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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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SYNTHESIS REPORT ON THE LEVEL OF PREPAREDNESS FOR SMART FARMING OF BSB AREA COUNTRIES

Deliverable D.T1.3.2

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

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SUMMARY

The Deliverable *D.T1.3.2. Synthesis report on the level of preparedness for Smart farming of BSB area countries* 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.T1.3. Common research on the level of preparedness for Smart farming of BSB area countries*.
It is the outcome of work of PP4 partner in collaboration with all BSB Smart Farming project partners.

Joint Operational Programme Black Sea Basin 2014-2020

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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, Bulgaria, Armenia, Romania, Georgia and Moldova.

Chapter 1. GREECE REGIONAL ANALYSIS

1.1. 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 kilometres of coastline, while on its mainland there are various, mainly mountainous, regions and plains. Greece is neighbouring 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.

1.2. 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.

1.3. 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 cooperation 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 multiple access to international markets that could be significant channels for agricultural products trading.

1.4. 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.

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

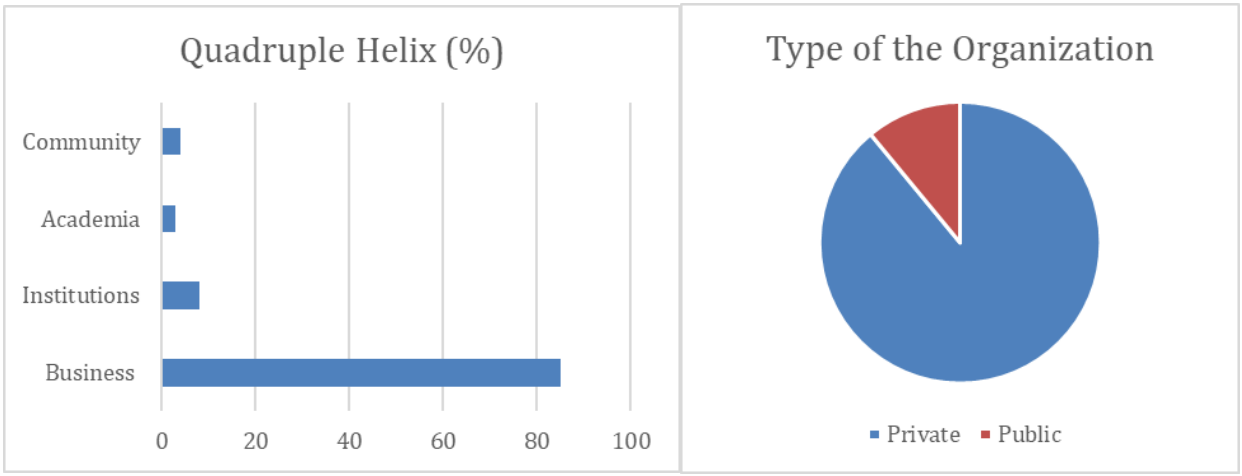


Fig. 2. Stakeholders allocated to the four helixes

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.

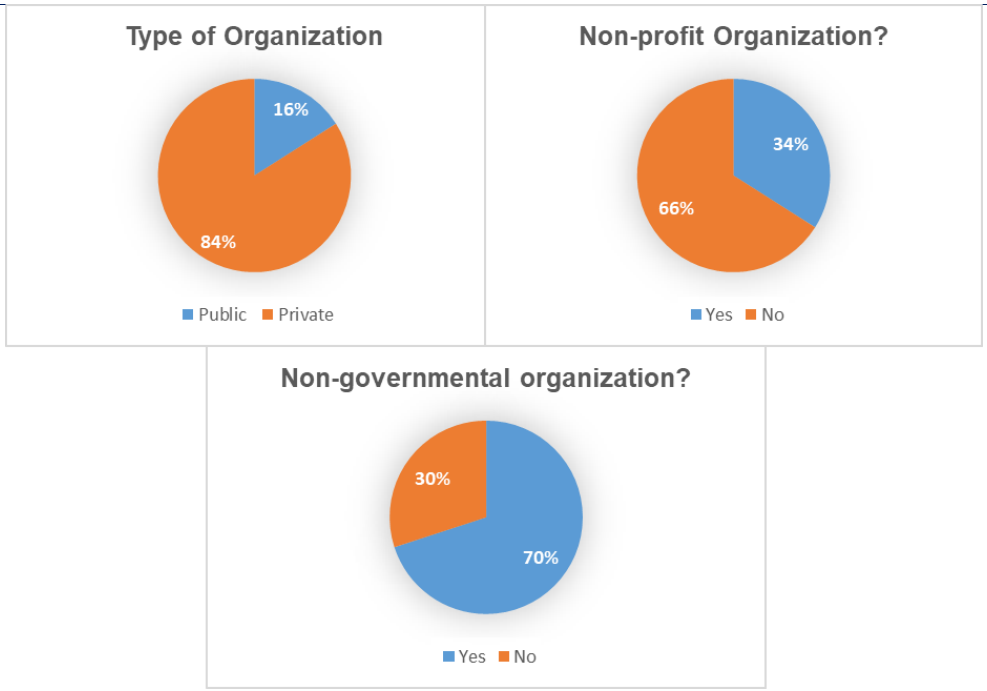


Fig. 3. Generic profile of interviewed stakeholders' organizations

There is a variety of fields of activities that the interviewed stakeholders' entities belong to (Fig. 4a). 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%) (Fig. 4b).

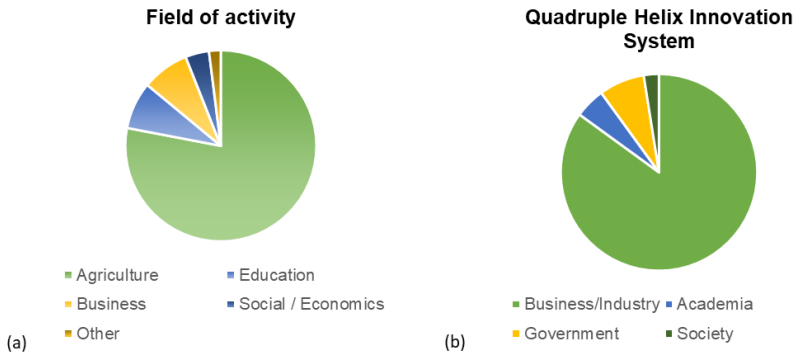


Fig. 4. Fields of activities (a) and Quadruple Helix systems (b) of the interviewed stakeholders

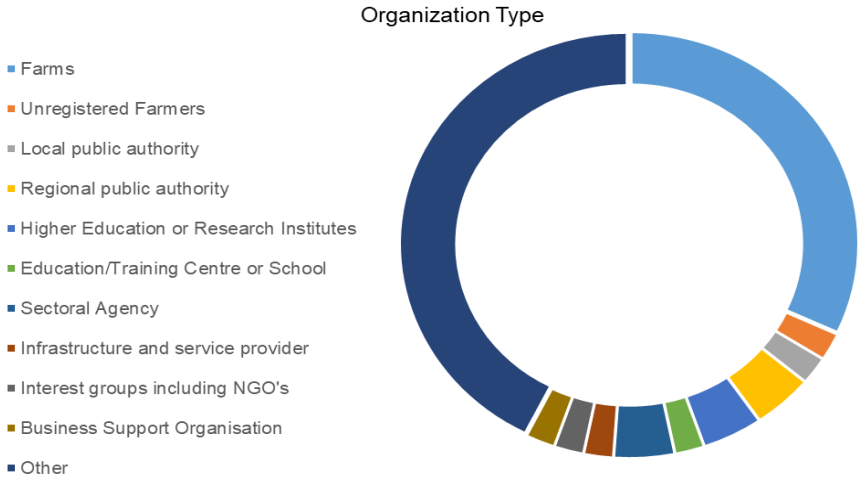


Fig. 5. Stakeholders' organization types

Going deeper to the analysis of the interviewed stakeholders's profiles, the Fig. 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.

1.5. 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 (Fig. 6). Moreover, the type of smart farming technologies used by farmers in each stakeholder's region was defined (Fig. 7).

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 Fig. 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 needs smart farming applications, while around the half of them pointed out livestock production, agricultural engineering and economics as well.

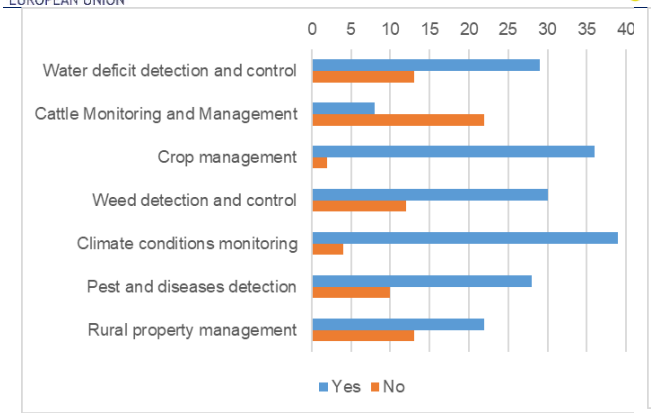


Fig. 6. Smart farming applications awareness

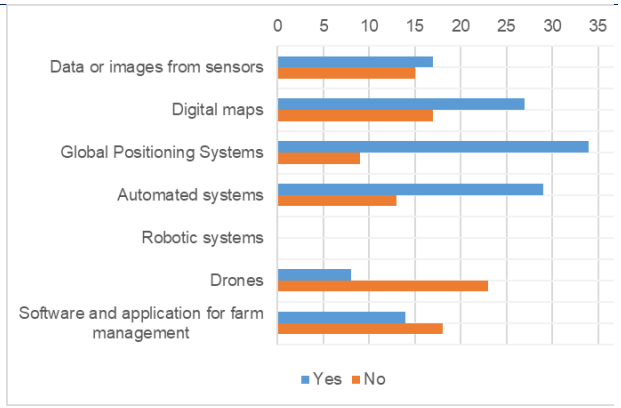


Fig. 7. Smart farming applications' local use

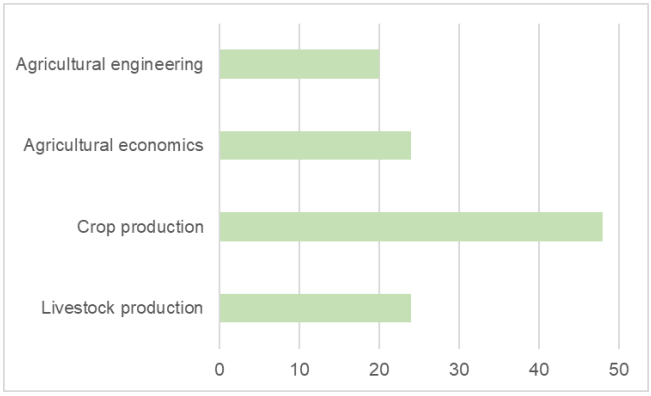


Fig. 8. Smart farming technologies local needs in agricultural sector

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 (Fig. 9), in crop production systems (Fig. 10), in agricultural economics (Fig. 11) and in agricultural engineering sector (Fig. 12).

