Project funded by EUROPEAN UNION

Jointly preparing the conditions in the agricultural and connected sectors in the BSB area for the digital transformation (BSB Smart Farming)

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REGIONAL ANALYSIS

Deliverable D.T1.3.1

WPT1 – Investigation on the level of preparedness for Smart farming in BSB area

Activity A.T.1.3. Common research on the level of preparedness for Smart farming of BSB area countries

Version 01, 17/03/2021

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SUMMARY

The Deliverable *D.T1.3.1. Regional analysis* constitutes a document that aims to provide conclusions and recommendations for the relevant BSB Smart Farming project partners countries agriculture and connected sectors.
It was produced during the implementation of *WPT1.1. Investigation on the level of preparedness for Smart farming in BSB area*, *Activity A.T1.1. Common research on the level of preparedness for Smart farming of BSB area countries*.
It is the outcome of work of LB (PP1) partner in collaboration with BSB Smart Farming partners.

Joint Operational Programme Black Sea Basin 2014-2020

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TABLE OF CONTENTS

Objectives of the investigation

The aim of this document is to present the results of the investigation in the Black Sea Basin (BSB) farming communities, that is in urgent need of becoming more competitive, sustainable and productive, by improving their businesses, production processes, products and services through a smart farming ecosystem, supported by the digitization of services. The main objective of the research is to identify the preparedness for smart farming in BSB Smart Farming project partners' countries. This regional analysis will become part of the final synthesis report that aims to present specific recommendations on smart farming and IoT solutions to agricultural problems and identified constraints/basic needs of the main actors in the partner's countries.

There were more research activities conducted: primary research and secondary research. In the following sections, it will be explained the main approaches that stand to the elaboration of this report, prepared with the collaboration of the BSB Smart Farming project partners, during the implementation of work package **T.1. Investigation on the level of preparedness for Smart farming in BSB area**, activity **A.T.1.3. Common research on the level of preparedness for Smart farming of BSB area countries**.

The present report started with the preparation of a common research methodology, applicable to every partner country participating in the project. The methodology is presented in Deliverable D.T1.1.1. Moreover, this research comes with results collected from a stakeholder's database of 600, 100 per country, and in-depth primary research and secondary research analysis. Desk research has been conducted using materials published in research reports and/or similar documents, available from public libraries, websites, data obtained from already filled-in surveys, etc. The resources used were the data available from the internet, governmental and non-governmental agencies collected and processed data, public libraries data, research and/or educational institutions data reports, commercial information sources like newspapers, journals, magazines, radio and TV interviews.

The focus was pointed on the overall situation, policies, quadruple helix stakeholders, projects implemented on both the agricultural needs/challenges of the rural communities and smart and IoT technologies that can be adopted to meet the needs/challenges.

Another research method was the elaboration of an online survey on the stakeholders' needs, concerns, level of preparedness, regional digital entrepreneurship ecosystem and related opportunities. The online survey was conducted through a specific questionnaire elaborated during the implementation of the project. It included specific questions related to the stakeholders' needs, concerns, level of preparedness, regional digital entrepreneurship ecosystem and related opportunities. There were created focus groups that offered support to the respondents in order to fill the proposed and agreed questionnaire, aiming the identifications of the smart and the IoT technologies that can address stakeholders' needs.

In addition, a training needs assessment and draft estimation were conducted, in order to identify the current level of competency, skill, or knowledge in the project specific field. In the case of the BSB Smart Farming project, the training needs assessment can be conducted in the following phases as the identification of the business needs, performing a gap analysis, assess training options, and finding training needs and training plans.

During the investigation on the level of preparedness for smart farming, in Black Sea Basin (BSB) partner countries, from the project consortium, all the stakeholders from the quadruple helixes were envisaged to be involved in the investigation. In order to obtain a detailed analysis of the regional BSB partners country areas level, the following quadruple helix figures were envisaged: farms, farmers, regional public and national public authorities, sectoral agency, infrastructure, and (public) service providers, interest groups including NGOs, higher education and research institutes, education/training centres and schools, business support organizations, international organizations under national law and enterprises.

The main research questions raised in the investigation were:

- What are the agricultural needs of the rural and peri-urban communities that, when addressed through the application of smart technologies and IoTs, can lead to poverty alleviation, improve the effectiveness and efficiency of use of the rural area resources;
- How is possible to address the agricultural local needs and identified constraints through IoT and smart technologies solutions to strengthen the development of smart farming in rural and peri-urban areas within BSB partner countries to decrease the poverty level and increase the efficiency of agricultural production and natural resources use? What smart and IoT technologies are implemented already in the country, which of the existing might be transferred from one country to another, and what smart technologies and IoTs can in the future be designed and developed by the involved stakeholders and entrepreneurs in the BSB area to meet these needs effectively and efficiently, mobilizing the local/regional resources to further fostering the competitiveness of the economies in the BSB area in answer to other main socio-economic challenges in the area, such as the brain drain, youth unemployment, and brain waste.
- What are the successful use cases of smart farming in BSB partner countries and how we can adopt and widen it?
- How to strengthen the interactions between the relevant helixes, particularly how to boost research, innovation, and business cooperation development?

In the investigation recommendations and conclusions on the level of preparedness for smart farming in BSB partner countries were drawn and will be presented in this deliverable. The recommendations are based on findings from the investigation achieved in Greece.

Chapter 1. GREECE's background / situation

Greece is located in the Mediterranean region and is a country with long history and culture from prehistoric times until today. The main pillars of its economy are agriculture, tourism, and the maritime industry. It is characterized by many islands and kilometers of coastline, while on its mainland there are various, mainly mountainous, regions and plains. Greece is neighboring Balkan countries, such as Italy, Albania, and Bulgaria, and in the East, countries in the Black Sea Basin, such as Turkey, Romania etc.

Greece is among the domain countries in the region that absorb a significant share of its economy from the agricultural sector. Even though the majority of Greece's mainland is covered by forests, there are regions, such as Thessaly, Central Macedonia, Thrace, etc. that are mostly exploited for agricultural purposes, while there are widely dispersed small-sized, family-owned fields all over the country, as well. Agricultural land in Greece is fragmented mostly in small-sized fields compared to other European countries. The cultivated land is used for intensive row crops (such as cereals, cotton, etc.), olive groves (for olive oil and olives production), vineyards (for wine and grapes production), other orchards (peach, apples, oranges, etc.) and other industrial crops that are absorbed in food industry after specific processing (for example tomato juice and canned fruits). In parallel, agriculture includes also livestock production that include sheep/goat/cow farming for milk, cheese and other dairy products. Poultry production as well is among the main livestock farming units in Greece. Last but not least, fish farming and fishing, in general, is always a notable income for coastline areas and islands in Greece.

These two main pillars of agriculture – crop and livestock production – has played significant role in the country's development from ancient years until today. Of course, the production means and the processes may have been changed but they continue to be part of Greece's culture and development.

As it has been mentioned above, agriculture is among the main pillars of Greece's economy, together with maritime industry and tourism. Of course, Greece has long history and culture both in maritime industry and tourism and up today they are both

very important fields for country's socio-economic development. Nowadays, a number of about 400,000 people are employed in maritime industry sector, more than 650,000 in tourism sector and about 500,000 people in agriculture. What agriculture really offers in comparison with other sectors is the primary production of agricultural products and not rendering of services as Greece is characterized as a country with a significant share of jobs related to any kind of services. Primary production is the core of the economy for a given country and it has high potential for financial and social development.

More specifically, Greece's agricultural sector has been developed the last decade towards the wider technological growth that has been applied also in this field. There are a variety of technological tools and applications that help farmers increase the quantity and the quality of the final products. Moreover, following the European targets a greener crop and livestock production has been achieved compared to previous decades.

Chapter 2. Agriculture policies in GREECE

National agricultural policy regard the interventions in the country's rural development and economy, including crop, livestock, forestry and fishery products development. The responsible ministry in Greece is the Ministry of Rural Development and Food and its bodies through national or European policies. The agricultural policy aims, firstly, at the production of agricultural products of adequate quality and under certain safety constraints. Secondly, the interventions aim at ensuring a satisfactory level of agricultural income and reasonable product prices to the consumer, while, on the other hand, they target on the provision of public goods, ensuring the sustainable use of natural resources and the protection of the environment.

Agricultural Policy manages the socio-economic, environmental, and cultural issues of rural areas and societies. More specifically, the Ministry of Rural Development and Food evaluates the data of the agricultural sector, connects and discusses with the field stakeholders, sets long-term and medium-term goals, assesses the difficulties and implements policies that should be always compatible with the framework set by the Common Agricultural Policy of the European Union.

