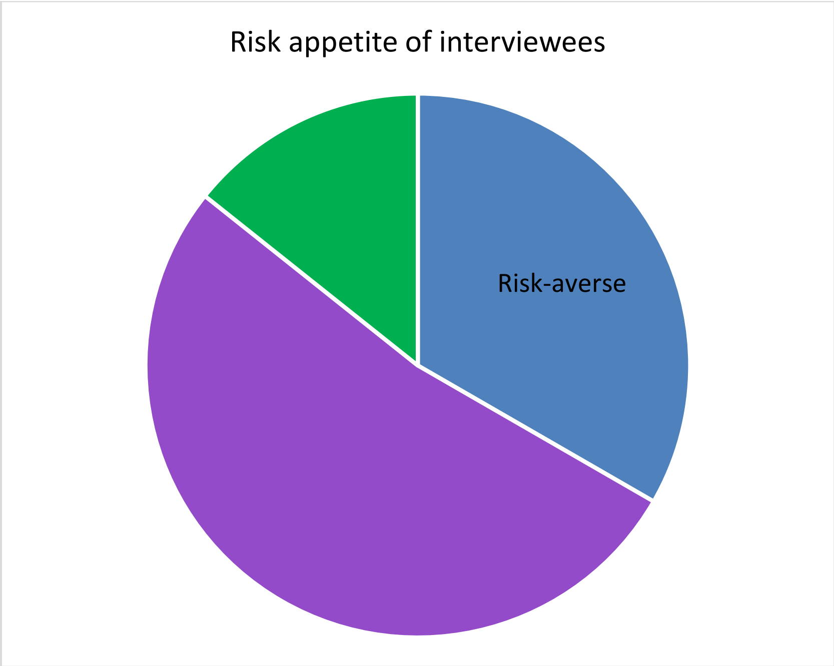


Figure 30. Valuation of sentences

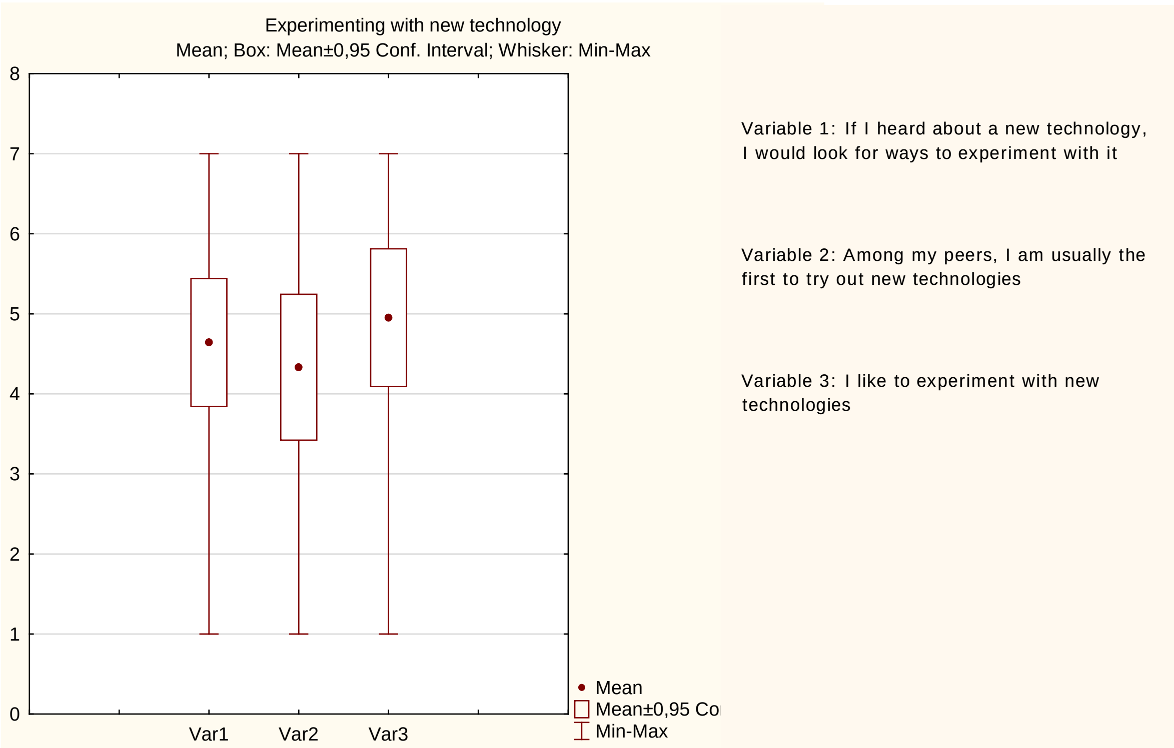


Figure 31. Limitations identified for improving water efficiency on irrigation