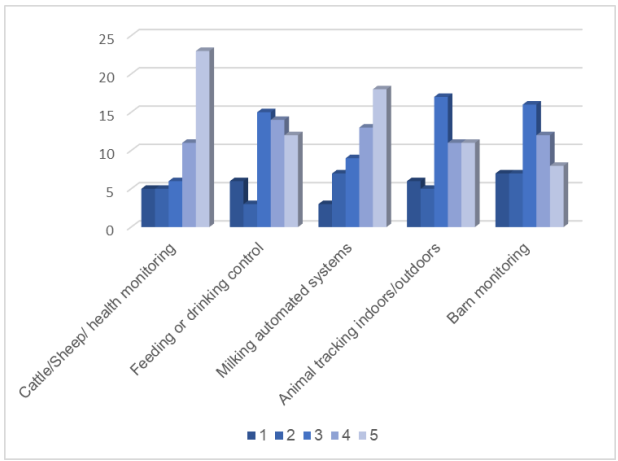


Fig. 9. Smart farming technologies needs in livestock production systems

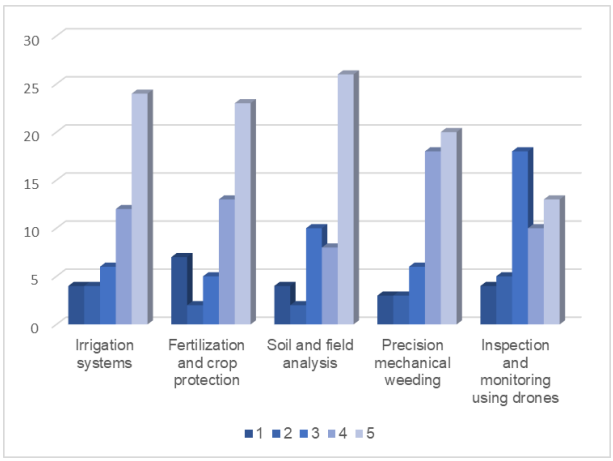


Fig. 10. Smart farming technologies needs in crop production systems

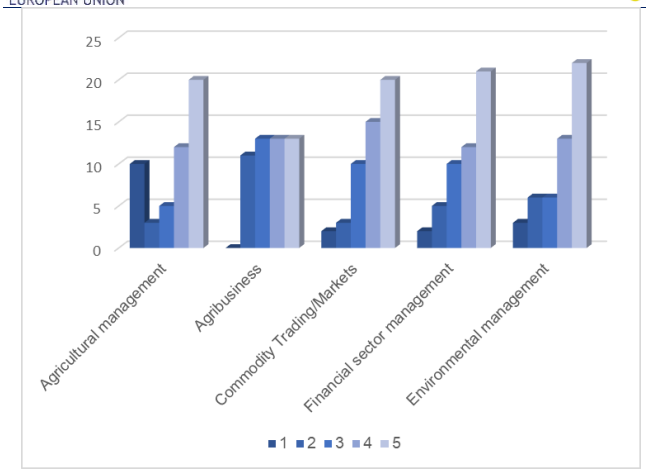


Fig. 11. Smart farming technologies needs in agricultural economics

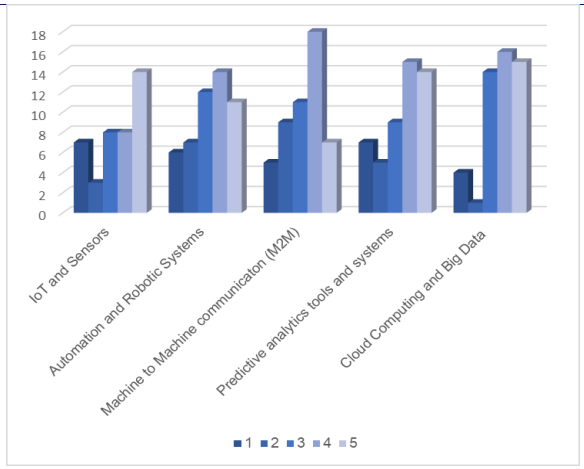


Fig. 12. Smart farming technologies needs in agricultural engineering

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 (Fig. 13).

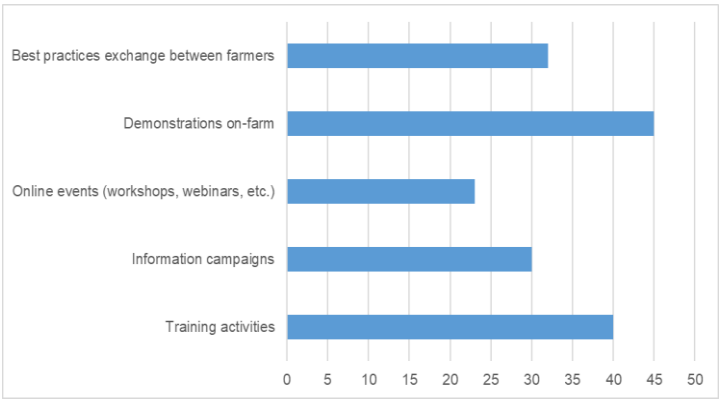


Fig. 13. Types of initiatives to for promotion of smart farming technologies

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.

1.6. Agricultural 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 Fig. 14. Most of the interviewed farmers were related to crop production farming rather in livestock production, agro-economics and/or agricultural engineering (Fig. 15).

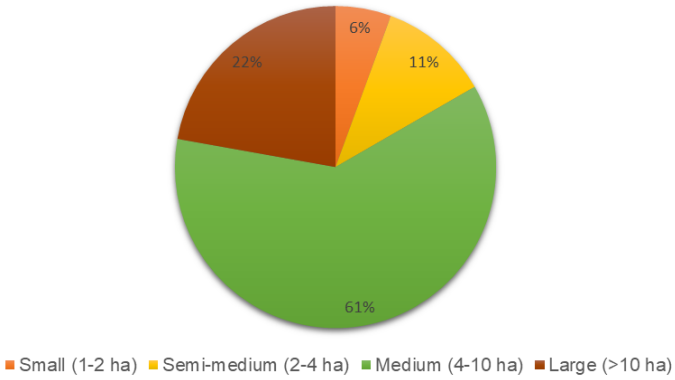


Fig. 14. Farm size enterprises

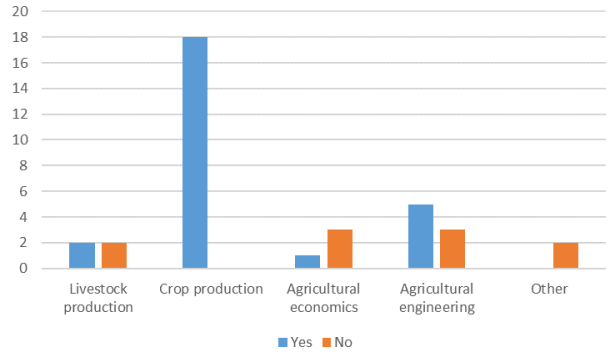


Fig. 15. Agricultural field of activity

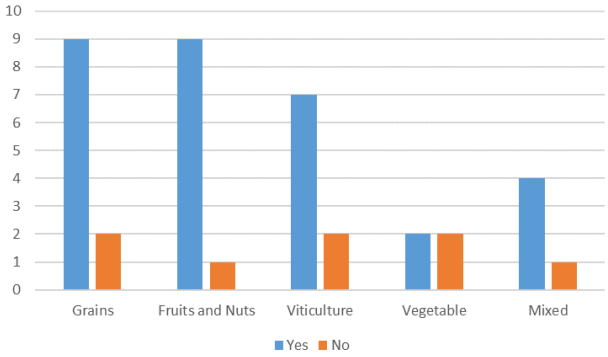


Fig. 16. Crop production categories' responses

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).

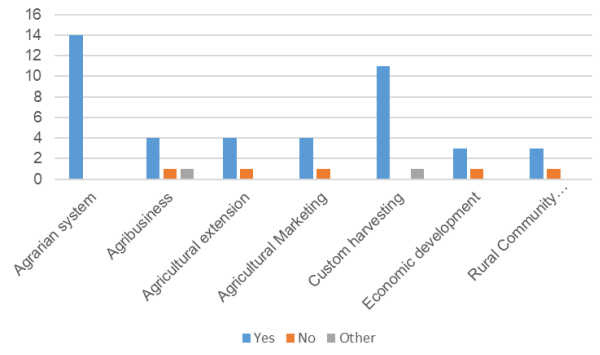


Fig. 17. Agricultural economics categories' responses

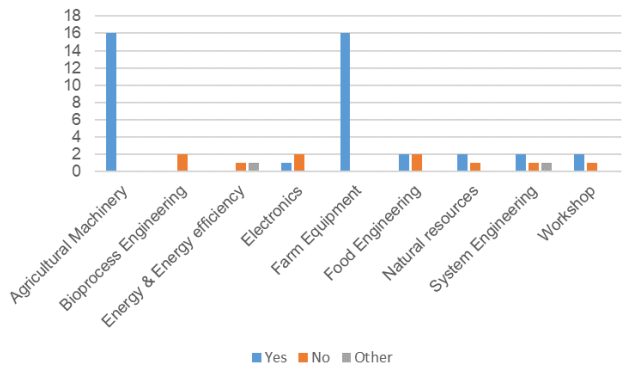


Fig. 18. Agricultural engineering categories' responses

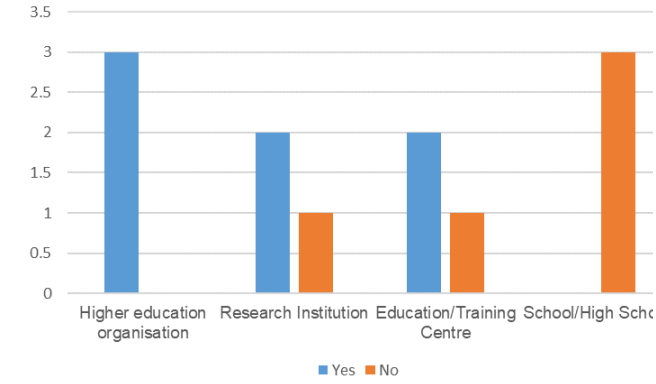


Fig. 19. Research and academia stakeholders

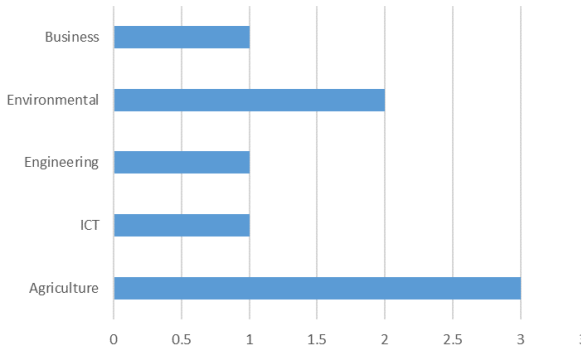


Fig. 20. Research and academia field of activity

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.