On a wider point of view, Common Agricultural Policy (CAP) is also applicable in Greece, as a member of European Union. It includes a set of regulations relating to agricultural production, farmers' financial aid, rural development and the regulation of agricultural products' markets. In parallel, it ensures conformity of agricultural activities to environmental regulations, the transportation/logistics of agricultural products, under the scope of price stability, the high product quality and sorting, the land use and employment in the agricultural sector. The set of all these regulations represent the Common Agricultural Policy, which was set in 1962. Since then it has been amended, sometimes radically. Now, after the new expansion of the EU with new country-members, its main goal is to define the role of agriculture in the conservation and management of natural resources, in the context of sustainable development.

Throughout these 40 years history of CAP, it has been one of the most important policy areas of the European Union, defining all the rules and mechanisms governing the

production, trade and processing of agricultural products in the European Union. In general, it was based on the principles of the unity of agricultural products, the community preference and financial solidarity. The CAP in its course has undergone several changes and reforms – institutional or not – in order to evolve and meet the changing needs of society and agricultural processes. With the reduction of the number of employees in the field of agriculture, the percentage of the financial resources that regard to the CAP from EU has been affected, as well.

Of course, the research and innovation regarding agricultural processes has a positive effect in the mid-term as well as in the long-term on the overall performance of agriculture. The European Commission (CAP 2021-2027) has set the digital transformation in the agricultural sector, as one of the main means towards production costs and environmental impact reduction through the more rational and optimized use of natural resources, agricultural inputs, etc. In terms of technological development and mechanization in Greece, there are steps that should be done yet, due to the low level of investment in agriculture.

Apart from the financing of the modernization of Greek agriculture through the CAP Strategic Plan, additional funding is provided through the Horizon European program to support research and innovation in the fields of food, agriculture and rural development, and bioeconomy, directly synergized with the rural development interventions co-funded by the EAFRD (European Agricultural Fund for Rural Development).

In Greece that is composed of a variety of rural areas, the role of new technologies could be considered dual, as on the one hand it improves the competitiveness and productivity in the various agricultural sectors and, on the other hand, highlights the significant development impact of these rural areas, helping to overcome obstacles to social, economic and geographical isolation. The application of innovative technologies and information and communication technologies can play an important role in encouraging healthy entrepreneurship and economic progress in rural areas, ensuring the most appropriate response to new challenges. At the same time, safer, more economical and sustainable production processes will take place, contributing to the increase of farmers' incomes and facilitating new collaborations. Also, with the use of

new technologies, the possibility of prediction, simulation and optimization is introduced in agriculture, which is important both for ensuring quality production and for maintaining the income of farmers and the protection of the environment.

Chapter 3. Funding initiatives in Smart Farming from GREECE

In order to attract funding resources and to achieve higher investments in agriculture and connected sectors, specific strategies should be followed. These strategies may be national or more regional and local in order to achieve and meet specific local needs and features. The main strategy that comes from European level up to national is the "farm to fork" Strategy. This regards ensuring sufficient economic yield throughout the agri-food supply chain. Practically, farmers and the related stakeholders on food production should have an adequate income, as the mean farmer in Europe earns about the half income of the mean employee, in general. In order, though, to achieve actual financial benefits, the farmers should adopt environmentally friendly production management models, such as reduction of CO_2 emissions produced by the overall agri-food supply chain, reduced use of chemical agrochemicals and fertilizers, integrated crop protection, and waste management. Smart farming contributes to the achievement of these targets. Another strategy regards biodiversity that is connected to climate change and has a core impact on agricultural production (i.e. yield and productivity). To this scope, farmers are encouraged to adopt production management system, such as smart farming systems, precision agriculture and organic agriculture.

In order to achieve the abovementioned strategies, Greek agriculture is financed directly by European Union through the Common Agricultural Policy Strategic Plan. Moreover, other funding resources are related to Horizon European Projects that win funding for the development of various applications and services in the wider agriculture sector and connected sectors such as secondary processing industry, post-harvesting processed products, etc. European Agricultural Fund for Rural Development is, also, another funding source for Greek agriculture, while other projects may be financed by European Investment Bank (EIB). It is obvious that significant funding opportunities are coming from the Ministry of Rural Development and Food, and other institutions and foundations of private or wider public sector of the country.

Greece, as a country with significant agricultural activity, has presented a variety of implemented projects in the agricultural field. Indicatively:

- Tastestevia: A holistic approach along the production cycle of Stevia Rebaudiana plant cultivated in Greece, via combined application of innovative methods of Precision Agriculture and bitter aftertaste removal techniques.
- Nexus: Research synergy to address major challenges in the nexus: energy-environment-agricultural production.
- FruitCluster. Collaboration Network for the Exploitation of Biodiversity and Quality Improvement of Greek Fruit Tree
- Jonah-Fuel: CASTOR bean (JONAH seed) cultivation in central Macedonia, Greece and industrial exploitation of its derivatives towards biofuel production
- Hadamloco: A holistic approach of drought adaptation mechanisms in Lotus corniculatus natural populations for optimization of production under water stress
- Systerp: A systems approach into the production of plant and algal diterpenes with high industrial and pharmaceutical value
- Grapenet: East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding
- Qubic: Animal Breeding: Quality Biodiversity Innovation Competitiveness
- Cost action: An integrated systems approach to determine the developmental mechanisms controlling fleshy fruit quality in tomato and grapevine
- Amylo: Utilization of modern techniques in the control of starch raw material and the role of starch in the production of food with improved qualitative and nutritional characteristics

In addition to these projects, there are others that have been implemented mostly in the smart and IoT technologies applied to agriculture:

- SmartAKIS: european Agricultural Knowledge and Innovation Systems towards innovation-driven research in Smart Farming Technology.
- Synergie: Human-Robot Synergetic Logistics for High Value Crops.
- Innoseta: Accelerating Innovative practices for Spraying Equipment, Training and Advising in European agriculture through the mobilization of Agricultural Knowledge and Innovation Systems.
- Biocircular: A bioproduction system for circular precision farming.

- Gates: A serious game-based training platform, in order to train professionals across the agricultural value chain on the use of Smart Farming Technologies, thus allowing deploying its full economic and environmental potential in European agriculture.

Apart from these projects that have been applied to the wider agriculture sector there are even more already fulfilled and currently running. In order to move forward scientifically and as a society, there is high need for investments and really capable people to accomplish the targets. In Greek agriculture, there are investment opportunities in several key areas. Under the current circumstances, the Greek Rural Development Program (RDP) will fund actions under all six rural priorities with particular emphasis on the competitiveness of the agricultural sector, as well as in restoration, conservation, and strengthening ecosystems related to agriculture. More specifically, for the knowledge transfer and innovation in agriculture, forestry, and agriculture areas where 285 cooperation projects will be supported by the Greek RDP. This will make available about 67.5 thousand training positions to enhance knowledge transfer. Regarding competitiveness of the agricultural sector, 25,600 farms in Greece will benefit from the support of the business development program for young farmers, while about 6,300 farms will benefit from support for restructuring and modernization of their entrepreneurship.

The organization of the food supply chain, (i.e processing and marketing of agricultural products, and risk management in agriculture) will boost 6.9 thousand farms for supporting the creation of short supply chains, local markets development, while 450 agri-food companies will receive investment support in processing and marketing sectors. Other investments in Greek agriculture are about restoration, conservation and enhancement of ecosystems associated with agriculture, natural resources efficiency and climate – targeting mostly on water resources management – and social inclusion and local development in rural areas with significant results in the employability of rural population.

In the BSB region, as it is almost on the border of two continents, Asia and Europe, there is high pressure on optimal natural resources management especially in

agriculture given that there are several countries in the region that should share the same resources. That is a real challenge but also provokes a series of opportunities for agriculture. Such opportunities may be:

- The creation of cooperations in the form of local farmers' associations in order to achieve homogeneous product quality, optimal yields, access to tools, applications and smart farming technologies which would be inevitable to afford individually. This will contribute to the social and economical growth of the region, as well.
- Land, water and natural resources limitations are exacerbating agricultural challenges. The protection of the environment and more specifically of the Black Sea Basin should be of high priority as a vital issue and constraint towards the sustainability of agriculture.
- In the region, the implementation of smart farming, climate adaptation and mitigation programmes will require a major transformation of the agriculture sector but also through economy-wide actions based on strategies and sectoral action plans. Addressing the multiple challenges on smallholder agriculture requires comprehensive innovation policy frameworks to drive collective farmer action, which will enable farmers to access market opportunities and achieve scale while preserving natural resources
- In the BSB region, there is low development and infrastructure regarding modern technologies that offer significant opportunities in modern agricultural systems. Mobile applications, remote-sensing solutions, big data, crop modeling, artificial intelligence, Internet of Things and agricultural robotics are only some of these opportunities. There are only a few regions that grow towards this direction in agricultural systems.
- Despite the aforementioned limitations, the BSB region offers wide opportunities for market expansion due to its mutiple access to international markets that could be significant channels for agricultural products trading.