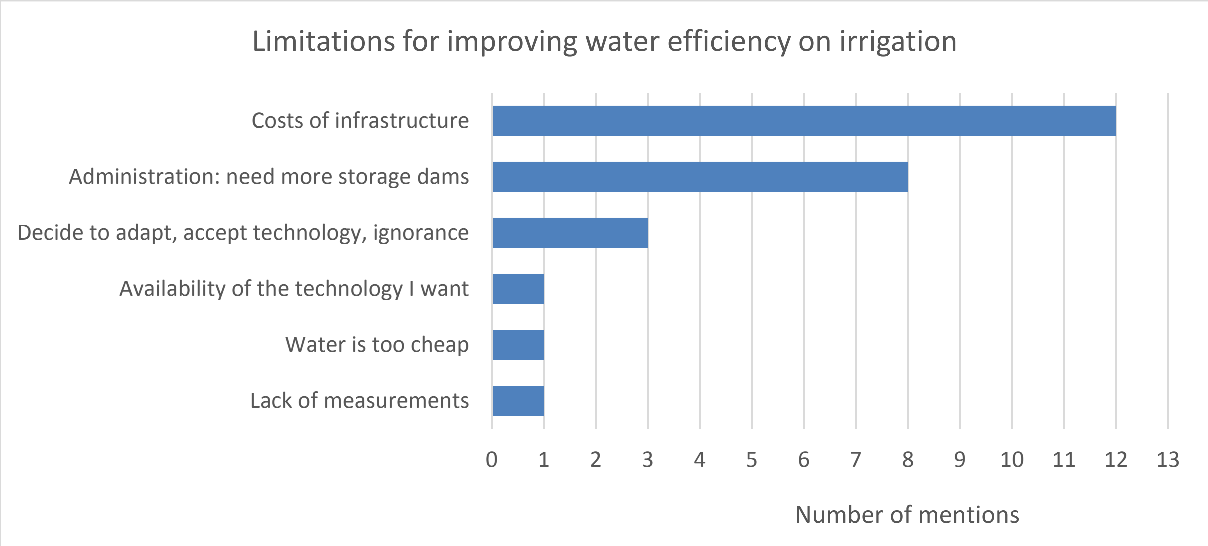


Figure 32. Preferred options selected to increase water efficiency

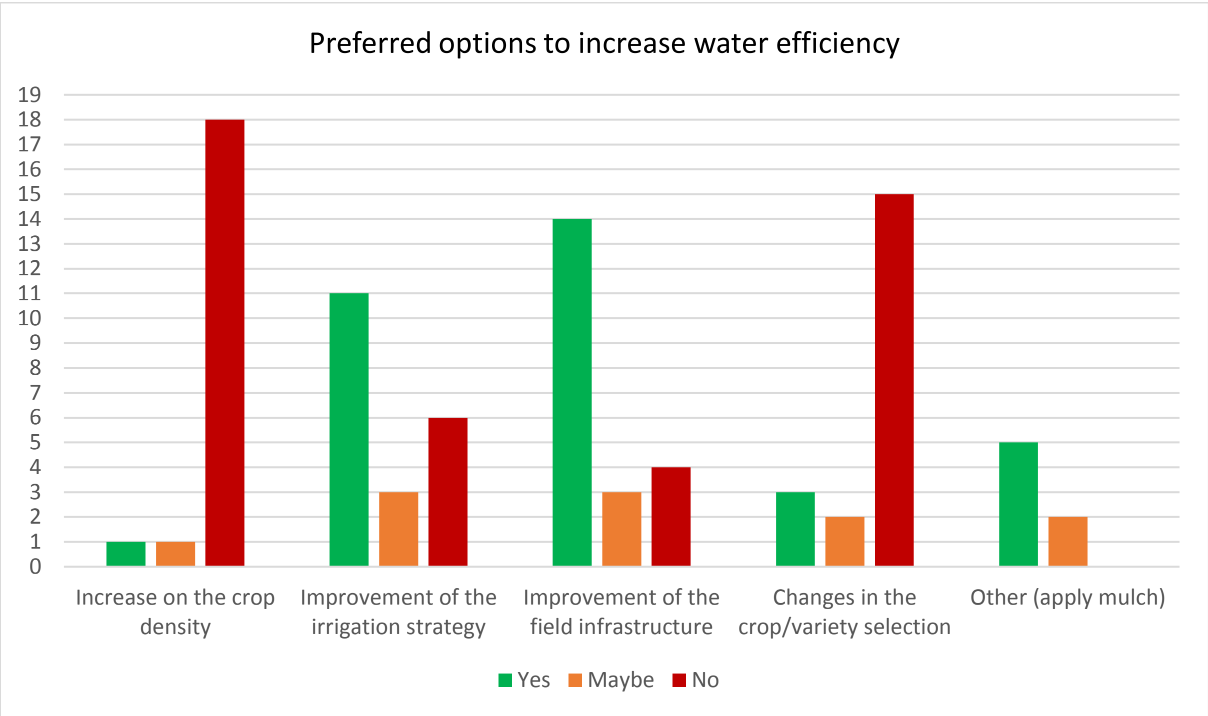


Figure 33. Reasons identified for farming with current crops.