1.7. 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.

Chapter 2. Bulgaria's regional analysis

2.1. Bulgaria's background / situation

2.1.1. Description of country's background

The Republic of Bulgaria is situated in the eastern portion of the Balkan Peninsula in south-eastern Europe. Founded in the 7th century, Bulgaria is one of the oldest states on the European continent. It is intersected by historically important routes from northern and eastern Europe to the Mediterranean basin and from western and central Europe to the Middle East. Before the creation of the Bulgarian state, the empires of ancient Rome, Greece, and Byzantium were strong presences, and people and goods traveled the land with frequency.

It is bordered by Romania to the north, Serbia and North Macedonia to the west, Greece and Turkey to the south, and the Black Sea to the east. The capital and largest city is Sofia; other major cities are Plovdiv, Varna and Burgas. With a territory of 110,994 square kilometres (42,855 sq mi), Bulgaria is Europe's sixteenth-largest country.

2.1.2. Brief description of COUNTRY or BSB region agriculture and history

In 2017 it amounted to 5,029,529 ha or 45.3% of the country's territory, increasing by 0.2% compared to the previous year. Arable land is the area that is included in crop rotation, temporary meadows with cereals and legumes, fallow land and greenhouses. In 2017, it decreased slightly (by 0.2%) compared to the previous year, to 3,473,825 ha, which represents 69.1% of the utilized agricultural area. In the 2016/2017 business year, the total number of farmers registered in the register under Ordinance № 3/1999 was 96,476, which is 1,827 more than in the previous year. As of the beginning of August 2018, the number of registered farmers in the 2017/18 business year is 92,328.

According to NSI data, in 2017 the gross domestic product produced in the country increased by 3.8% compared to the previous year in real terms. The nominal value of GDP for the year amounts to BGN 101,043 million (EUR 51,662 million). At the end of 2017, inflation increased by 2.8% on an annual basis, and the average annual inflation was 2.1%. According to BNB data, in 2017 exports amounted to BGN 52,710 million (EUR 26,950 million), which represents 52.2% of GDP. Imports for the year amounted to BGN 54,208 million (EUR 27,716 million) or 53.6% of the country's GDP. As a result of the outpacing rate of increase in exports compared to imports, the negative trade balance for the year shrank by 22.2% compared to the previous year, to -1,498 million levs (-766 million euros).

In 2017, foreign direct investment in Bulgaria amounted to BGN 2,718 million (EUR 1,390 million), which represents 2.7% of GDP. The gross value added by the branches of the national economy in 2017 amounted to BGN 87,634 million (EUR 44,807 million) at current prices, marking a real growth of 4.2% compared to the previous year. The value added of the entities from the agricultural sector in 2017 amounts to BGN 4,114 million at current prices. In real terms, it increased by 8.9% on an annual basis. According to preliminary seasonally issued NSI data, in the first and second quarters of 2018 the total GVA for the country's economy increased by 3.1% and 3.0% respectively compared to the respective period of 2017 in real terms. Regarding the

GVA formed by the agricultural sector, the preliminary data show an increase on an annual basis in real terms by 0.4% in the first quarter of 2018 and a decrease of 0.9% in the second quarter. In 2017, GVA from agriculture, forestry and fisheries represented 4.7% of the total GVA for the country.

2.1.3. Agriculture field in comparison with other sectors

The agricultural sector in Bulgaria (including rural economic activities agriculture, forestry and fisheries) is the third most important sector in the national economy. Its contribution to the gross value added created steadily declining - from 12.1% in 2001 to 4.4% in 2016, and the trend is comparable to that in the EU, where the share of the agricultural sector according to Eurostat is even smaller - about 2.0%. However, taking into account its role in feeding the population, in creating additional employment, respectively to provide additional income, to limit depopulation and the desolation of the territory and for the sustainable development of the environment, then its importance for the functioning of the state and the quality of life of the population acquires strategic dimensions.

Agriculture as an economic activity has a dominant place in the agricultural sector of Bulgaria. According to economic accounts for rural holding gross value added at basic prices, created by agriculture amounts to BGN 2,961.2 million, which is 84.1% of the total added value for the agricultural sector.

Taking into account the socio-economic role of agriculture and its importance its Conservation of Ecosystems and Biodiversity, the European Union annually allocates around € 40 billion (almost 50% of the Community budget) to policies aimed at supporting its sustainable development and conservation of agricultural holdings as main production structures.

The adaptation of Bulgarian agriculture to European norms and practices began immediately after the early 1990s last century agrarian reform that lasted more than a decade. As a result of the restoration of ownership of agricultural land it is fragmented into small pieces plots. Due to lack of funds and material base, but also due to lack of economic interest among owners in the late 90's more than 25% of arable land in Bulgaria is abandoned. Most agricultural techniques are physically and morally obsolete. The building stock of the existing to current production structures is highly depreciated, and much of farm animals - destroyed. Investments in the industry are practically terminated. Much of the traditional markets for agricultural exports outputs are lost. All these circumstances largely predetermine how successfully Bulgarian agriculture will be integrated into the agrarian community of the EU.

The harmonization of Bulgarian agriculture with European policies in the sector began at the beginning of our century with the implementation of pre-accession SAPARD program. After Bulgaria's accession to the EU, the trends in its development are almost entirely determined by the principles and mechanisms of the General Agricultural Policy (CAP).

2.2. Agriculture policies in Bulgaria

2.2.1. Local/regional/national policies in agriculture and connected sectors

According to the Ministry of Agriculture, Food and Forestry, the Common Agricultural Policy (CAP) for Bulgaria is an integral part of the treaties created by the European Community (EC). The CAP is based on three fundamental principles: free trade within the Community on the basis of common

prices, preferences for European production on Community markets, and common financial responsibility.

The aim of the European CAP is to ensure an acceptable standard of living for farmers, to provide quality food to consumers at reasonable prices, to preserve Europe's heritage in rural areas and to help protect the environment.

One of the main documents on national policies in agriculture, part of National Development Program BULGARIA 2030 is a detailed strategy under Priority 6 "Sustainable Agriculture" Structural and sectoral balance of agriculture.

Establishing a more rational structure of agriculture will improve its economic, social and environmental sustainability. The main focus of agricultural policy will be to accelerate the restructuring processes in the sector - strengthening small family farms, achieving an appropriate balance between crop and livestock and their subsectors, the entry of young people into the agricultural business. This will help to improve the viability of economic structures and ensure food security.

Crop production - the existing imbalance between the different production lines of crop production will be overcome through targeted support (coupled support, investment and market support) for the development of intensive sub-sectors with potential for production of higher value-added products - vegetable production, fruit growing and viticulture. winemaking, for which the country has favorable conditions for development.

Efforts will be focused on improving the sustainability, efficiency and profitability of livestock farms. Particular attention will be paid to sensitive sectors such as dairy and beef cattle, buffalo, sheep and goat farming, as well as beekeeping. The breeding of animals with high productive qualities will be encouraged, which will contribute to the optimization of production and will create conditions for better marketing of the products.

2.2.2. Economic potential of small farms

In order to reduce the disparities in the development of the economic structures of different sizes in agriculture, measures aimed at increasing the economic potential and improving the competitiveness of small farms are envisaged. Investments for modernization and implementation of innovative solutions, improvement of their market access, increase of knowledge and professional skills of farmers will be encouraged, mechanisms for more balanced support of their incomes will be applied.

2.2.3. Rural competitiveness economy

The basis for increasing the competitiveness of agriculture are increased production efficiency, accelerated entry of innovation, productivity growth, improving marketing and market organization of supply, and finding access to new markets. Improved competitiveness will contribute to increasing the added value of agriculture will create greater resilience to industry and will increase its capacity to respond to environmental and social challenges and commitments.

2.2.4. Modernization, innovation and digital technologies in agricultural holdings

Investment in agricultural modernization will continue to be encouraged in holdings and processing plants aimed at improving their productivity and competitiveness. Interventions will

have a special focus, aimed at implementing innovations and digital solutions, including related ones with precision farming. The application of modern information and communication technologies in agriculture will increase its potential for more productive, environmentally friendly and less productive food production.

It is envisaged to build a complete Electronic Information System in agriculture, which will allow the electronicization of information flows from and for carrying out the administrative activity and, electronization of services provided to farmers. Automated exchange of data will provide optimization of the decision - making process as in policy formation by the administration and in the management of the activity of the farms themselves.

2.2.5. The role of the agricultural sector in the protection of environment

In addition to providing food, the agricultural sector also provides a number public benefits in the field of environmental protection. In order to strengthen this contribution will encourage the application in agricultural production of environmentally friendly practices, contributing to the protection of water, soil, air and biodiversity. Emphasis will be placed on the use of solutions for adapting agriculture, forests and rural areas to the changing environment and those contributing to mitigating the effects of climate change.

2.2.6. Institutional changes to improve performance in agriculture

Based on the analysis, the effects and trends in the resource security of agricultural holdings are outlined.

The emphasis is on the study of small farms. Their scope, economic potential, specialization, role and problems are outlined. The effects of the CAP on their economic situation are indicated. The factors influencing the restructuring of small farms and their transformation into viable and market-oriented business units are analyzed.

The guidelines and opportunities for increasing the efficiency, competitiveness and income of agricultural holdings in the country are outlined.

2.3. Funding initiatives in Smart Farming from Bulgaria

2.3.1. Local/regional/National Strategies for funding agriculture and connected sectors

With the implementation of the common agricultural policy of the EU and the support policy under the I and II pillars, the Bulgarian producers gained access to a huge financial resource, which in recent years amounted to over BGN 2 billion per year. Only direct payments and area and payments tied support is over BGN 1.7 billion. Bulgaria is among the few countries where between 2007-2016 there is a significant increase in the amount received subsidies per holding. The jump in the support received, without taking into account investment aid reaches six times for the period under review.

Along with the direct and other compensatory payments that come through I and II pillars of the CAP, the agricultural sector also receives national funding under the state aid line. State aid in agriculture is granted in compliance with EU law, aiming to cover sensitive proceedings where temporary problems are observed and in cases where there are unusual or emergency situations. In general, state aid schemes can be summarized in the following areas: investment aid, compensatory aid, aid aimed at ensuring the use of quality crops material in plant growing and

maintenance of breeding activity in animal husbandry, food aid and raw materials, de minimis aid, aid for participation in exhibitions. These State aid schemes target crop and livestock production, as the funds and the overall administration are carried out by the State Fund "Agriculture".