Chapter 4. Quadruple helix approach in agriculture field

The Quadruple Helix (QH) is an innovation and collaboration model with a citizen/end-user perspective. It is useful in an innovation process where the citizens' needs are central, as in agriculture. Using the Quadruple Helix and involving the citizens in the development of an innovation can lead to more successful, user-oriented innovations. The end-users will be more likely to accept and use the innovation.

The Quadruple Helix involves representatives from all members of society: public authorities, industry, academia and citizens (Fig. 1).

- Public authorities can be government and regional development agencies and policy makers, as well as formal health care providers in some countries
- Industry can consist of businesses, for example private health care providers, and business clusters.
- Academia can be for example the universities or research & development institutes.
- The fourth actor of the quadruple helix is the citizen.

To increase the success of the collaboration it is important to define which are the specific QH stakeholders that should be involved (stakeholder mapping) and to make sure all QH actors are involved, motivated, and have an open mind.

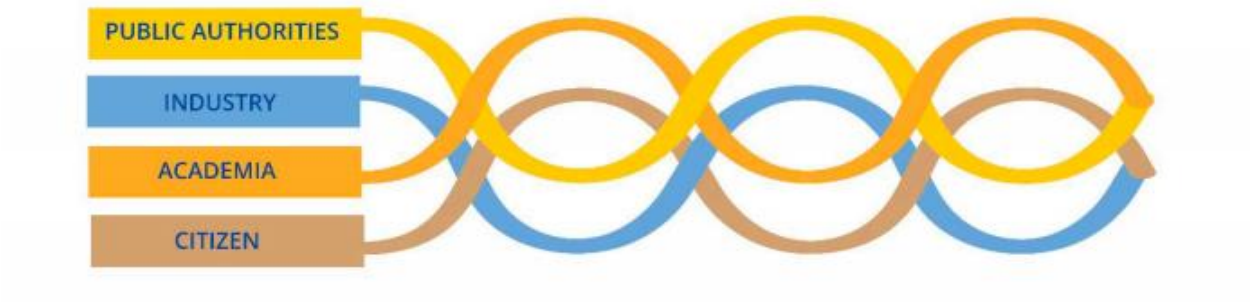

Figure 1. Quadruple Helix

A detailed database of stakeholders from the quadruple helixes of the agricultural sector and connected sectors in their regions have been elaborated trying to encompass the most representative entities for the four helixes in rural development (public authorities, industry, academia, citizen/civil society).

The list of stakeholders (100 entities) that were involved in the investigation include briefly:

- Union of Young Farmers
- Regional Unit authorities
- Municipality authorities
- Agricultural Cooperatives
- Consortium of Agricultural Cooperatives
- Agricultural businesses
- Wineries
- Farmers
- Greek Payment Authority of C.A.P. Aid Schemes
- Hellenic Agricultural Organization Dimitra
- Universities and research institutions
- NGOs

In Figure 2, the allocation of these stakeholders in the four helices for private (89%) and public (11%) sector are presented.

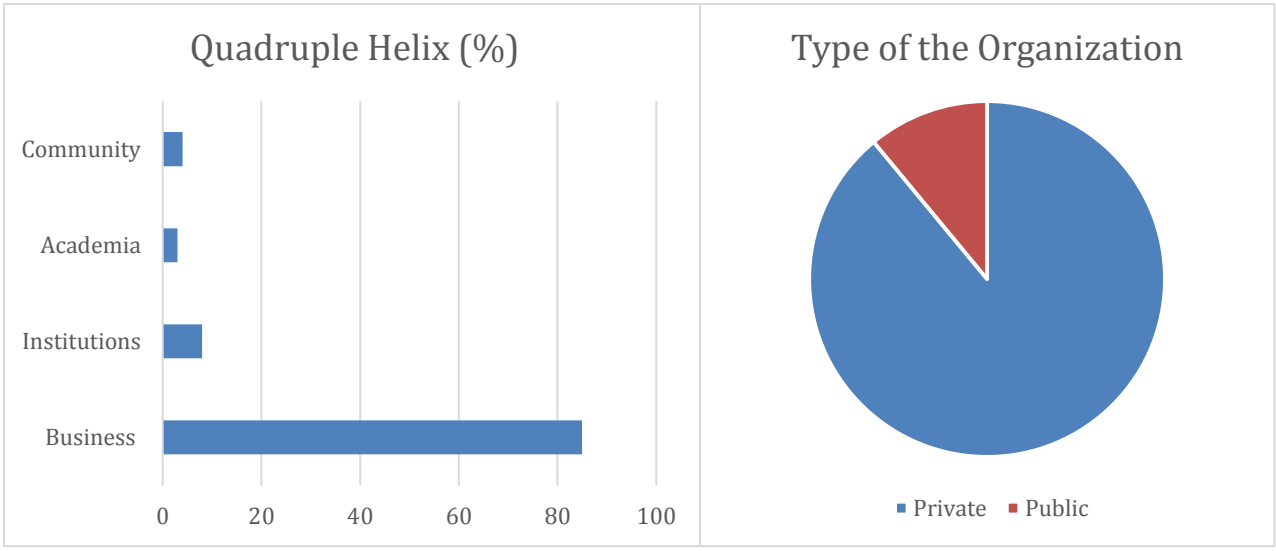

Figure 2. Stakeholders allocated to the four helices

From the broad stakeholders' list, 50 key stakeholders responded to the questionnaire, 42 come from the private sector and 8 from the public. In Figure 3, the type of organization is depicted in three types of pies according to the sector they belong to, profit or non-profit and governmental or not.