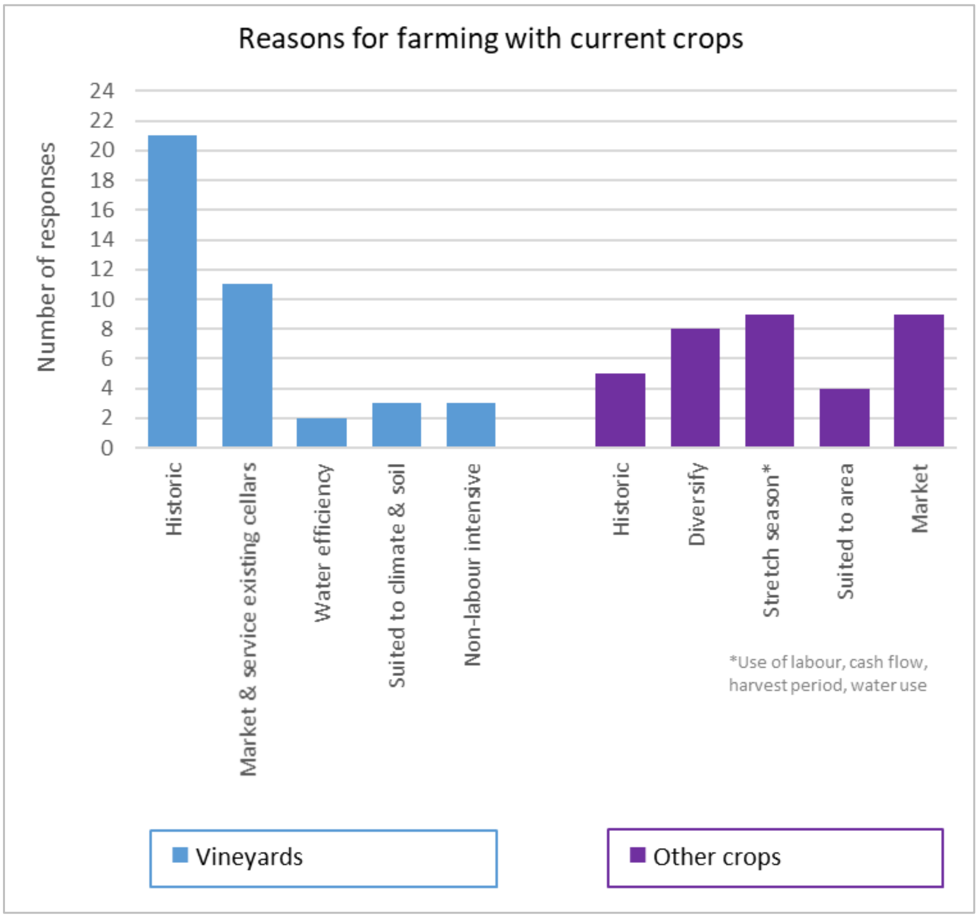


Figure 34. Factors identified to switch crops

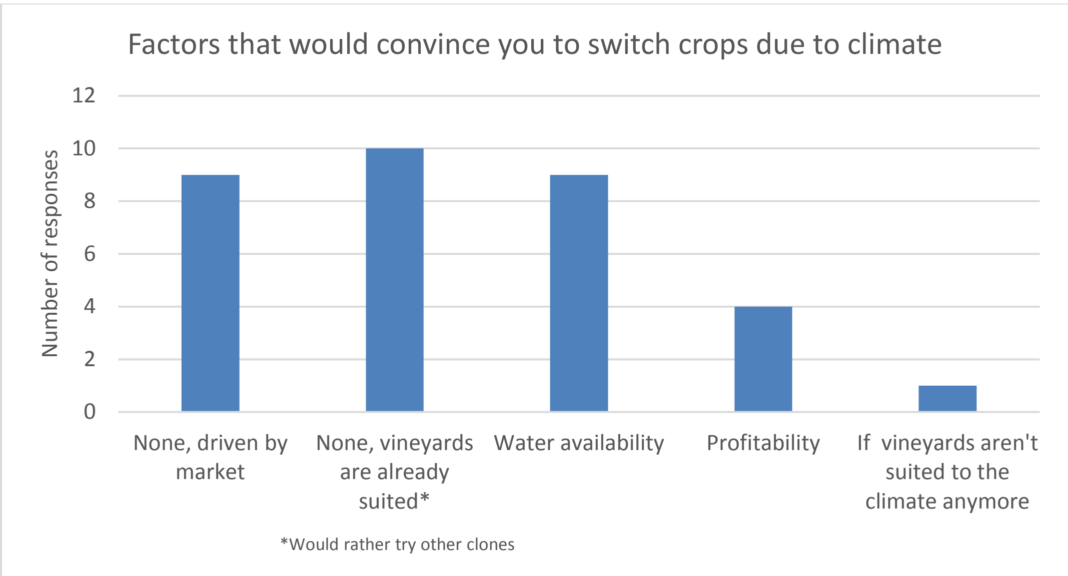