Along with them, state aid is applied in the form of tax relief for both sectors, one of which is of an investment nature and the other is in the form of vouchers for excise duty discount on fuels used in agriculture. State aid for investments in agricultural holdings by transferring corporate tax administered by the NRA and aims to encourage investment in new and new buildings agricultural machinery in the production of unprocessed plant and animal products. The last 2 schemes are aimed at reducing the costs that farmers do in their business and although they can not be called mass schemes, covering a very large number of beneficiaries (on average over the years about 10% of all recipients of such aid), the amounts distributed through they represent about 50% of the total annual amount of state aid in the sector.

2.3.2. Projects implemented in the agricultural field

The Bulgarian Rural Development Programme (RDP) was formally adopted by the European Commission on 26 May 2015, outlining Bulgaria's priorities for using € 2.9 billion of public money that is available for the period 2014-2020 (€ 2.4 billion from the EU budget, including € 28 million transferred from the Bulgarian envelope for CAP direct payments and € 0.5 billion of national funding). Under the first objective of improved competitiveness and balanced development of the country's agri-food and forestry sectors, about 3 500 agriculture holdings and about 120 companies active in the forestry sector are expected to receive investment support. More than 4 000 small farmers will receive support to develop their farms and 1 630 young farmers will receive start up aid to launch their businesses. Under the second objective of protection and sustainable management of ecosystems, efficient use of natural resources and mitigation and adaptation to climate change, support for conversion and maintenance of organic farming will cover about 46 000 ha (out of which 23 000 ha will cover conversion to organic farming). Agri-environment-climate measures will be implemented on 113 000 ha and 60 000 ha in designated Natura 2000 areas will benefit from compensatory support. Under the third objective of socio-economic development of rural areas, more than 4 200 jobs will be created through diversification and development of small enterprises, and another 600 jobs via the implementation of local development strategies. One third of the rural population will benefit from improved infrastructure.

Upcoming EU funding opportunities on sub-measure 6.3 and their financial parameters - the total amount of financial assistance is EUR 15,000, divided into two payments: first payment in the amount of the BGN equivalent of EUR 10,000 - is carried out after concluding the contract for providing financial assistance; second payment in the amount of the BGN equivalent of EUR 5,000 - is performed when after inspection the RA establishes the correct implementation of the business plan.

2.3.3. Projects implemented in the smart and IoT technologies applied to agriculture

As part of the European Union's Sixth Priority set out in Regulation 1305/2013 namely, “promoting social inclusion, reducing poverty and economic development in rural areas, with a focus on improving access to information and communication technologies (ICT), use and quality them in the rural areas”, in the Rural Development Program of the Republic of Bulgaria In 2014-2020, funds in the amount of EUR 30,000,000 are provided under measure 7.3 - Support for broadband infrastructure, including its creation, improvement and expansion, passive broadband infrastructure and access measures to broadband infrastructure and e-government solutions.

10. Financial resources for the development of digitalization in the period 2021-2027.

2.3.4. Investments in agriculture

Credit scheme of the State Fund "Agriculture" for investments in agriculture, which aims to stimulate the investment process in the field of agriculture, increase the competitiveness and quality of agricultural products by providing credit for projects in the fields of crop production, animal husbandry and technical support - purchase of machinery, equipment and inventory used in agriculture.

EUR 458 million from the Rural Development Program will be used for investment measures and support for young farmers and small farms.

This decision was taken at a meeting of the Rural Program Monitoring Committee.

At the meeting were discussed and updated criteria for evaluation of projects under the various measures. Applicants for investment measures will now be required to have a 3-year farm history, which will eliminate random applicants. The projects for investments in the farms will have a maximum cost of up to EUR 1 million, half of which will be EU funds and EUR 1.5 million with an aid intensity of 35%.

The projects for processing of agricultural products will have a ceiling of 2 million euros at 50% intensity and 3 million with 35% support with European money.

The maximum amount for the purchase of agricultural machinery is 250,000 euros. The requirement for priority projects for rural areas is dropped. The main goal is to focus on organic production, irrigation and implementation of new technologies in agriculture.

2.4. Qudruple helix approach in agriculture field

2.4.1. Theoretical Approach (theory)

Quadruple helix approach is an innovative system, aming to research and identify the level of preparedness of smart farming and enhance the active participation and collaboration of all of the parties from the four helixes: business, academia, government and civil society.

The success of digital transformation requires active involvement and collaboration of many different parties. Many of the regional strategies and policies aimed at developing innovation emanate from policymakers in centrally located urban conurbations and are assumed to be universally applicable. An example is the classical “Quadruple helix” model and its successors for economic development based around the idea of business, academia, government and civil society organisations all coming together to foster innovation and economic prosperity. In many remote, rural and less-favoured localities, there may not be a university or other knowledge-intensive institution present which makes a difference from the point of view of local development agendas. In many regions, also the business community may be scattered and insufficiently developed in terms of innovation. And furthermore, this kind of region may also have a weak public sector to enhance innovativeness. In such regions, social and community groups may often play the dominant entrepreneurial role. The community may also play a significant role in remote, rural and less-favoured regions where the basic elements of “quadruple helix” model are present.

2.4.2. List of stakeholders from the investigation (100)

- Ministry of economy, Ministry of Transport, Information Technology and Communications
- Regional Directorate of Agriculture - Burgas, Regional Directorate of Agriculture - Varna,
- Executive Agency for SME Promotion, Employment Agency, Agency for Social Assistance,
- National Council for Social Inclusion, Economic Development Agency - Varna, Association of young farmers, Farmers association, Agricultural Academy, Agricultural Institute Shumen,
- Dobrudzha Agricultural Institute - General Toshevo, Public Environmental Center for Sustainable Development, Association for International Social Development - Varna Branch,
- Varna Tourist Chamber, International Youth Chamber - Varna, REGIONAL AGENCY FOR ENTREPRENEURSHIP AND INNOVATIONS – VARNA, Bulgarian Association of Manufacturers of Greenhouse Products, National Union of Gardeners in Bulgaria, Union of Danube Fruit Growers, Association of Meat Processors in Bulgaria, Vocational School of Agriculture Yambol, Vocational High School of Agriculture Targovishte, VOCATIONAL SCHOOL OF AGRICULTURE AND LIGHT INDUSTRY Karnobat, VOCATIONAL SCHOOL OF AGRICULTURAL FARMING, Dolni Chiflik Vocational High School of Agriculture, Vocational High School of Agriculture and Food Technology - Shumen, PROFESSIONAL TRAINING CENTER at DK GROUP BULGARIA OOD,
- Vocational High School of Agriculture - Novi Pazar, Suvorovo Vocational School of Agriculture, Vocational High School of Agriculture Veliki Preslav, Center for Development and Business Support, Association of Bulgarian Grain Producers, Association of Agricultural Producers in Bulgaria, Register of cooperatives, Municipality of Varna, Varna District Administration, University of Economics – Varna, Bulgarian Industrial Association, Agria Group Holding JSC, Octopod C, Bg Agro, Magic Flame, “MANEX SUN” JSC, Noor Poultry,
- Agricultural Production Cooperative NIVA - Vetrino village, Agricultural Production Cooperative Zvezditsa, Fruit Nursery Ltd. Provadia, Nadezhda - 97 EOOD, Sortovi semena,
- Dobrich municipality, Dobrich District Administration, Farm Sense, Sunfoods, Klasolio, Podbie food, Yaitza i Ptitzi – ZORA“ JSC, Dominion Green, Agropact LTD, Agroprom, Madara agro, Nova agro, Bulagro mashini, Stoychevi Ltd, Renesans, Pesticid LTD,
- Targovishte municipality, Rosa LTD, Ameta Tetrahib, Nara Mel Ltd, E Comers M, HIKS PETROL, Agroelit, Alfacomerse, Kvins Argo, EXPERIMENTAL STATION IN AGRICULTURE, Ardea 2008, Agrovariant, Sem Agro Todor Stoyanov, Yankovi Ltd, US comerce, Burgas municipality, Agrodar Ltd, CHICKEN GROUP Ltd, Agrotehniki & Ko LTD, Bulgarian Association of Agricultural Land Owners, Dairy Yotovi, Biser Oliva AD, Ajaxgroup, Ken Ltd, Alfamaks, Karad Ltd, Bioagro, Eskargot, Agroin, Napredak Agricultural Production Cooperative.

2.4.3. The key stakeholders involved in the questionnaire (50)

Eggs and Birds ZORA AD, BOYAR AD, Executive Agency for SME PromotionE Comers M, Farm Sense, Tetrahib, Ministry of Agriculture, AGRARA LTD, Agrix Bulgaria Ltd., ROSA AD, Agroin Ltd. Stara Zagora, Yotovi Dairy Processing Company, Agroelite, Vocational High School of Agriculture - Novi Pazar, Agropact Ltd., Madara AGRO EOOD, Chicken Group Ltd., Ajax Group, Dobrudzha Agricultural Institute, Suvorovo Vocational School of Agriculture, Stoychevi Ltd., Class Oil AD, Biser Oliva AD, MANEX,
Cross-border cluster for food and organic production BioSafe Dobrogea, The National Association of Young Farmers in Bulgaria, Municipality of Dobrich, Vocational School of Agriculture Yambol, AGRODAR BULGARIA EOOD, National Union of Gardeners in Bulgaria, YANKOVI LTD,

Association "Public Center for Environment and Sustainable Development", Agricultural Production Cooperative NIVA, Vetrino village QUINCE-ARGO AND C-IE, Nara Mel Ltd., Municipality of Varna, Burgas Regional Directorate of Agriculture, UES COMMERCE, Agroprom Service Ltd., Novaagro, Bulgarian Association of Greenhouse Producers, Bulgarian Farmers' Association, sole trader "Renaissance KPDT - Kiril Zhendov", Bulagro AGRICULTURAL COOPERATIVE "ZVEZDITSA", "KARAD" Ltd., DOMINION GRAIN BULGARIA AD, "Nur chicken" Ltd., Varna University of Economics, KEN Ltd

2.5. Smart and IoT technologies existent in Bulgaria

According to the results of the questionnaire, it is clear that farmers in Bulgaria are somewhat aware of the existing smart solutions for rural producers, but most of them do not use or own them.

To the question "What application for intelligent agriculture do you know?" less than half answered that they were familiar with some existing technologies - water deficit detection and control, climate conditions monitoring, crop management, pests and diseases detection, cattle monitoring etc.

Results show that we have applied some smart technologies in different farms. These include automated systems, data or images from sensors, digital maps, and global positioning systems and rarely drones.