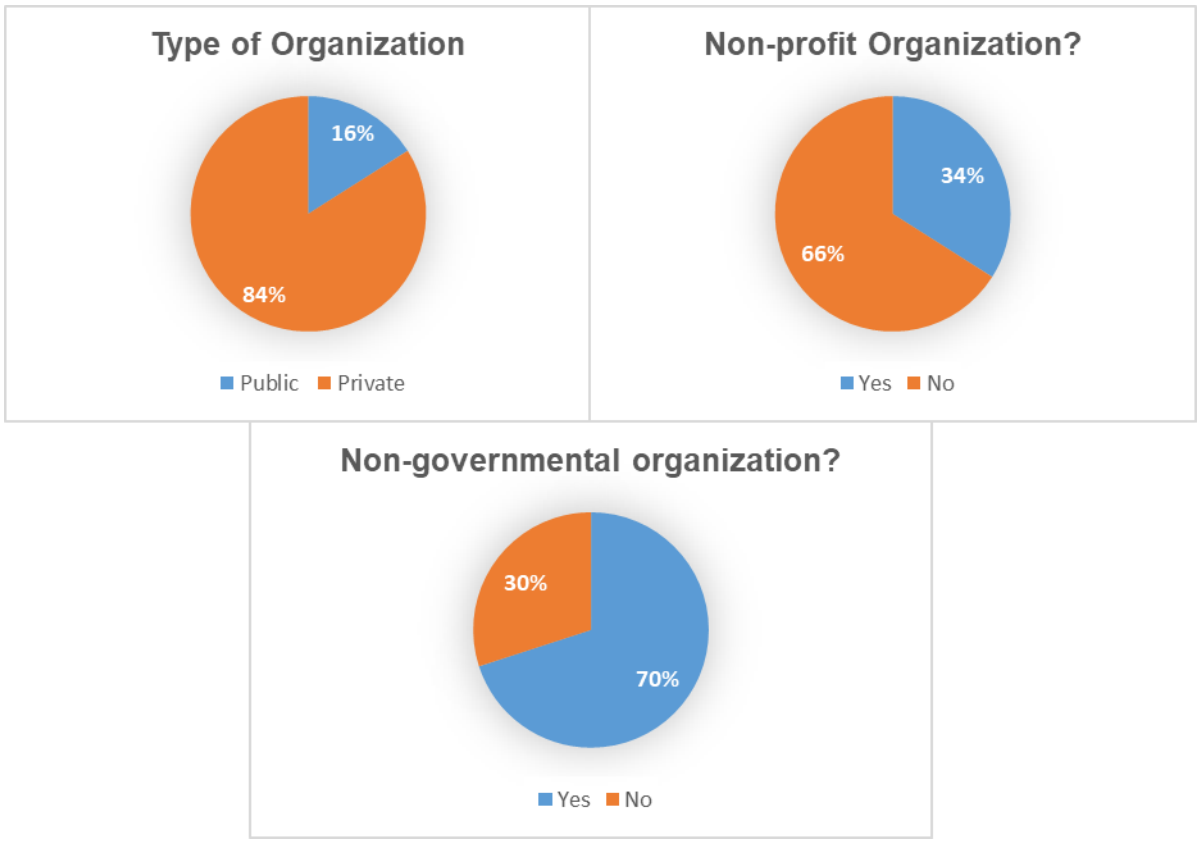

Figure 3. Generic profile of interviewed stakeholders' organizations

There is a variety of fields of activities that the interviewed stakeholders' entities belong to (Figure 4(a)). The majority of them (78%) come from agricultural sector, the 8% of the interviewed were related to education and 8% to businesses, while the rest 6% was connected to socio-economical or other fields. As for the quadruple helix innovation system they belong to, the 85% of the interviewed are from Business/Industry Helix, 5% from Academia Helix, while the rest 10% is related to the other two helices (i.e. Government: 7.5% and Society: 2.5%) (Figure 4(b)).

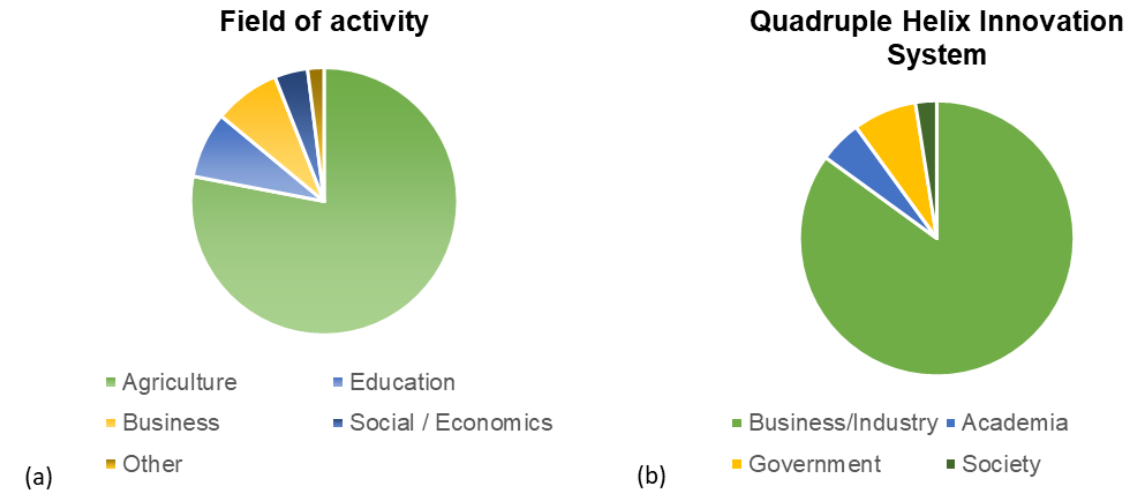

Figure 4. Fields of activities (a) and Quadruple Helix systems (b) of the interviewed stakeholders

Going deeper to the analysis of the interviewed stakeholders's profiles, the following Figure 5 depicts a categorization of the involved organizations. To this light, registered or unregistered farms constitute the 42% of all stakeholders, about 6.5 % are local/regional public authorities and another 6.5 % represents educational/research entities. The rest of the groups are related to Sectoral Agency (4.3%), Services Providers (2.1%), NGOs (2.1%), Business Support (2.1%) and a huge percentage of 42.6% for other unregistered types of organizations.

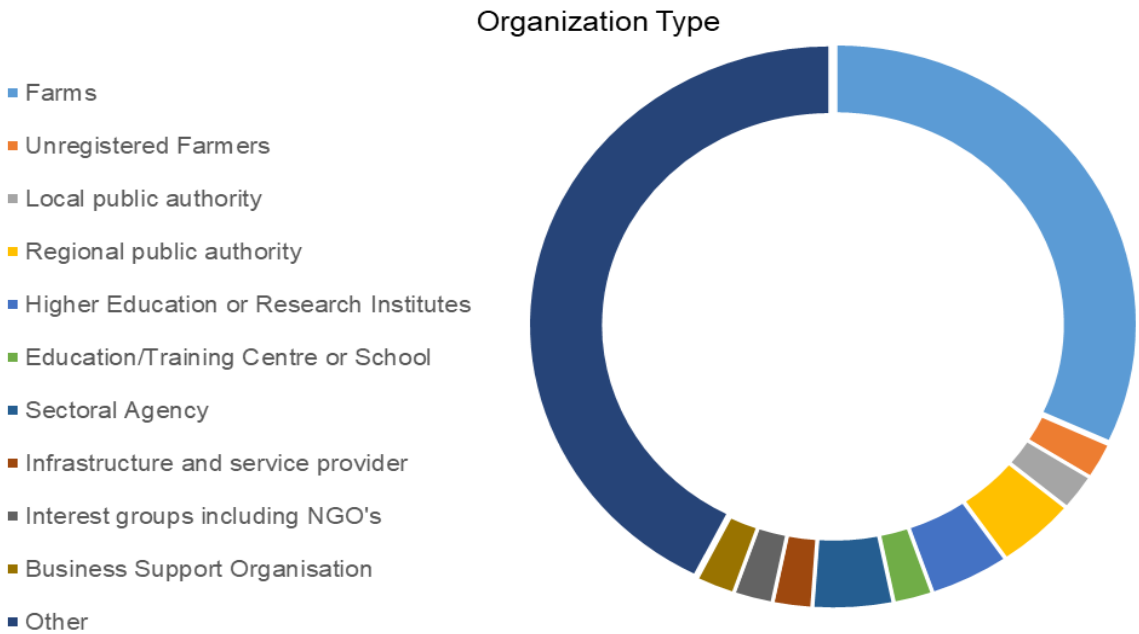

Figure 5. Stakeholders' organization types

Chapter 5. Smart and IoT technologies existent in GREECE

A series of questions were submitted to the interviewed stakeholders in order to identify the trends and current condition regarding smart and IoT technologies in Greece. First and foremost, the awareness of smart farming applications among the stakeholders was detected (Figure 6). Moreover, the type of smart farming technologies used by farmers in each stakeholder's region was defined (Figure 7).