Figure 35. Main limitations for planting other crops

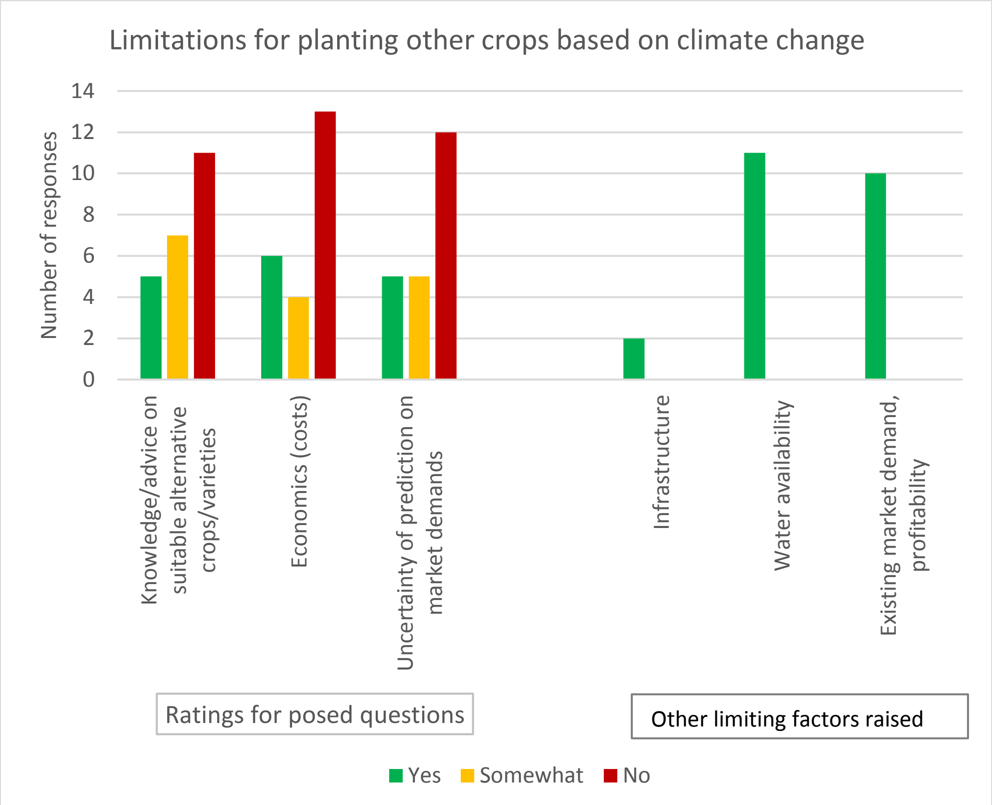
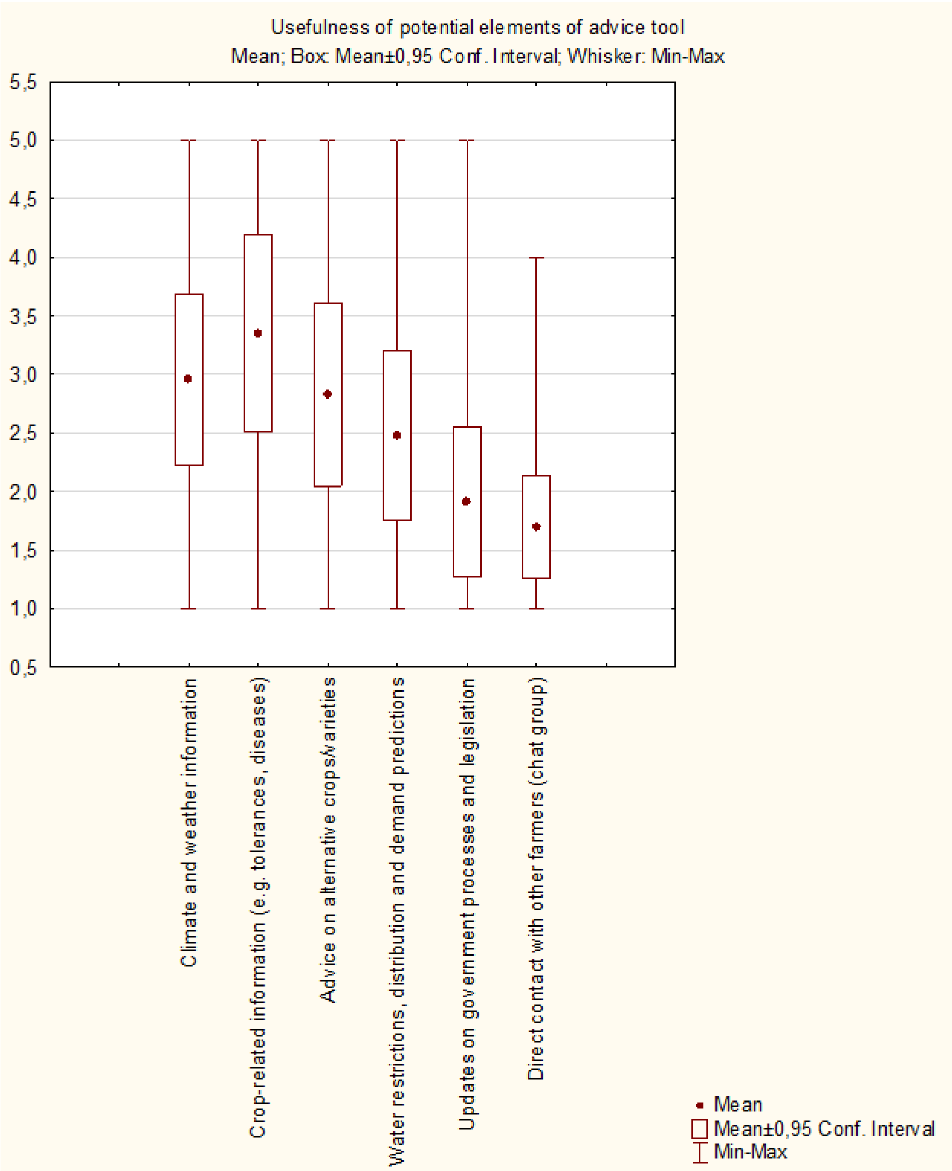