73,5 % of all participants think that smart farming is increasing productivity, 59,2 % - that it gives us high quality products, 57,1 % - that leads to cost reduction, increase in profit - 32,7 %

When asked about the desire of farmers to apply technologies for intelligent agriculture, according to the participants, 96% answered in the affirmative.

Regarding which areas of the selected territory farmers need technologies for intelligent agriculture, 46% of them answer - animal husbandry. 49% believe that technologies are needed in crop production, 25% - in agricultural economics, and 13% - in agricultural technology.

Regarding the need for intelligent technologies in the field of agricultural engineering, most of the participants in the questionnaire indicated the need for IoT and sensors and tools and systems for predictive analysis, cloud computing and analysis of large data sets, the need for automation and robotic systems. secondly, thirdly - the communication between machines.

Regarding the type of initiatives suitable for the promotion of intelligent agriculture within the farming community in the respective territory, 64% note the need for training activities, 88% - the need for information campaigns, demonstrations on the farm - 52%.

2.6. Agricultural needs of the rural communities in Bulgaria

Here are some results and analysis of the agricultural field by sectors. In Bulgaria not all the farmers involved in agriculture are engaged in crop production as well. More than half are involved in agricultural production, the other part is involved in livestock, economics and engineering.

From Crop production, sector farmers mainly cultivated grain, vegetables, fruits and nuts. Analysis of Livestock production sector shows that main types of livestock are cattles and poultry, pigs. A

small number of farmers are engaged in sheep breeding. The main directions of the agricultural economics sector are development of economy, rural communities and agribusiness.

Agricultural engineering includes workshops, energy & energy efficiency, farm equipment, agricultural machinery etc.

Regarding the question, do farmers from their territory would like to adopt smart farming technologies, all the participants firmly stated the need of them, and that they should be applied both - in crop and livestock production.

In the crop production field it's mainly connected with irrigation systems, fertilisations and crop protection, soil and field analyses, precision mechanical weeding. Some farmers stated the need for drones, although its high cost.

In the livestock production field it includes cattle milking automated systems, health monitoring, feeding or drinking control, etc. The results show that farmers need more milking automated systems, rather than animal indoors tracking or barn monitoring cattle, health monitoring and feeding control were also needed.

In the field of plant growing farmers stated the need of mechanical weeding, irrigation systems fertilization and protection.

In the Agricultural, economic specific field the main emphasis is on agricultural management and agribusiness.

Finally, in the Agriculture engineering field are important IoT and sensors, Automation and robotic systems, Machine to machine communication, predictive analytics tools and systems, cloud computing and big data analysis and processing.

2.7. Conclusions and recommendations

Accelerated digitalization of Bulgarian agriculture and rural areas, including the public administration in the person of the Ministry of Agriculture, Food and Forestry (MAF), State Fund "Agriculture", regional and municipal directorates and services, is a necessary process to reduce the bureaucratic burden, optimization of production processes, increase of incomes and yields of farmers, achievement of sustainable bio-industry, maintenance of food safety in conditions of increased industrialization and new non-established technologies, drastic increase of competitiveness and increased demand of Bulgarian products of the single European and on world markets. Digitization allows the agricultural economy to realize its high potential and reap the same successes as the high-tech areas of the economy: increase productivity, add value, improve quality and safety, and thus income and quality of life, drastically reduce pollution to sustainable levels, flexible and quick response to market trends. Monitoring the conditions for the development of production in real time, precise control of enemies, tracking "farm to fork", balancing consumption and other new technologies, easing the administrative burden, accurate prediction of stages in the development of the harvest - all this is possible with the application of the latest computer, robotic and artificial intelligence technologies. Progress and availability of new sensors connected via the Internet of Things (IoT), precise and Internet-connected and geolocated mechanization, Blockchain distributed computer platforms (Blockchain), artificial intelligence systems processing large data sets (Big Data) in real time, robots, satellite systems, drones, ubiquitous access to information - these are the new tools of progress in agricultural business. These new and revolutionary technologies come from many diverse scientific fields and must be properly directed towards successful and highly productive Bulgarian agriculture.

Chapter 3. Armenia's regional analysis

3.1. Armenia's background / situation

Armenia is situated at a cultural, historical, and religious intersection and located at the crossroads between Europe and Asia, in the southern Transcaucasus. Armenia, situated along the route of the Great Silk Road, is a landlocked country of rugged mountains and extinct volcanoes, located in the southern Caucasus, between the Black Sea and the Caspian Sea. It is the smallest of the former Soviet republics, bounded by Georgia on the north, Azerbaijan on the east, Iran on the south, and Turkey on the west.

The country spans 29,700 square kilometres of mountainous terrain centered on the Ararat Valley, the heart of the Armenian nation since biblical times. Ancient geographers called the Armenian Highlands the "Island of Mountains" or the "Rooftop of Asia Minor."

Armenia was a regional empire with a rich culture in the years leading up to the 1st Century CE, at one period controlling all the land between the Black and Caspian Seas. In 301, Armenia was the first state to formally adopt Christianity as its official state religion, twelve years before Rome. In fact, Armenia is a relatively small country located in the Transcaoucasian and Iranian ecogeographical crossroad which resulted diversity in ecosystems, landscapes, soil and climatic conditions to allow cultivate diverse cultivars throughout the year.

Armenia has a rich flora of ca. 3600 plants species (ca. 50% of the entire Caucasian flora), distributed across (semi)desert, steppe, forest and alpine landscapes. Armenia is rich with crop wild relatives 2518 and considers one of the significant center of crops origin (wheat, grape etc) and the part of the most important "hotspots" of the World biodiversity- Caucusus.

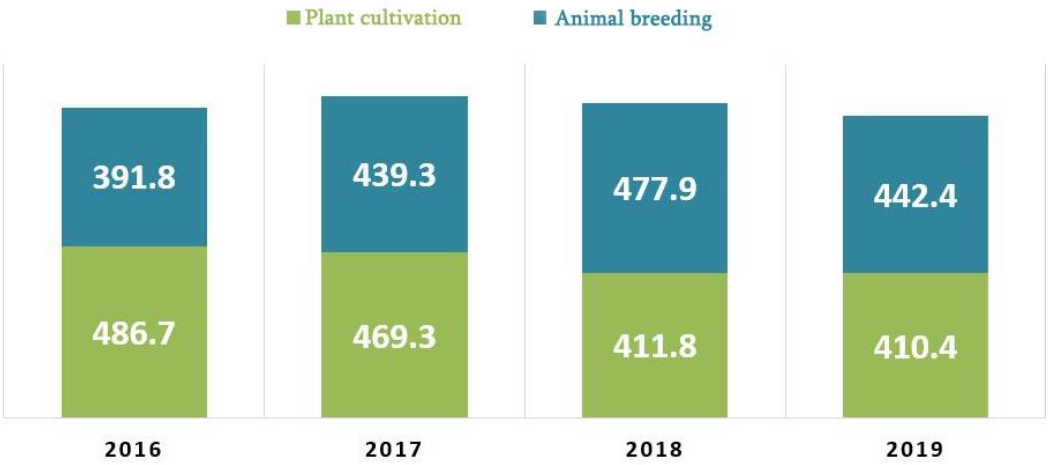
Agriculture is the main source of economic activity in rural areas and significant contributor to GDP. It produces 13.7 % of GDP (as of 2018) and employs **33, 15%** (2019) of the working population of whom nearly 56% are female farmers. Women are over-represented in seasonal and precarious employment and 82.1% of all women working in agriculture do so informally. However, in recent decades, Armenia has moved from an agriculture-based economy to service provision. Agriculture accounted for the lion's share of GDP in 1993, when it reached 48.2 per cent of total economic output. Its share has declined steadily since, to 13.7 per cent by 2018 (Table 1).

Table 1. Basic agriculture indicators in Armenia (World Bank WDI database)

Basic agriculture indicators in Armenia	2008	2018	Difference	Diff. %
Population	2 907 618	2 951 745	44 127	1.52
Agriculture, value added (% of GDP)	17.9 (2012)	13.7	-4.2	-23.47
Agricultural land (% of total population)	61.43	58.9 (2016)	-2.53	-4.12
Rural population (% of total population)	36.36	36.85	0.49	1.35
Employment in agriculture (% of total employment)	37.35	33.29	-4.06	-10.87
Employment in agriculture, female (% of female employment)	44.38	36.59	-7.79	-17.55

About 317,000 farming enterprises provide 97% of the gross agricultural output, of which each enterprise has 1.48 hectares of land (*Table 2*).

Table 2. The dynamics of the gross agricultural output as of separate branches, Armenian dram, billion (World Bank WDI database)



The total population was slightly less than 3 million (2.951.7 million) in 2018. Armenia is generally mountainous country, having its lowest point 375m above sea level and culminating at 4095 m with an average altitude of 1850m. In fact, geographical constrains decreased number of sgricultural lands. For instances, 44 % of the territory of Armenia are high mountainous areas, not suitable for inhabitation thus for agriculture. Thus, the degree of land use is strongly unproportional. The zones under intensive development makes 18.2% of the territory of Armenia with a concentration of 87.7% of total population. On these areas the population density exceeds several times of the ecological threshold index (200person/km^2) reaching here up 480-558. Meanwhile, the average population density is 100 inhabitants per sq. km; and about 37 per cent of the population lives in rural areas.

The greatest part of Armenia is mountainous (about 1 800 meters above sea level), while 1/3th is pastureland. A land of rugged mountains and extinct volcanoes, its highest peak is Mount Aragats, 4 095 m. There are more than 200 streams and rivers in Armenia, none navigable, however, because of their steep descents and rapid currents. The Armenian countryside also boasts some 100 small, but picturesque lakes. One of the largest mountain lakes in the world, Lake Sevan, covers an area of 1 400 square kilometers and is about 2 000 meters above sea level.

Armenia has 2.974 million ha of land, of which 2.043 million ha is considered agricultural land. The total area of arable land is 446.0 thousand ha (21.8% of agricultural lands), out of which 68.1 thousand ha is concentrated in Ararat valley (15.2 %). More than 57% of agricultural land in Armenia is pastures and meadows. Around 29.1% of cultivable land is not utilized for various reasons.

The Agricultural Census distinguishes two main farm types:

- holdings without legal status which includes individual households and individual farms of members of horticultural associations,
- holdings with legal status being legal entities and private entrepreneurs.

The second category are the larger, commercial companies which comprise of less than 0,1% of all farmers and about 4% of all private land.