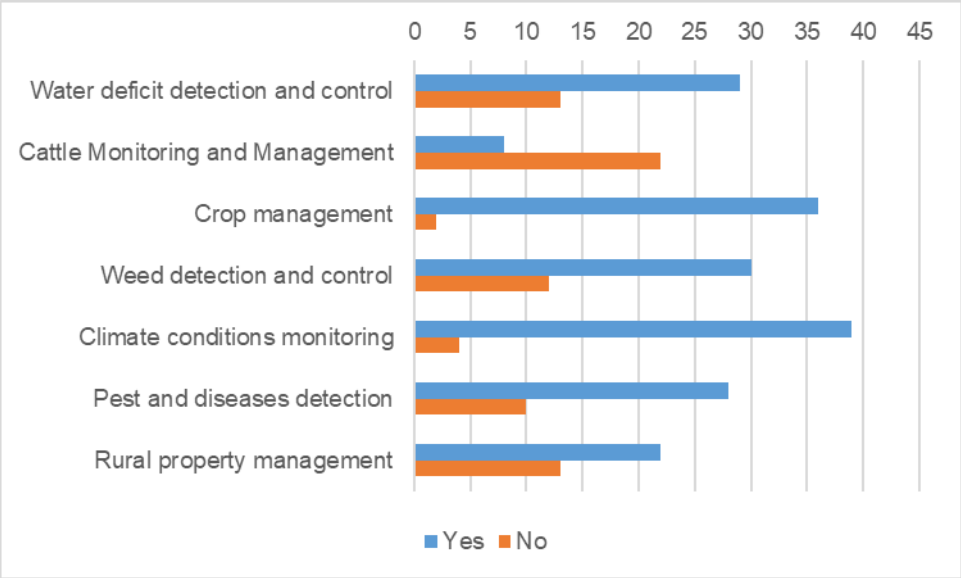

Figure 6. Smart farming applications awareness

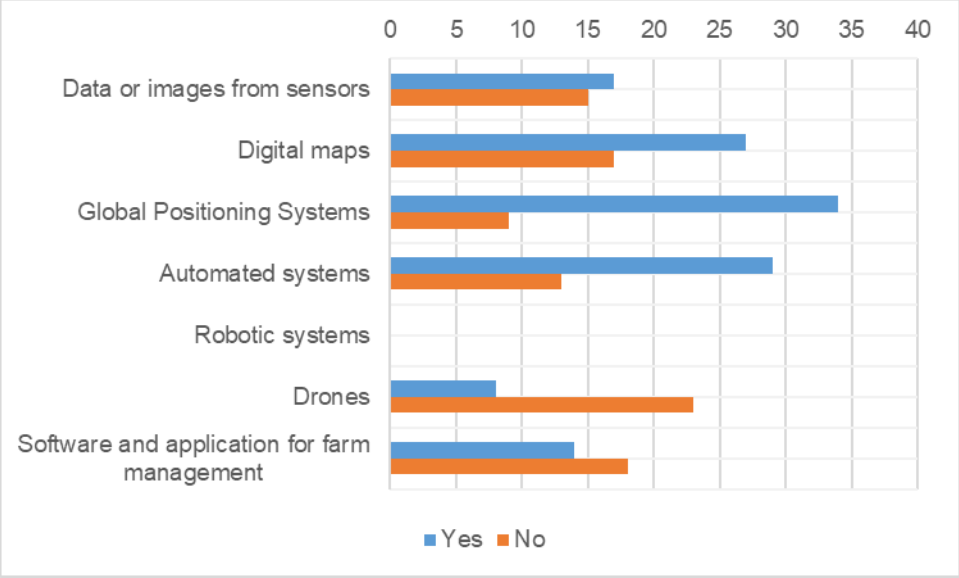

Figure 7. Smart farming applications' local use

Extracted by the questionnaire, the main advantages provided by the use of smart farming technologies are related to increased productivity (~81% of the stakeholders),

reducing environmental impact (77% of the stakeholders), high quality products (50% of the stakeholders), cost reduction (~81% of the stakeholders), increased profit (~42% of the stakeholders), activity planning (~69% of the stakeholders) and labor efficiency (~77% of the stakeholders. In addition to this, according to participants' awareness 58% of their local farmers would like to adopt smart farming technologies, 8% wouldn't like, while 34% of the stakeholders were not sure. In Figure 8, the agricultural fields that need smart farming technologies in their region based on stakeholders' awareness, are presented. 96% of the respondents believe that crop production need smart farming applications, while around the half of them pointed out livestock production, agricultural engineering and economics as well.

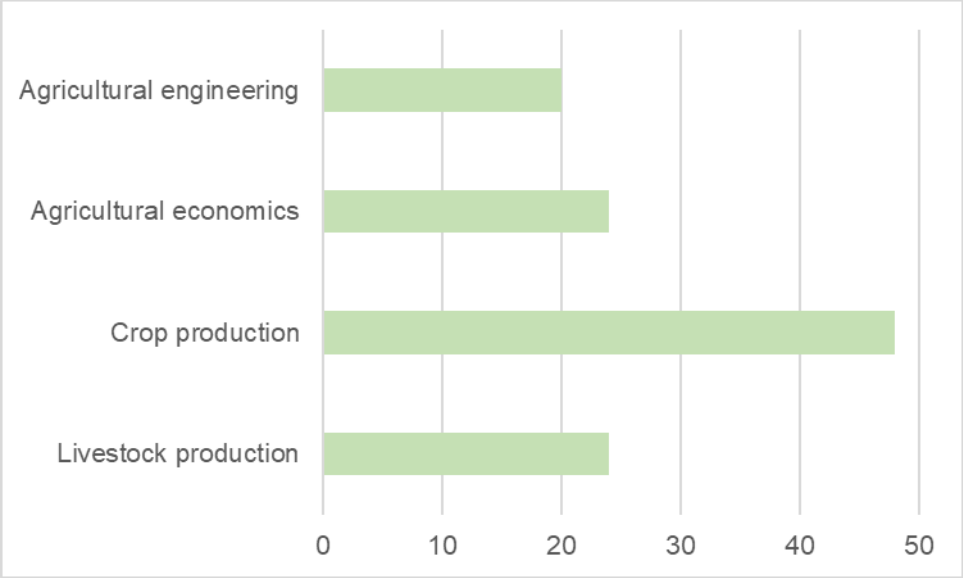

Figure 7. Smart farming technologies local needs in agricultural sector

More specifically, the attendants were asked to specify the need (to a scale from 1 to 5) to adopt such technologies in livestock production systems (Figure 8), in crop production systems (Figure 9), in agricultural economics (Figure 10) and in agricultural engineering sector (Figure 11).