Figure 36. Usefulness identified of potential elements of advice tool



Case Study Spain

Figure 37. Actions identified to increase the competitiveness

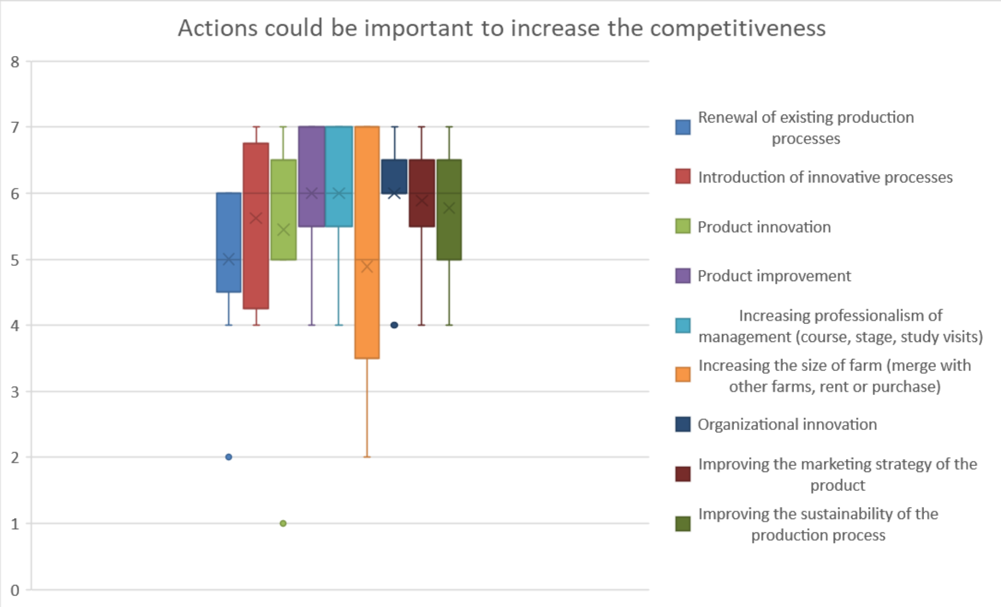


Figure 38. Valuation of sentences

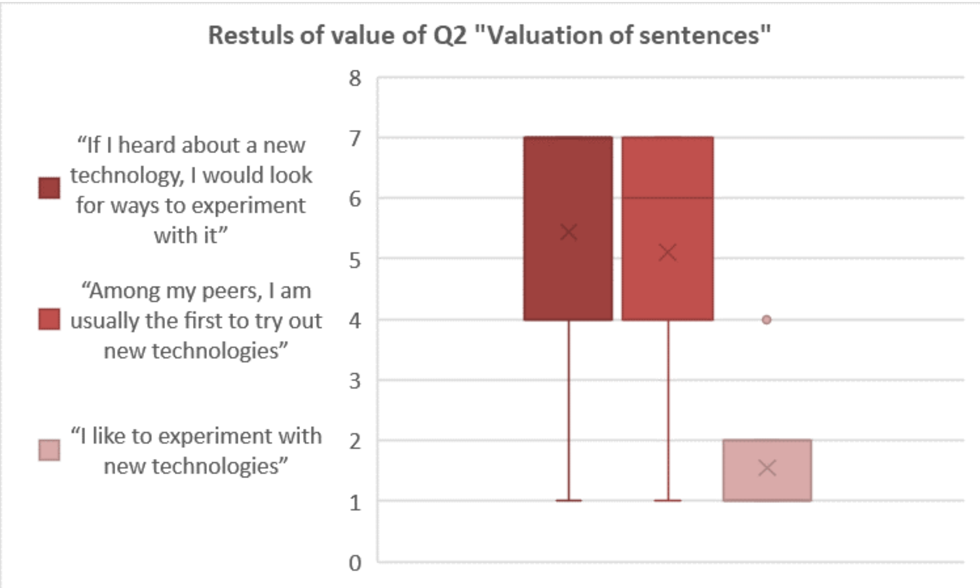


Figure 39. Limitations identified for improving water efficiency

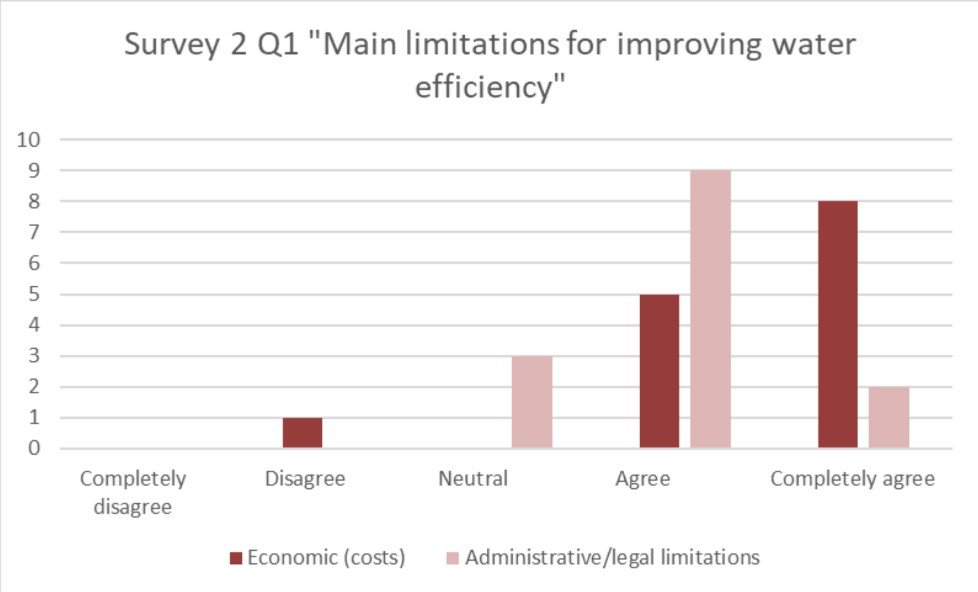