The distribution of the farm sizes are as follows: 340.000 family farms between 1,2 and 1,4 hectares, fragmented into an average 2 to 3 parcels. 42.000 ha have plantations (65% orchards, 34% vineyards and 1% berries 2), mainly in private ownership. Most arable land is located in the Araks river valley and along its tributaries (e.g. in Ararat, Armavir, Shirak, Kotayk and Aragatsotn regions) and around Lake Sevan (Gegharkunik). Most plantations are located in Armavir, Ararat and Aragatsotn regions.
Most cultivated essential plant in Armenia requires between 500-700mm average precipitation, however the annual precipitation comprises about 300mm in the cultivated area, which is mainly spread over winter season, thus the irrigation is very crustal for the production of fruit trees, grape, vegetables, berries, cereals etc. Only 7.6 % of total agricultural land and 26.7 % of arable land are irrigated by comprising 170 Th.ha. Actual irrigated in 2019 around 100 Th. Ha.

3.2. Agriculture policies in Armenia

3.2.1. Local/regional/national policies in agriculture and connected sectors

One of the guiding documents of the agrarian policy is the 2020-2030 strategy of the main directions ensuring the economic development of the RA agricultural sector approved by the RA Government Decree No.1886-L dated December 19, 2019. The core of the agricultural policy is the increase of agricultural efficiency, increase of the food security level, introduction of modern technologies, increase of exportation volumes, increase of profitability of all entities engaged in the entire value chain of agriculture - small households, farming cooperatives, processors, and exporters.

The Sustainable Agricultural Development Strategy gives primacy to technology-focused modernization: promoting digital agriculture and technological innovation; investing in digitalization of the agricultural sector; building the local ecosystem for technological innovation; and boosting regional digital agricultural services leadership. Since 2018 the RA has developed new loan policy for local farmers to boost smart farming systems (intensive orchids, greenhouses, smart cattle breeding bars etc).

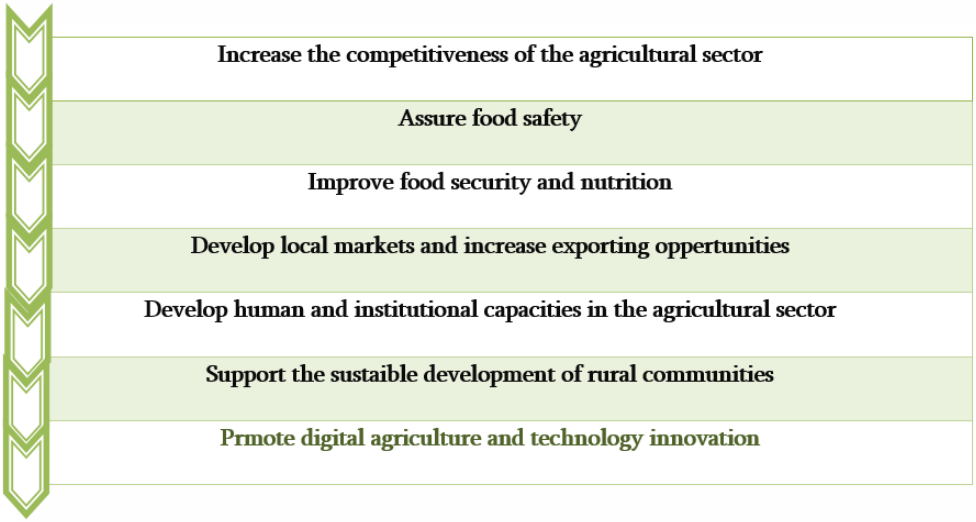


Fig. 21. Priorities of agrarian policy in Armenia

The vision of the strategy for the next 10 years is to have agriculture that ensures sustainable development, is innovative, creates high added-value, is careful towards natural resources and environmentally friendly, creates ecologically clean products and guarantees the well-being of people living in rural areas.

Along with the task of creating a competitive and efficient agriculture that is based on new technologies and science, the RA Government has also set a goal to:

- Support the development of cooperative agriculture and define the minimum prerequisites required for realization of cooperatives.
- Create educational, scientific and research, industrial clusters and contribute to enhancement of cooperation between educational, scientific, scientific and production and consultation centers in agricultural and agrarian sector.
- Support the introduction of agricultural and food system equipment, new technologies, as well as food safety systems.
- Implement state support programs aimed at development of local seed breeding and seed production, intensive agriculture, and livestock breeding, as well as support establishment of pedigree farms.
- Contribute to the expansion of non-agricultural activities in rural communities and development of agritourism.
- Ensure the introduction of an effective system for prevention of animal and plant diseases.
- Ensure the introduction of a system on dissemination of agriculture-related knowledge and experience and access to information among agricultural producers.
- Ensure the introduction of insurance system in the agricultural sector.
- Define the main principles, methodology, and strategy of assistance to agriculture.

In order to implement the afore-mentioned policy, the expenses envisaged by the state budget for the mid-term program in the Republic of Armenia will be primarily aimed at execution of the following projects:

- Application of subsidizing the loan interest rates and compensation mechanisms to enterprises operating in the agricultural sector and agricultural products processing entities.
- Supply of technical means for the agrifood and agricultural sector through affordable mechanisms - financial lending, leasing.
- Activities to promote intensive gardening implemented by modern technologies.
- Introduction of modern technologies for irrigation.
- Support to introduction of hail protection nets.
- Introduction of small and medium-sized greenhouse enterprises and “smart” livestock buildings using compensation mechanisms.
- Activities for development of viticulture and winemaking.
- Agricultural and chemical surveying of soils and increase of fertility.
- Implementation of state assistance programs aimed at development of animal breeding.
- Introduction of advanced technologies in livestock raising.
- Implementation of a pilot agricultural insurance project.
- Enhancement and development of information and consultation sector.
- Organization of seed breeding and seed preservation activities.
- Seed quality inspection and state-funded testing of sorts.
- Plants protection measures.
- Anti-epidemiological measures against infection diseases of farm animals.
- Targeted and coordinated use of natural grazing lands.

The Agrarian Strategy acknowledges the importance of partnerships and includes a final section with calls to ation and ideas for collaboration with other Armenian line ministries Governmental institutions and initiatives. These include, for instance, the Ministries of High Tech, Finance, Environment, Territorial Administration and Infrustructure, Education, Science, Culture and Support, and other Governmental bodies and programmes such as the Work Armenia initiative. The main key indicators of the Strategy are presented in the Table 3.

Table 3. The Main Indicators

N	INDICATORS	2019	2024	2029
1.	Annual average income per farm holding (Armenian drams)	0.640. mln	2.0 mln	5.0 mln
2	Labour productivity improvement of farmers	3%	+45%	+ 100%
3.	Average annual growth rate, agricultural value-added	- 2%	5.50%	7%
4	Share of uncultivated arable lands	45.5%	35%	<25%
5	Increase of agricultural lands productivity	-5%	+25%	+103%
6	Share of irrigated arable lands	26%	>35%	>40%
7	Export volumes of primary agricultural products and processed food	697.7 mln USD	850.0 mln USD	>1.0bln USD
8	Degree of diversification of agricultural products export (10% more foreign markets)	1	2	3
9	Share of eco-products in gross agricultural product	0.20%	1%	>5%
10	Global food safety index	52.3	65.3	75.0

As a result of the implemented agrarian policy and realization of projects aimed at it, in the mid-term perspective, each year 3.5-5.5% growth of the gross agricultural output will be ensured compared to the previous year.

3.2.2. Institutional changes to improve performance in agriculture

The Government of Armenia has first decided in 2008 to integrate information technologies and use innovations in the public sector, so as to improve the provision of public services and make them more efficient. In 2010, the Government introduced “www.e-gov.am”, an electronic governance portal aimed at making all electronic government tools and databases available in one place and at creating a comfortable environment for their use. In addition, in 2010, it approved the Concept Paper on the Development of the Electronic Society in Armenia. In 2014, it approved the Electronic Governance Strategy, to improve public service provision and solve other issues.
While adopting policy documents on ICT, e-society and e-governance development, the Government moved the provision of a number of public services and broad public access to information and databases to online platforms. Its priorities include to ensure maximum output at minimum cost in all spheres of public administration, based on know-how and technologies; to provide accessible, affordable, reliable, safe, high-quality and internationally competitive services to develop the economy; and to improve the people’s quality of life. To achieve these objectives, the Government has decided to:

- put in place contemporary infrastructure ensuring information security, cybersecurity and personal data protection, and develop e-platforms for delivery of e-services by government agencies;
- digitize the information managed by public administration bodies;
- develop unified and comprehensive databases, synchronize State information programmes, and enhance interoperability of information systems and their rational use;
- increase the efficient use of digital technologies by public administration bodies, cut expenditure, maximize output and improve the quality of public information and services;
- design State standards for information security and ensure implementation and control. The e-governance ecosystem in Armenia is currently being developed thanks to the efforts of the Government and donor agencies.

The *Sustainable Agricultural Development Strategy in the Republic of Armenia (Vision 2029) gives primacy to technology-focused modernization: promoting digital agriculture and technological innovation; investing in digitalization of the agricultural sector; building the local ecosystem for technological innovation; and boosting regional digital agricultural services leadership*.

According to the strategy, the agricultural sector currently has poorly developed modern information systems, and this is having a negative impact on the development of more accurate policies and efficient implementation thereof.

The following are the most important missing components:

- development and launch of a digital farmer register;
- development and realization of digital systems for counting and registering livestock;
- elaboration and use of a database of digitized maps of agricultural lands and agrochemical research;
- development and application of a centralized database of technical and economic performance indicators and standards in the agricultural sector.

During its session on August 27, 2020, the Government of the Republic of Armenia approved the Small and Medium-sized Entrepreneurship Development Strategy for 2020-2024 and its associated action plan for 2020-2022 developed by the RA Ministry of Economy.

The goal of the strategy is to create a favorable environment for SMEs of the Republic of Armenia through development of entrepreneurial skills, implementation of ideas, increasing the competitiveness, which will allow providing SMEs with access to domestic and foreign markets.

The target measures of the strategy are aimed at increasing the accessibility of financial resources for SMEs, capacity building, as well as formation of institutional and legal environment necessary for promotion of entrepreneurial culture.

At the effect of implementation of the measures defined by the strategy, it is planned to facilitate the growth of the SME productivity, increasing the productivity by 3% in 2020-2023, and by 7.5% in 2024. In particular, the benefit produced by one employee in SMEs in 2024 will amount to 12 million AMD, which is almost doubling the same indicator in 2018 (6.7 million AMD in 2018).

At the effect of the targeted activities stipulated by the strategy, the number of people employed in SMEs will increase by an annual average of 2.5%.

In order to mitigate the effects of the pandemic, more attention was paid to improving the mechanisms of the bankruptcy process and the second chance, overcoming additional difficulties related to access to financing, the need of SMEs engagement in large value chains. At the effect of the implemented activities, not only will the productivity of SMEs significantly improve and the number of employed will increase, but also, due to the transferred skills and improved environment, engagement in an entrepreneurial activity can become an alternative to work abroad, lost jobs, and recovery of income.