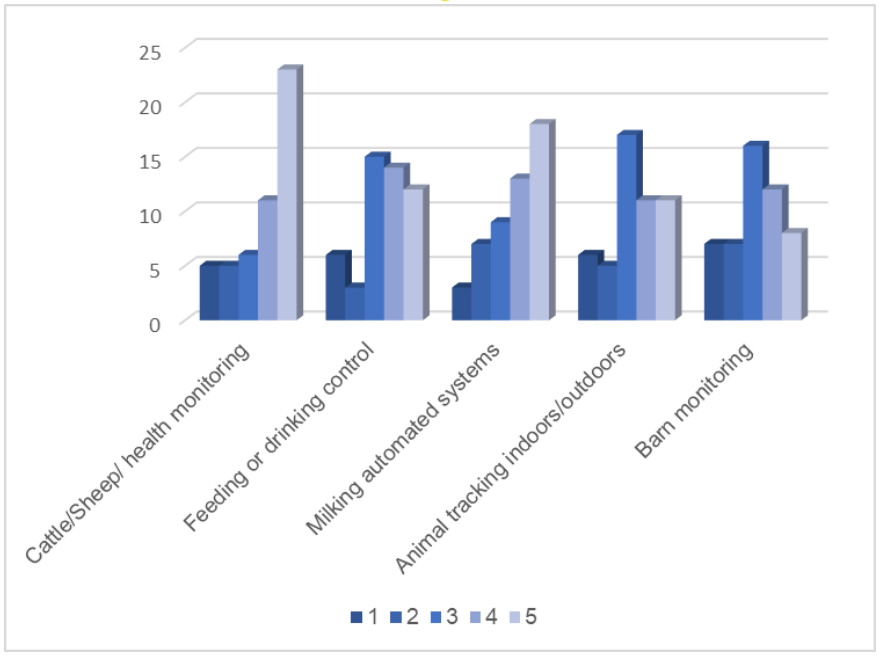

Figure 8. Smart farming technologies needs in livestock production systems

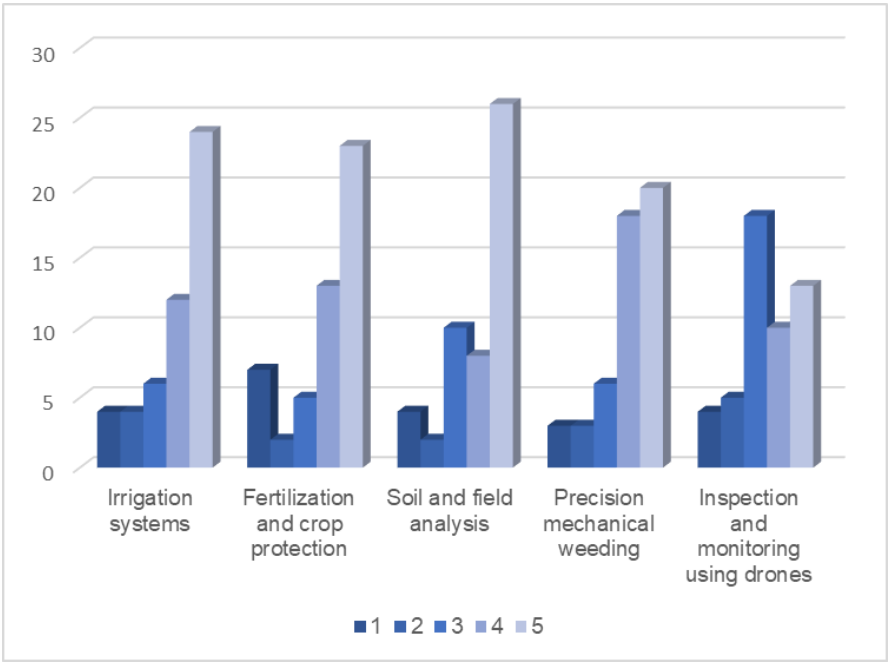

Figure 9. Smart farming technologies needs in crop production systems

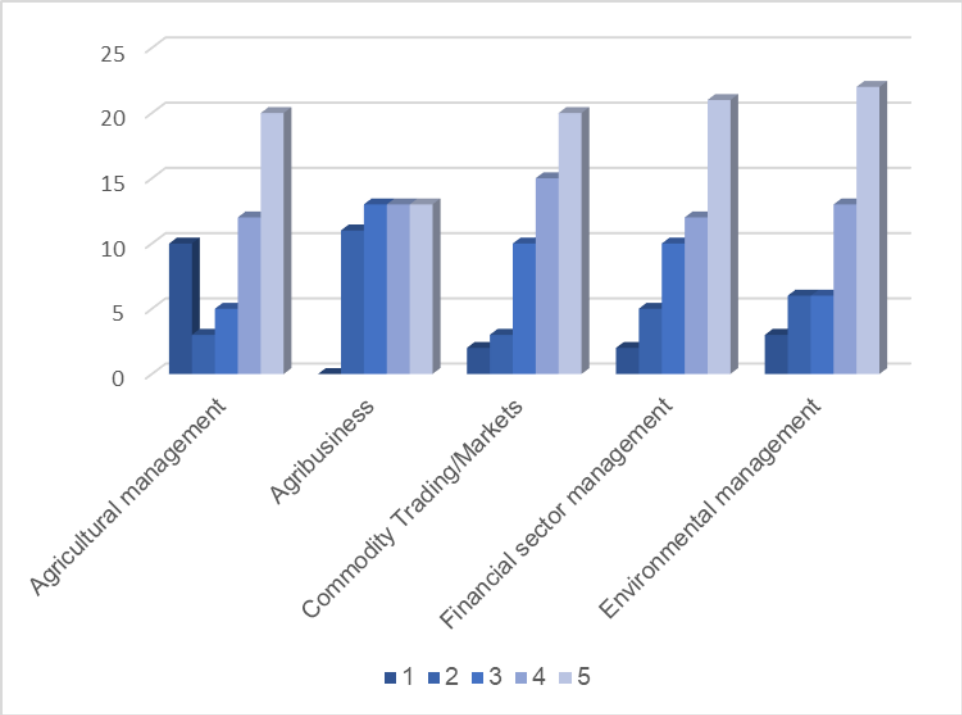

Figure 10. Smart farming technologies needs in agricultural economics

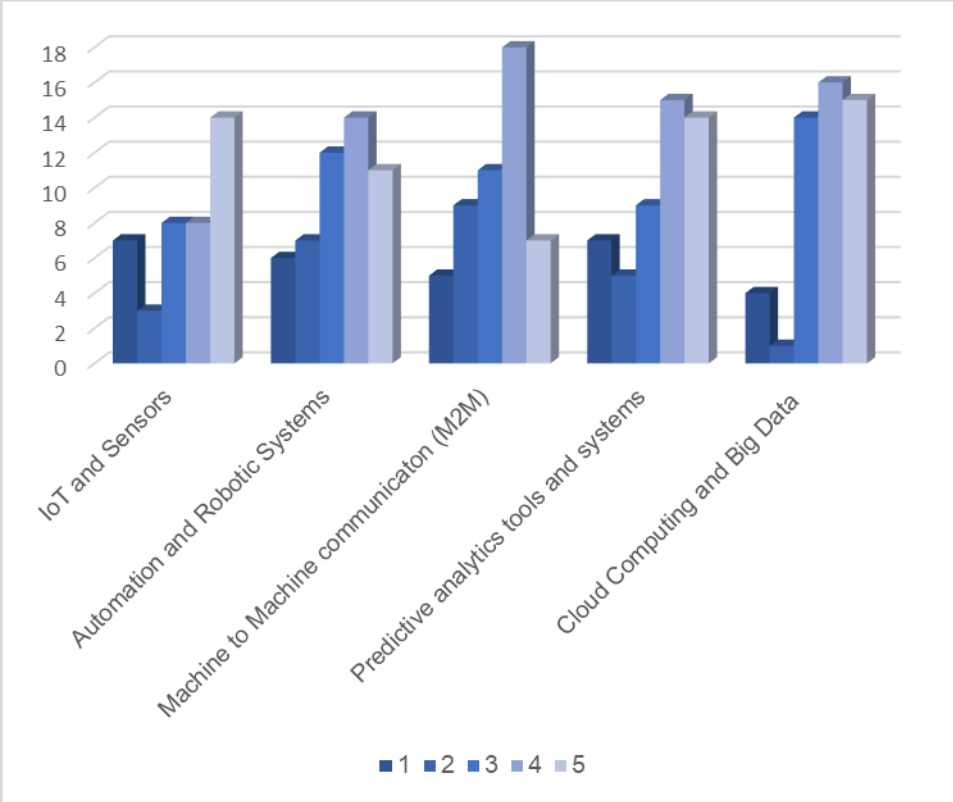

Figure 11. Smart farming technologies needs in agricultural engineering

According to the questionnaire most of the participants are pointed out that smart farming and IoT technologies can lead to proper management of the agriculture field and answer to other main socio-economic challenges in the area, such as the brain

drain, youth unemployment and brain waste. Moreover, they suggested various type of initiatives that are suitable to promote smart farming within the farming community (Figure 12).

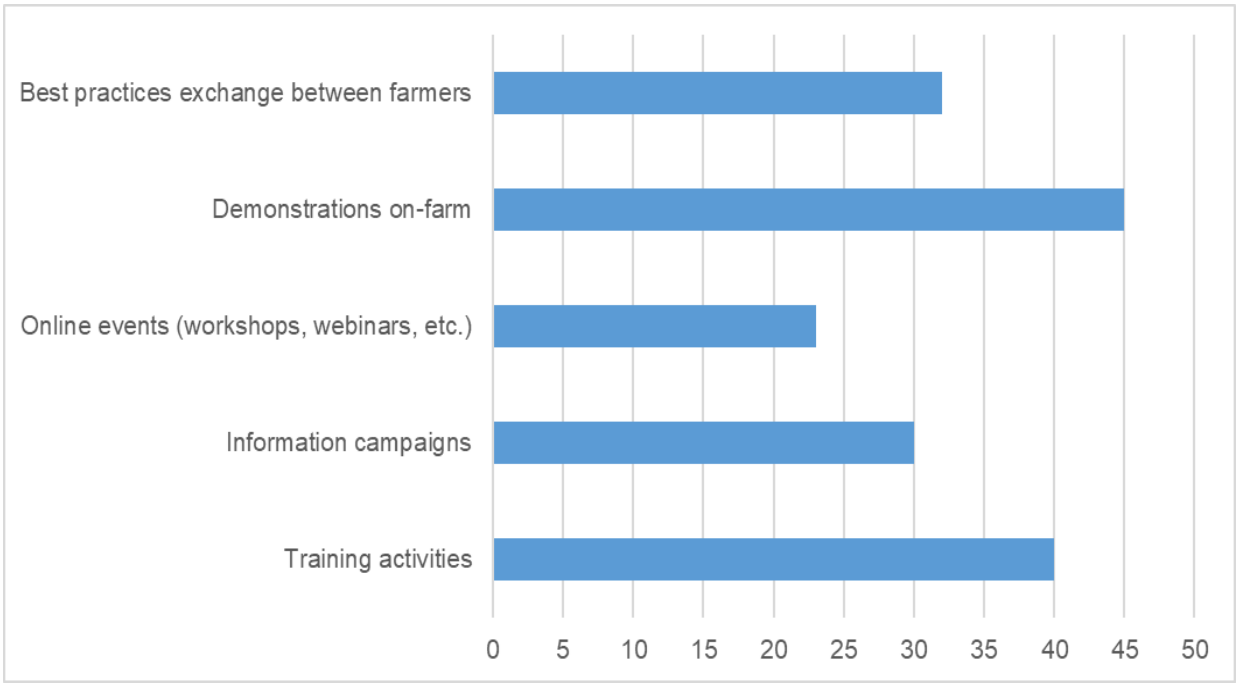

Figure 12. Types of initiatives to for promotion of smart farming technologies

Similar investigation methods that include questionnaires have pointed out the current situation regarding the use of smart farming and IoT technologies in Greece. More than 200 questionnaires have collected and analysed by Central Macedonia farmers only. The most widely-known smart farming technologies among these farmers where related to smart irrigation (85%), robotic harvesting equipment (75%), agricultural sensors (58%), mobile applications (54%), unmanned automatically-driven tractors (53%), and automatic sowing and spraying machinery (52%). On the other hand, only smart irrigation applications are widely used in fields (65%) while the rest of smart applications is rarely used (1-2%) in Greek fields. Overall, most of the farmers are willing to adopt such technologies in their crop production strategic plan.