Figure 40. Limitations identified for adopting alternative crops/varieties

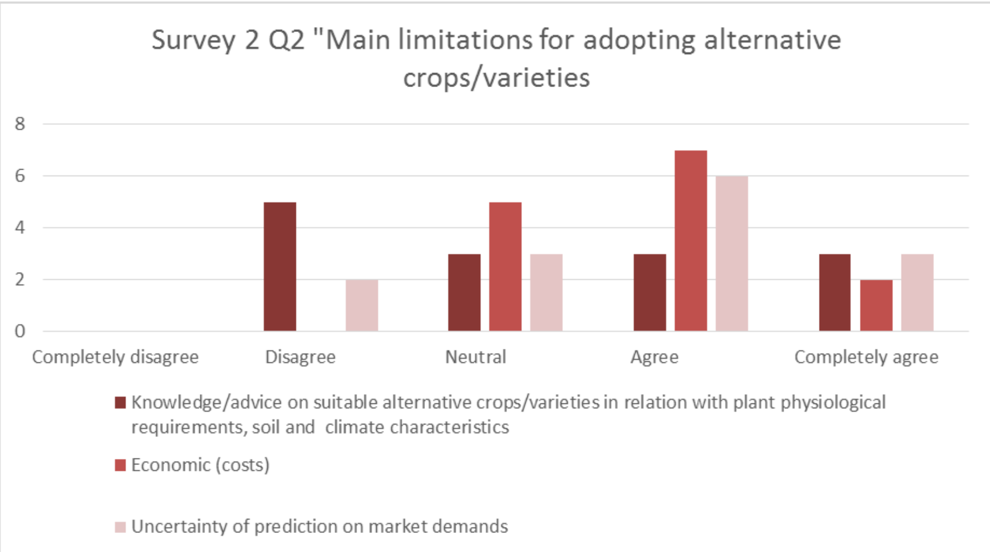


Figure 41. Valuation of farmers/producers

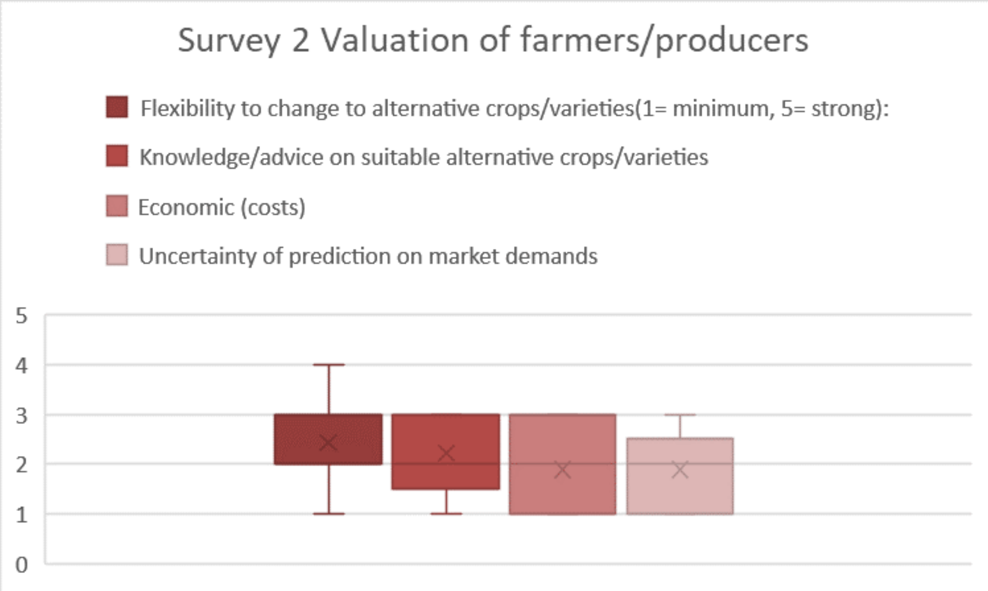


Figure 42. Preferred options to increase water efficiency on irrigation

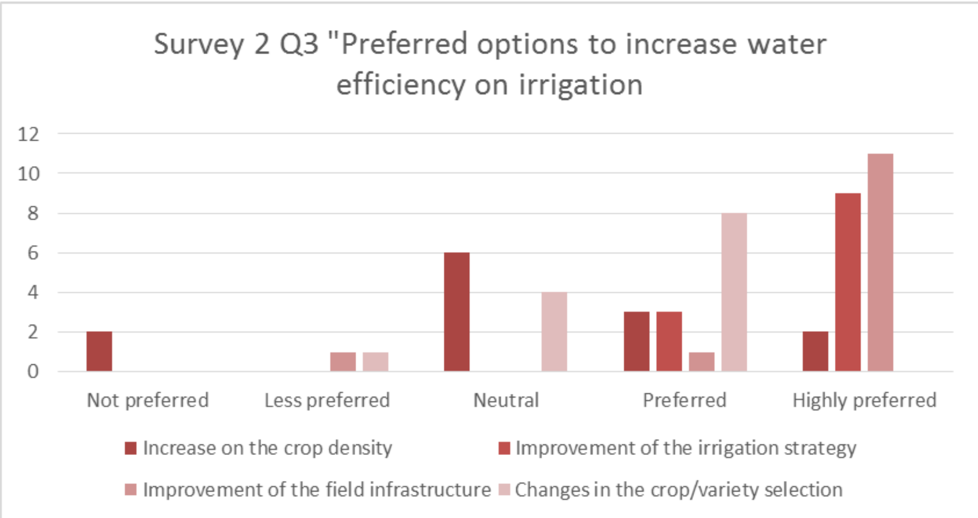
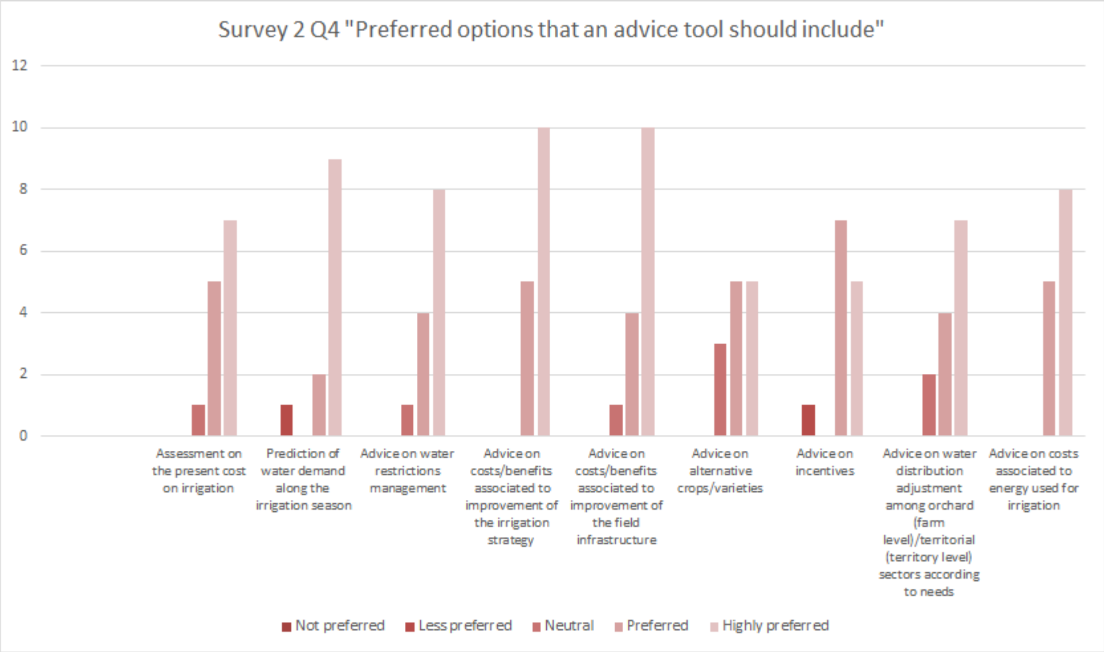