3.3. Funding initiatives in Smart Farming from Armenia

3.3.1. Local/regional/National Strategies for funding agriculture and connected sectors

The main directions of ensuring economic development in agriculture for 2020-2030 according to the Ministry Strategic Development Policy is strengthening sustainable, innovative, high value-added agriculture in a harmony with the environment, ensuring care of natural resources.

In order to develop large scale investment of modern technology in the agriculture the government offers favorable conditions for the loans and subsidization on the different programmers e.g. - *establishing drip irrigation systems* in orchards etc while applying within the agricultural cooperatives (so in 2019-2023, it is anticipated to contribute the establishment of about 1800 ha of drip irrigation system in Armenia); - *Small and Medium Smart Cattle Barn constructing* and

reconstructing programmes (in 2019-2021 some 3.2 billion drams are to be invested in the construction of 230 "smart' farms, the project is for the period of 2019-2024); - *greenhouse construction and reconstruction* support projects; *-intensive orchids investment p*rojects etc.

The development and establishment of intensive orchards or smart cattle breeding farms will contribute to increase the yield or production capacities (e.g. in case of intensive orchard the yield capacity can increase over 50%). In parallel, it contributes the natural resources efficient use e.g for water around 30-50%. In addition, considering the fact that about 28 thousand ha has over normative irrigation demand (Ararat, Aragatsotn, Kotayk Regions), the development of drip irrigation system is highly demanded and crucial to improve efficient use not only for the water but cultivated land resources, which is limited due to country's mountainous relief. Thus, the development of drip irrigation system in Armenia is one of the essential issues due to its scare water resources and harsh climate condition in the country during the crops vegetative period.

The government planned in March 2019 to proceed up to 8000 ha of land area in Armenia to drip irrigation by 2023. Between 2019 and 2023 drip irrigation systems will be installed in 1600 ha of land areas and raining systems will be installed in 200 ha of land areas. Loans will be provided to carry out these works with 3 years of repayment term and interest rate of 12%. 10-percent point will be subsidized for 1200 ha and 12-percent point will be subsidized for 220 ha.According to the governmental decision made on September 10 in 2019, the drip irrigation has potentially growing for the last decade and within the period of 2017-2019 the growing ha of drip irrigation.

The drip irrigation is continually growing in the country over the last decade from 0,4 % comprising 3.27% of all irrigated area, particularly in the vegetables, orchards (grape, fruits) agri-land (ref. governmental decision N 212-L, different statistical research). The growing rate is increased especially during the recent 5 years, as the government gives special subsidize loans (over 106,6 billion) for the farmers, in order to contribute the development of drip irrigation in Armenia.
In addition, the government supports the local farmers or SMEs in the agri-food production system in Armenia who has suffered due to the COVID-19.

3.3.2. Projects implemented in the agricultural field

Main state institution, which provided assistance to farmers and small and medium entrepreneurs in 2016-2018, was SME Development National Center of Armenia (SME DNC). The organization was responsible for the implementation of SME state support programmes, aiming to help start-ups and already functioning SMEs to develop their capacities and knowledge. Support to SMEs was provided by different assistance tools, some of which with assistance of the donor community. Programme implemented by the SME DNC to support start-ups is **The Loan Guarantees Provision programme,** with the location of all marzes/regions of Armenia.

The Loan Guarantees Provision programme supports SMEs that lack collateral and have low liquidity for loans. The programme allows entrepreneurs to qualify for loans by guaranteeing up to 70% of the principal of the loan and the interest rates for up to 5 years. The maximum amount guaranteed cannot exceed 15 million Armenian drams. The loan guarantees are provided to SMEs operating in the regions with low level of economic activity (close to the border and rural areas, disaster zone, former industrial and scientific sites) in manufacturing, services provision and trade sectors. They should be involved in import substituting activities or be and exporting SMEs or have an export potential. Only SMEs that introduce and use new technologies and innovations are considered. Detailed information and procedures are available on https://smednc.am.

The European Neighbourhood Programme for Agriculture and Rural Development (ENPARD)

The purpose of the project was to strengthen and establish primary producers' groups within the targeted value chains in selected regions of Armenia, improve their capacity and actively engage in value addition and provide direct assistance within the selected value chains that will benefit not only stakeholders of those value chains but also Armenian consumers locally and nationally.
EU contribution: € 5 000 000 (plus EUR 20,000,000 as a budget support)
Implementing organisations: Ministry of Agriculture of the Republic of Armenia, the United Nations Industrial Development Organization, United Nations Development Programme and the Food and Agriculture Organization of the United Nations, local authorities and farmer groups.
Duration: October 2014 – September 2018
Location: All marzes/regions of Armenia

EU Organic Agriculture Support Initiative (OASI)

This project specifically aimed at increasing local value-added of Armenian organic products as well as assisting higher efficiency of relevant public and private institutions. Supporting the Ministry of Agriculture with creation of a clear and enabling legal environment for organic producers and processors in line with international standards was one of the objectives of the project.
Activities of the project included promotion of organic extension services, raising awareness of organic production and products, and increasing market access for the producers. The OASI Project has also provided 45 beneficiary farmers and processors with financial assistance of about 1 million euros to start or expand their organic production. Moreover, nearly half-a-million euro worth export has been registered because of the continued participation at the international exhibitions.
Total budget: € 3 300 000***, EU contribution:*** € 2 800 000
Implementing organisation: Austrian Development Agency (ADA)
Duration: 42 months | September 2015 – March 2019
Location: All marzes/regions of Armenia

Boosting competitiveness of regional SMEs

The overall objective of the project is to boost the competitiveness of regional SMEs and to create employment opportunities in Lori, Syunik and Armavir regions of Armenia, focusing on the sectors of food processing and tourism. It promotes the development of entrepreneurship by creating business opportunities for progressive young people, equipping start-ups and growing SMEs with contemporary business skills and competences, facilitating access to finance and markets, providing relevant skills and promoting sustainable employment.
Three group of activities are involved in the project:

1. **Establishment of a Road Side Station (RSS) in Lori region**, as a marketing infrastructure for local products and services. The RSS is a multi-functional sale and rest facility on the highway, facilitating the development of local production and tourism, and includes a local brand shop, an information/training centre, and a rest station. Market research in the food processing and tourism sector was conducted for the planes RSS.
2. **Entrepreneurship promotion:** A special toolkit for start-ups "Successful Start" was implemented in target regions of Armenia. In the framework of this assistance, operating SMEs and start-ups received targeted business trainings contributing to business skill development. The toolkit included also a loan guarantee facility: the most viable business plans received during the successful start campaign had an opportunity to apply for SME DNC's loan guarantee facility for start-ups.

3. **Job promotion**: to address the issues of the mismatch between job seekers' skills and required qualifications on the labour market, the project organised a series of sector specific and general business trainings for young job seekers

Total budget: € 1 604 808, ***EU contribution:*** € 1 123 370
Implementing organisations: "Small and Medium Entrepreneurship Development National Center of Armenia" (lead) and its partners: "Strategic Development Agency" NGO, "Armavir Development Center" NGO, "Spitak-Farmer" NGO and "Syun" NGO
Duration: 2016 - 2019
Location: Lori, Syunik, Armavir (regions) of Armenia

Advice for Small Businesses
Implementing organisation: European Bank for Reconstruction and Development (EBRD)

The programme aims to promote good management in the small and medium-sized enterprise sector by providing technical assistance and consultancy, helping them to grow their businesses. Objectives of the programme are:

- Contribute to improved access to finance for SMEs and enhance competitiveness of assisted SMEs.
- Strengthen and improve sustainability of local business advisory services infrastructure

The activities of the programme include:

- Provision of a business advice through international advisers and local consultants. This includes teaching and mentoring activities as well as the dissemination of commercial and technical know-how to key managers;
- Organisation of study visits;
- Provision of financial support.

The programme is implemented in all regions of Armenia. As of today, about 76% of assistance was provided to SMEs operating outside of Yerevan. The programme works in almost all sectors of economy. Eligibility criteria of the assistance are:

- **Size**: annual turnover up to EUR 50mln or balance sheet total of less than EUR 43mln. Usually support is provided to companies which have fewer than 250 workers;
- **Ownership:** Businesses established by local Armenian citizens;
- **Operation:** Businesses should be operational two and more years;
- **Sector:** Almost all sectors (except military sector, producers of tobacco, gambling or financial sector).

Total budget: € 16 000 000
Duration: 2010 – 2019
Location: All marzes/regions of Armenia, other Eastern Partnership Countries

Enterprise Europe Network (EEN): Scaling up for grow
Implementing organisations: SME Development National Center of Armenia
Duration: 2017 - 2018
Location: All regions/marzes of Armenia

The main objective of the project was to boost regional scaling up SMEs in further grow and internationalization.
Main supporting tools included:

- Thematic trainings,
- Individual consultancy,
- International partner search by EEN tools

Target groups of the project were scaling up SMEs operating up to 5 years in food processing sector.

Investments in agriculture

Subsidizing interest rates of loans provided to agricultural sector Implementing organisation: Ministry of Economy of the Republic of Armenia
Location: All marzes/regions of Armenia
Overall objective of the programme is contribute to improve capacities of business operators involved in agricultural sector, introduce modern technologies and increase agricultural productivity by through the partial subsidization of interest rates of loans provided to business operators by financial institutions.
In the framework of the programme, the interest rate of agricultural loans is defined 0% for beneficiaries of borderline communities[3], 3% for agricultural cooperatives and 5% for other economic operators. The amount of the loan is AMD 3-15 mln. The loan term is maximum 5 years depending on the direction of the investment.
For the implementation of the programme, the government works with the following financial institutions:

- ACBA-Credit Agricole Bank CJSC
- Armbusinessbank CJSC
- Converse Bank CJSC
- "CARD AgroCredit" Universal Credit Organisation CJSC
- "Farm Credit Armenia" Universal Credit Organisation Commercial Cooperative
- "Kamurj" Universal Credit Organisation CJSC
- "Aniv" Universal Credit Organisation LLC
- Agroleasing LLC
- "Development and Investment Cooperation of Armenia" Universal Credit Organisation CJSC

To be entitled to benefit from the programme the business operator should have relevant certificate provided by the Ministry of Economy. The Application procedure is available on the website www.minagro.am.
Detailed information can be obtained also from the Agriculture Development Programmes Department of the Ministry of Economy, tel.: +375 11 525 232.