Another research targeted a broader audience and included personal semi-structured interviews from various stakeholders. The audience included small and medium enterprises and production units in the fields of wine and vineyard, olive oil, beekeeping, cosmetics, livestock, dairy products, legumes, and herbs production. In addition to the abovementioned, technological companies operating in the field of precision agriculture, experts from various universities and institutions' research groups of the country,

representative bodies of relevant disciplines as well as relevant policy-making and implementation bodies were interviewed. This investigation has concluded briefly in the following:

- The model of agricultural production in Greece is changing rapidly through the convergence of factors that include the radical technological developments, productive needs at the level of productivity and predictability, quality and resource and cost savings, the restructuring of consumer habits, its new promotion policies, technological penetration but also the reduction of environmental impact through sustainable practices as well as new commercial practices and standards along the food chain. These developments are combined with the intensification of international trade and economic interdependence in the wider food industry.
- The productive utilization and the effects from the use of new technologies differ among the sub-sectors, products, regions, and features of the production units.
- The main barriers to adoption are distinguished in both economic and non-economic factors. In many cases, the cost of acquiring new technologies is a particularly important factor, while in other cases it is much more limited. An important parameter, however, is the need to integrate broader systems and not individual technologies as well as the need to maintain and upgrade equipment. Respectively, at the level of non-financial factors, education, training and new skills related to the better understanding and efficient use, maintenance and multi-level technological-economic utilization of new applications emerge as a critical and fundamental parameter.
- It is widely recognized as a necessary and critical condition, the development of mechanisms for upgrading knowledge and skills at professional, business and digital skills level
- The technological transformation affects both productivity issues in agricultural production as well as in dimensions related to management and conservation of natural resources and productivity savings.
- It is critical to develop an ecosystem of techno-consulting support of primary production sector throughout the value chain, focusing to the primary and secondary stages of agricultural production and processing.

- The technological upgrade of agri-food sector requires the intensification of cooperation of various production units and scientific institutions and universities.
- New planning and organization standards and practices should be developed amongst with the promotion of advanced cooperative formations at product and regional level.

Chapter 6. Agricul3tural needs of the rural communities in GREECE

Based on the results of the questionnaire, results from the four business categories were outlined; i.e. farmers, technology providers, government/public institutions, and research & academia.

More specifically, the majority of farmers (up to 89%) responded the questionnaire have conventional farms while the rest own traditional or artisanal farms. Regarding the size of the fields/farms, the majority of them has medium size (4-10 ha) as it is shown in Figure 13. Most of the interviewed farmers were related to crop production farming rather in livestock production, agro-economics and/or agricultural engineering (Figure 14).

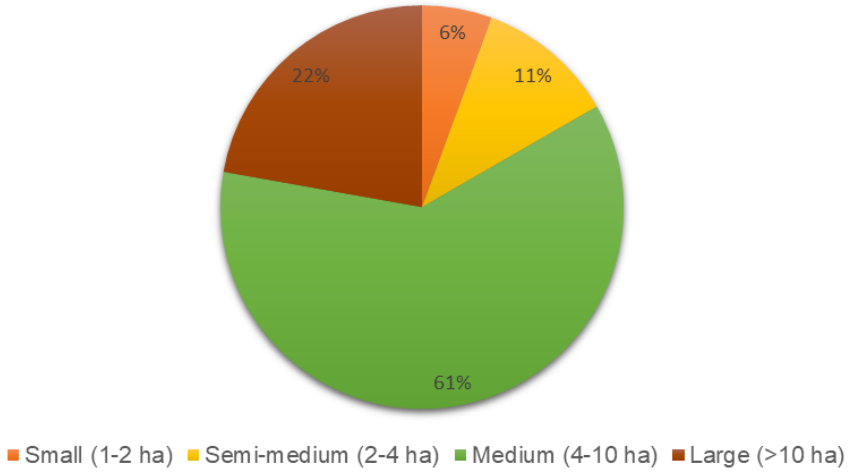

Figure 13. Farm size enterprises

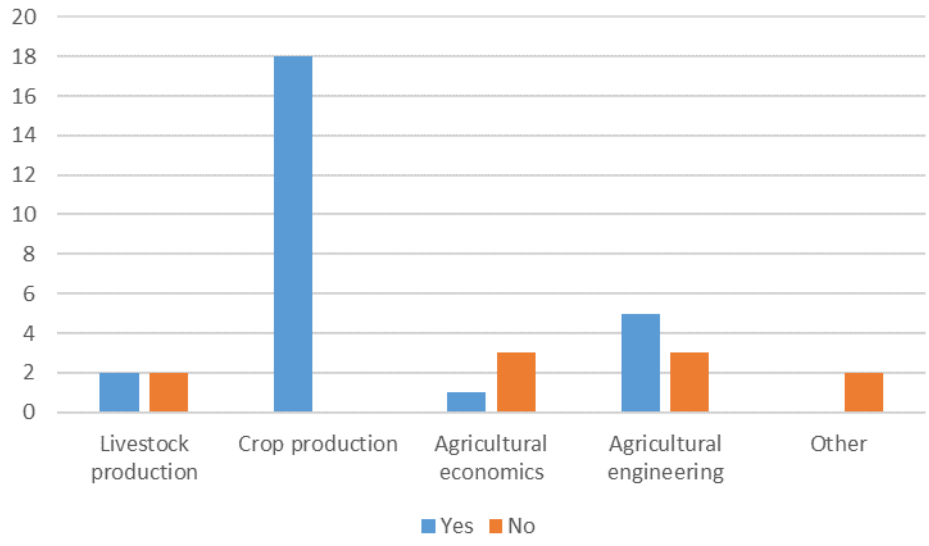

Figure 14. Agricultural field of activity

More specifically for livestock production only 3 participants responded positively for cattle and sheep farming while 9 responded negatively for all livestock categories (cattle, pigs, poultry and sheep).As for crop production systems, the most farmers responded positively for grain crops, and fruit & nuts, while less were those for viticulture, vegetable or mixed crops (Figure 15). The most positively outlined agricultural economics categories were agrarian system, custom harvesting (Figure 16). Finally, for agricultural engineering category, agricultural machinery and field equipment were positively highlighted by the interviewed stakeholders (Figure 17).