Figure 43. Preferred options that an advice tool should include



Case Study 6: the Netherlands

Figure 44. Actions identified to increase the competitiveness

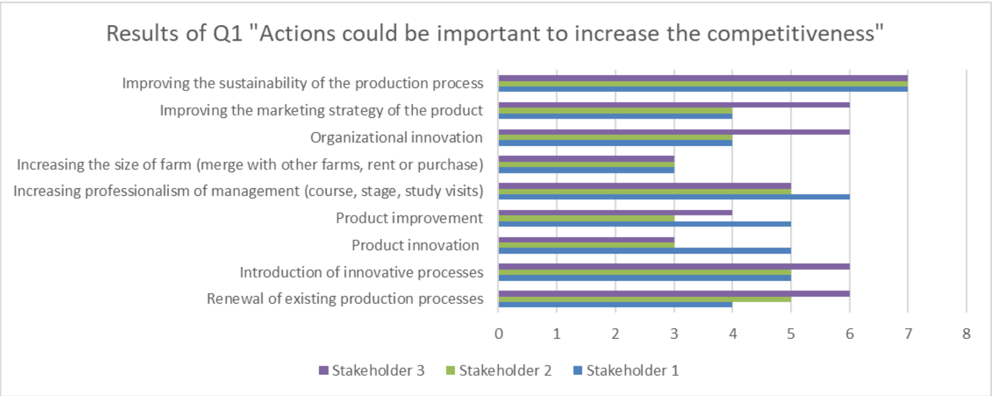


Figure 45. Valuation of sentences

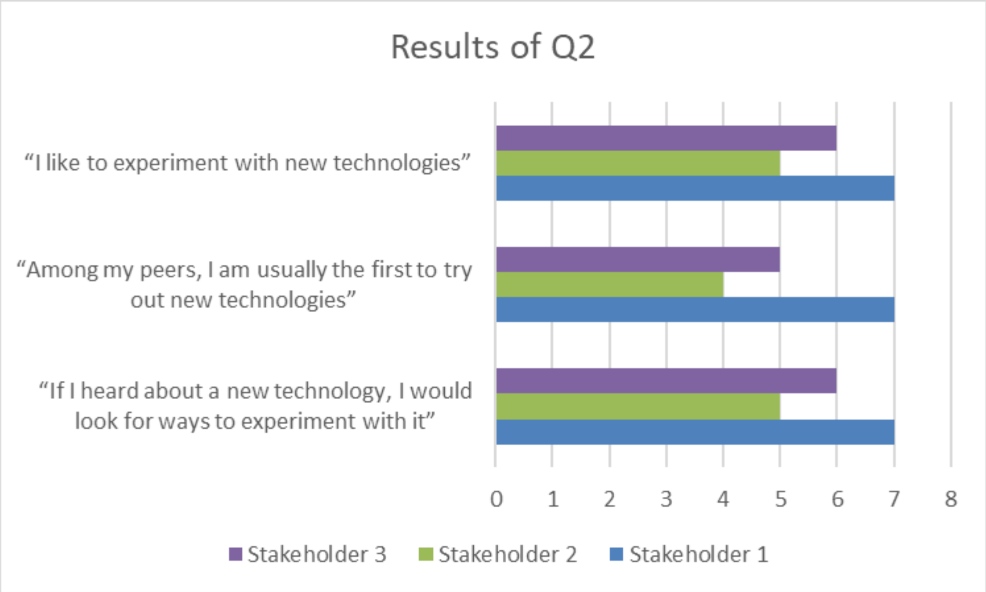


Figure 46. Limitations identified for improving water efficiency on irrigation

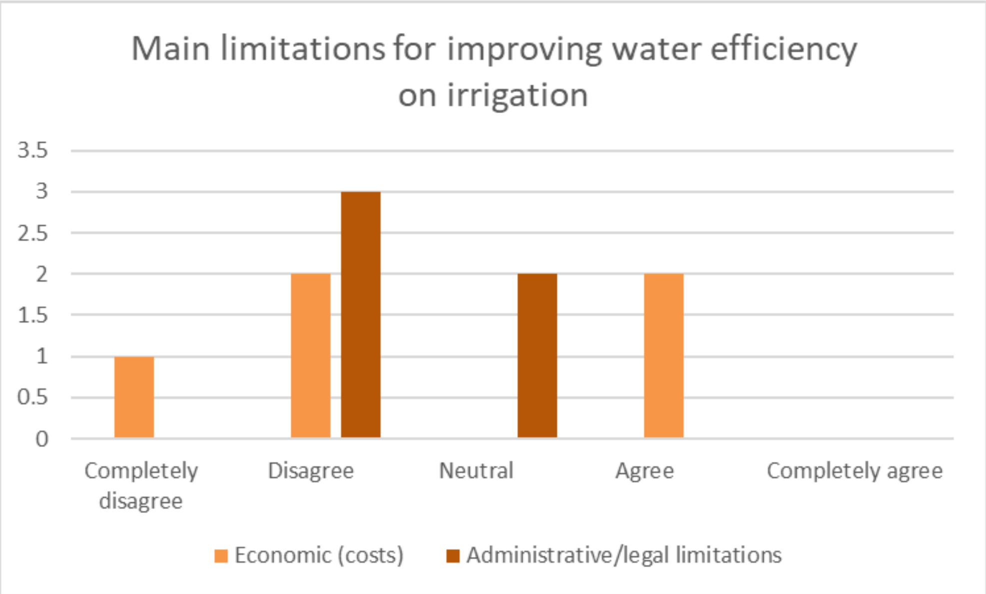


Figure 47. Limitations identified for adopting alternative crops/varieties

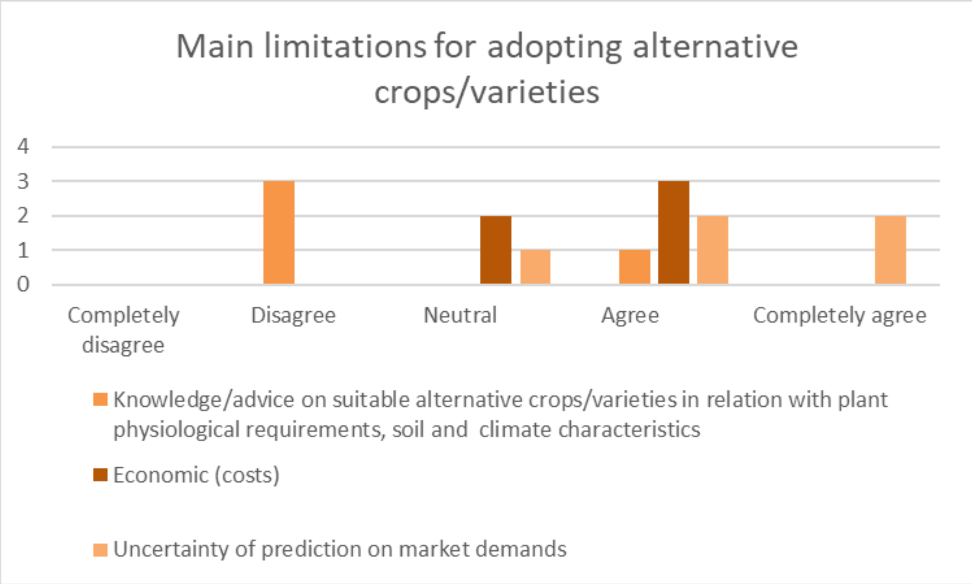


Figure 48. Preferred options to increase water efficiency on irrigation

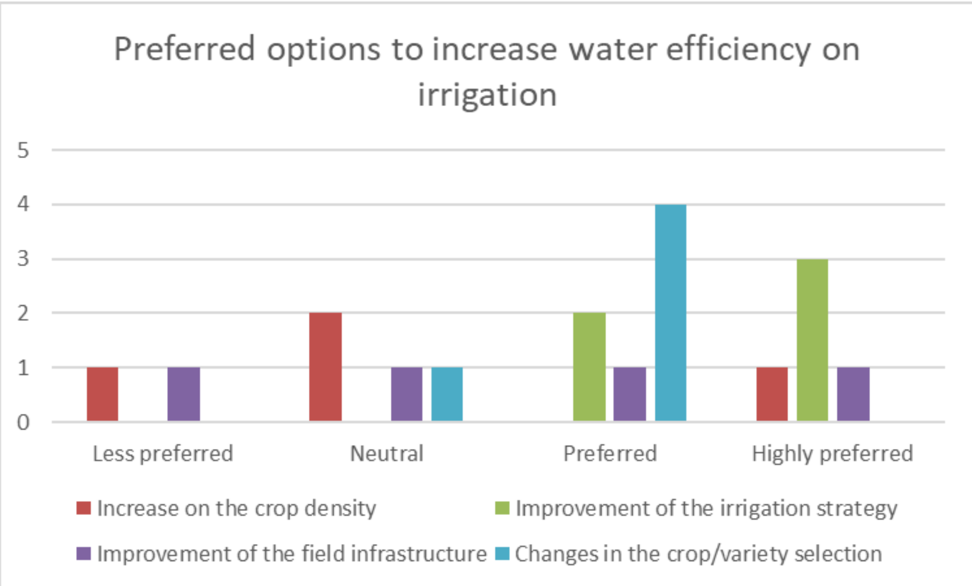
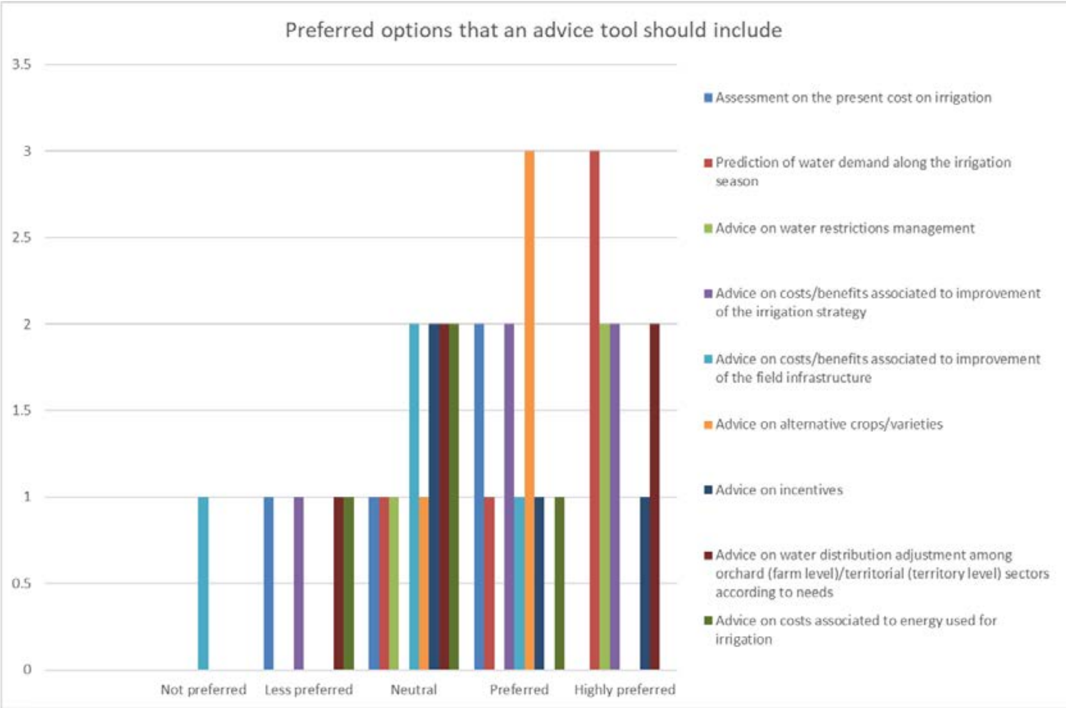


Figure 49. Preferred options that an advice tool should include



Annex 3: Pictures

Figures 50 and 51. Pictures from Italian workshop

Figures 52 and 53. Pictures from Spanish workshop

Figure 54. Drip irrigation from South Africa Case Study.

Figure 55. Variable Speed Drives