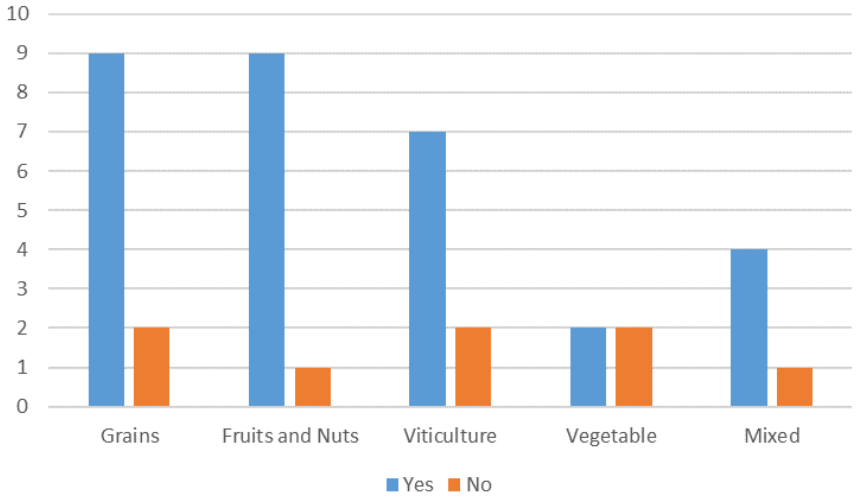

Figure 15. Crop production categories' responses

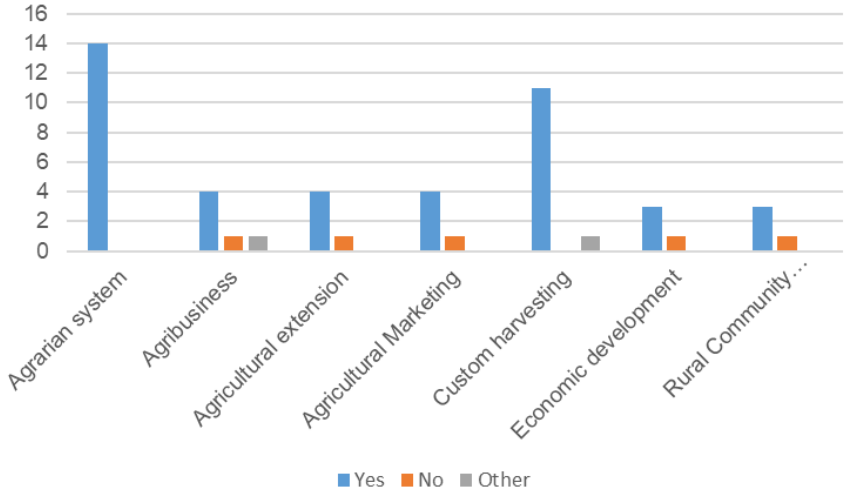

Figure 16. Agricultural economics categories' responses

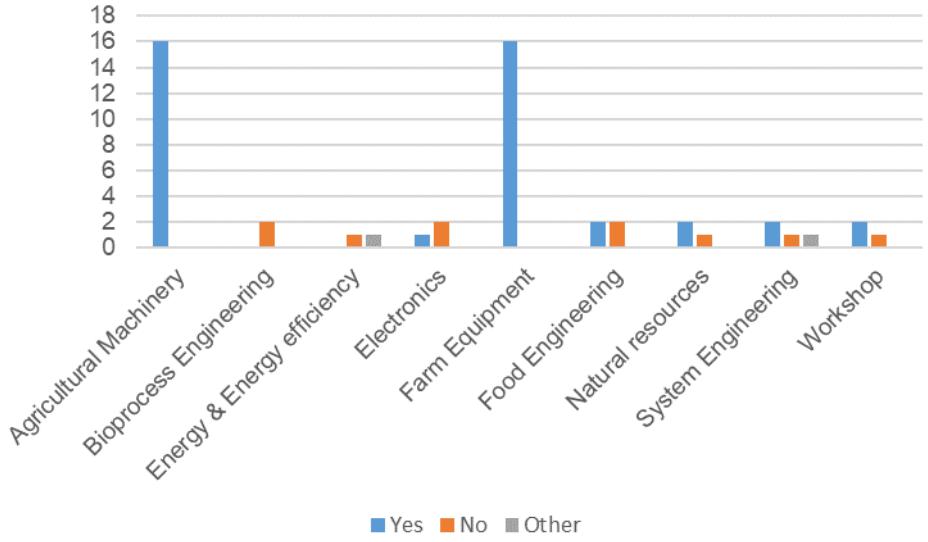

Figure 17. Agricultural engineering categories' responses

As for the smart technologies provided, all of the responses were negative. More specifically, there were about precision agriculture equipment, control and command systems, sensors, IoT, agricultural drones and robots, and smart farming software. Moreover, the government/public institutions were positively represented by municipality and government authority. Finally, academic and research institutions are represented efficiently as shown in Figure 18, while their field of activity is presented in Figure 19.

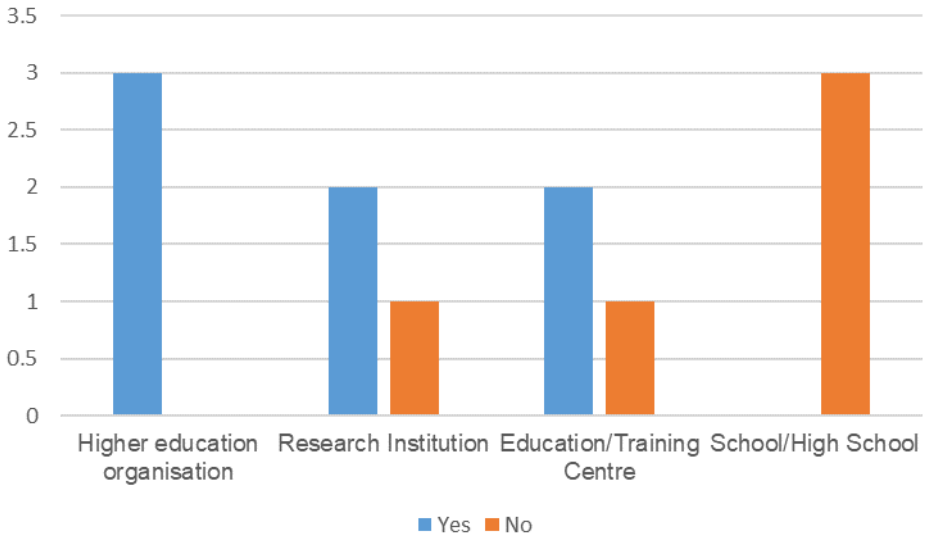

Figure 18. Research and academia stakeholders

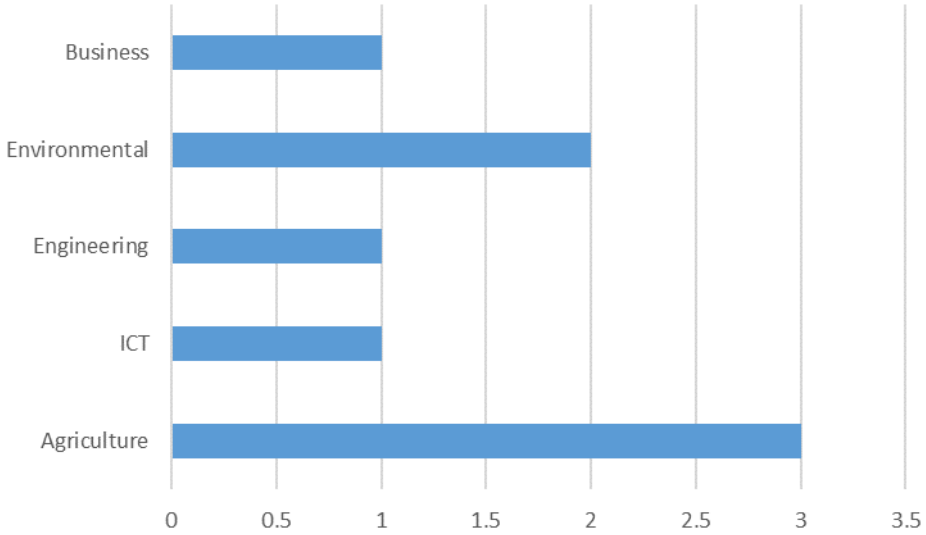

Figure 19. Research and academia field of activity

Conclusions and recommendations

Given the present regional analysis of Greece, a set of conclusions and recommendations have been extracted as follows:

- Agricultural production in Greece has changed the latest years. The radical technological developments, the increased standards at the level of productivity, quality, cost and sustainability has affected the whole supply chain of agri-food products.
- Smart farming technologies has been inserted in the country's agricultural targets.
- Farmers and other relevant stakeholders are aware of smart farming and IoT technologies, while only a few have been implemented in real conditions and farms.
- Innovative technologies such as agricultural robotics have not commercial use in country's agricultural reality. There is significant lack of technological providers in the country
- The agricultural academic sector of the country has made huge steps under the scope of the development of smart technologies and applications, while the national agricultural industry seems to follow their innovative solutions.
- Significant percentage of local farmers are not sure if they want to adopt or not smart technologies, while this seems to change year by year.
- The use and the effects from the use of new technologies differ among the sub-sectors, agri-food products, and features of the production units.
- It is important to upgrade, where possible, current field machinery and equipment, or even promote funding for new technological equipment supply.
- Education, training and new skills related to the better understanding and efficient use, maintenance and multi-level technological-economic utilization of new applications emerge as a critical and fundamental parameter, as well. In parallel, it is crucial to develop mechanisms for upgrading knowledge and skills at professional, business and digital skills level.

- It is significant for the country's status (medium farm size stakeholders) to encourage cooperative opportunities and fundings towards new technologies adoption.
- Secondary agricultural sub-sectors (such as aquaculture, apiculture, forestry) should be encouraged by developing new smart applications.
- The simultaneous growth of research and agri-food industry is vital under the scope of knowledge and experience exchange.
- An ecosystem of techno-consulting support of primary production sector throughout the value chain should be developed for both primary and secondary stages of agricultural production and processing.
- Environmental targets should be of high priority throughout crop and livestock production processes. The reduction of C02 emissions can be accomplished by the development of greener and smarter technologies.


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