***Subsidizing interest rates of loans provided for the purchase of* agricultural raw materials**
Implementing organisation: Ministry of Economy of the Republic of Armenia
Location: All marzes/regions of Armenia

Overall objective of the programme is increase the loan accessibility level for business operators engaged in processing of agricultural products in the territory of the Republic of Armenia.
The annual interest rate of loans provided in the framework of the programme should not exceed 12%, 9% of which will by subsidized by the Government. For businesses, operating in borderline communities [4] the interest rate of mentioned loans is 0% (fully subsidised by the Government).
The balance of the principal amount of loan cannot exceed AMD 1.5 billion, the maturity date is up to one year. Loans subject to subsidy should be targeted solely on the payment of the harvested agricultural raw materials.
In the framework of the programme, the government works with the following financial institutions:

- ACBA-Credit Agricole Bank CJSC
- Ameriabank CJSC
- Ardshinbank CJSC
- Armbusinessbank CJSC
- Armeconombank CJSC
- Armswissbank CJSC
- Biblos Bank Armenia CJSC

- Converse Bank CJSC
- Evocabank CJSC
- HSBC Bank Armenia CJSC
- Inecobank CJSC
- VTB-Armenia Bank CJSC
- "CARD AgroCredit" Universal Credit Organisation CJSC
- "Development and Investment Cooperation of Armenia" Universal Credit Organisation CJSC
- "Farm Credit Armenia" Universal Credit Organisation Commercial Cooperative

In order to benefit from the programme the business operator should sign the raw material procurement contract with relevant farmers (template is available at www.minagro.am), fill in the application form and submit the documents to relevant financial institutions. Detailed information can be obtained from the Agri-processing Development Department of the Ministry of Economy, tel.: +375 11 230 180.

***State support for leasing: Financial lease of agricultural equipment in agri-* food sector of the Republic of Armenia**
Implementing organisation: Ministry of Economy of the Republic of Armenia
Location: All marzes/regions of Armenia

The main objective of the programme is to provide support to business operators involved in agri-food sector of the country, by supplying equipment on affordable terms, particularly with the use of financial leasing mechanisms. It is expected, that this assistance will create prerequisites for increasing the volumes of agricultural primary production and processing, as well as to produce qualitative and safe products according to international standards and increase competitiveness of Armenian agricultural products in foreign markets.
In the framework of the programme, the equipment is provided in following sectors:

- Livestock breeding, including cattle breeding, sheep breeding, pig farming, poultry farming, beekeeping, fish breeding, industrial animal husbandry;
- Crop production, including greenhouses;
- Cold storages, including for milk;
- Sorting, packaging of fresh fruit and vegetable;
- Slaughterhouse
- Agri-processing
- Other activities in agri-food sector

Leasing is given in Armenian drams, with the maturity term of up to 8 years and annual interest rate of up to 11%, up to 7% of which is subsidised by the Government (final annual interest rate for the business operator should be 4%). For businesses, operating in border-line communities[5], the interest rate is 0% (fully subsidised by the Government).
The total amount of the equipment obtained in the framework of programme should not exceed AMD 400mln.
In order to benefit from the programme, the business operator should select a supplier organisation, together with whom submits a financial leasing application to selected financial institutions. As soon as the applicant pays the prepayment (20% of the price of equipment); the financial institution signs delivery agreement with supplier organisation and provides equipment to the applicant, as soon as it is imported to Armenia.
The following financial institutions are involved in the programme

- Ameriabank CJSC
- Armeconombank CJSC
- Armswissbank CJSC
- Converse Bank CJSC
- "ACBA Leasing" Credit Organization CJSC

- "CARD AgroCredit" Universal Credit Organisation CJSC
- "Development and Investment Cooperation of Armenia" Universal Credit Organisation CJSC

Detailed information can be obtained from the Agri-processing Development Department of the Ministry of Economy, tel.: +375 11 230 180.

Projects implemented in the smart and IoT technologies applied to agriculture

Green Agriculture Project

Total budget: € 11 700 000***, EU contribution:*** € 9 700 000
Implementing organisation: Austrian Development Agency
Duration: 2019 – 2022
Location: Northern marzes/regions of Armenia

The expected start of the project is September 2019, aiming to create high-value agriculture ventures and develop capacity of agricultural stakeholders, establish quality infrastructure for increasing efficiency and sustainability, and enhance export opportunities in agriculture and irrigation sector. The project will be implemented in three norther regions of Armenia: Lori, Shirak and Tavush.
Main support foreseen by the project include:

- Capacity building activities for agricultural stakeholders,
- Improvement of machinery and post harvesting infrastructure,
- Support to VET in agricultural sector
- Provision of small grants
- Marketing support and awareness raising.

Currently the project does not have any sectoral preference. Sectors of further assistance will be decided after implementation of value chain analysis. However, harvesting of herbs and production of organic herbal teas are considered as one of possible sectors, where the project will intervene.

IMPACT AIM ANAU AgriTech Accelerator program is designed to support science and technology-backed startups and budding entrepreneurs offering solutions to tackle challenges in the agricultural sector of Armenia and worldwide. The program is launched by UNDP ImpactAIM Accelerator and implemented jointly with Armenia National Agrarian University (ANAU), International Center for Agribusiness Research and Education (ICARE) Foundation, Foundation for Armenian Science and Technology (FAST), Nation in Action initiative, is supported by Armenian National Innovation SDG Lab and ADB Ventures Facility.

AIM ANAU AgriTech Accelerator program is the follow-up phase of the ANAU AgTech incubator launched in 2019 at Armenian National Agrarian University (ANAU) with a 10-week pre-incubation training program and deep learning workshops for 44 participants including ANAU students and the young professorship. Several monetary prizes were awarded. One of the main outcomes of the program is the construction of the venue for ANAU AgriTech Incubator in the premises of ANAU with an expected opening in September 2020 granting students and professors the opportunity of testing their entrepreneurial projects in real life.

AgriTech Acceleration program aims to provide the necessary knowledge, expertise, network, and funding for setting up, and/or scaling up existing ventures. Gap assessment is conducted to offer a tailored program best fitted to the participants' individual needs.

The program targets only science and technology-backed startups **(pre-seed, seed, and growth stage)** and budding entrepreneurs (Idea Stage). **Individuals, teams and registered entities** (CSO/NGO, LLC, LTD, etc.) both from Armenia and around the world are eligible to apply if they offer solutions to tackle the following **challenges in the agricultural sector:**

- Data-driven agriculture
- Online management systems and E-commerce
- Increased efficiency in food production value chain through new technologies

EU-GAIA with join efforts of Nation in Action, ICARE foundation and Armenian National Agrarian University has been implemnated start-ups call under 35 000 Eur compition fund. 10 companies were presenting interesting topics in green agriculture and challenges.
3 companies were selected as a final winner such as Revalcon, Garoon Tech and MiCofe:
Revalcon - presented digtal app and web projects to controle irrigation system
Garoon tech – presented interesting digital platform for agricultural extention
MiCofe – presented novel technologies for reusing of coffee grounds to receive ecologically safe and biodegradable organic fertilizer.
ArmSIS – Soil map
The Armenian Soil Information System has been formally launched during World Soil Day 2020, December 5. ArmSIS represents an essential assessment of soil resources to duide the effective and knolwdge-baesd policymaking to combat land degradation in Armennia.
The project has been initiated by the Ministry of economy of Armenia, and ArmSIS were established through a collaboration between FAO, the Global Soil Partnership, the Armenian National Agrarian University, the Center of Agricultural Services (SNCO) and the Institute of Geological Sciences.
ArmSIS is financially supported by the Ministry of Finanace of the Russian Federation. The new and fully functional ArmSIS was created by digitizting legacy and soil data while compilling fresh data based on agrochemical sampling campaigns.

In the second half of 2018, the EU-funded FAO European Neighbourhood Programme for Agriculture and Rural Development (ENPARD) project, “Technical Assistance to the Ministry of Agriculture of the Republic of Armenia”, which benefits from FAO technical cooperation, helped the government develop a vision for the national e-agriculture strategy. FAO continues to support the development of the action plan for digital agriculture in conjuction with the Ministry of Economy and Ministry of High-Tech Industry of Armenia supports the elaboration of national digital agriculture stratedy starting in May, 2020. FAO supports in transforming agriculture through the adoption of digital technologies and innovation.
The national digital agriculture strategy can help Armenia increase food production, establish incentives and facilitate the development of digital technologies for the agrifood sector. It can be used to promote new markets, strengthen social protection, decentralize trade and serve as a driver for digital agricultural innovation.

Armenia SME Finance and Advice Facility
Implementing organisation: European Bank for Reconstruction and Development

Started in 2017, the SME Finance and Advice Facility aims to deepen and diversify access to finance for local SMEs by combining technical advisory services with the grant support for equity and other forms of capital investments. The facility will try to improve access to finance for SMEs through a combination of investment projects and technical assistance, and a diversification of sources of finance, ultimately creating jobs, contributing to increased investment, capital market development and diversification of economic activity.
The facility has two pillars:

- Expanding financing options to SMEs in Armenia including equity and quasi-equity (around EUR 11mln is planned to spend for achievement results of this component).

Component, including the creation of a private equity fund, expected to make investments in eligible Armenian SMEs over a five-year investment period
- Providing advisory services to SMEs in order to promote competitiveness and innovation and enable businesses to grow and to attract further investment (EUR 4mln will be spentunder this component). Particular focus will be on investment readiness to help targeted SMEs to access the financing they need to grow.
- Beneficiaries of the Facility are SMEs operating in all regions of Armenia.

Total budget: € 15 380 000 (EU funded)
Duration: 2017 – 2029
Location: All marzes/regions of Armenia

Rural Economic Development – New Economic Opportunities (RED- NEO) Program
Total budget: USD 4 000 000
Implementing organisation: Center for Agribusiness & Rural Development (CARD), AM Partners Consulting, Armenian Women for Health and Healthy Environment NGO, and Hicks Burnham and Williams LLC
Duration: 2019 – 2024
Location: At least 60 communities in all marzes/regions of Armenia

The RED-NEO project launch was in April 2019. RED-NEO activities will promote inclusive, sustainable economic security and economic growth by supporting at least 100 businesses in at least 60 communities. The program will accelerate the growth of small- and medium-sized enterprises (including farms and cooperatives) in the regions; facilitate market linkages between producers and buyers; and establish networks to promote local economic development. It will foster the development of a competitive agriculture sector by improving the performance of rural businesses and cooperatives, and their ability to meet quality standards.
The project is currently in the stage of identifying target communities and analysing their needs. However, harvesting of herbs and production of organic herbal teas are considered as one of possible sectors, where the project will intervene.

German Nature and Biodiversity Conservation Union (NABU): Free Organic Certification
Implementing organisation: NABU and ACBA-CREDIT AGRICOLE BANK
Duration: Annually
Ocation: All marzes/regions of Armenia

German Nature and Biodiversity Conservation Union and ACBA-CREDIT AGRICOLE BANK signed a cooperation agreement on February 20, 2015. Within its framework, a project for the development of organic agriculture is being implemented annually.
The project is aimed at development of organic products' market in Armenia and export promotion. Every year an organic certification contest is being organized.
The support includes assistance for organic certification, as well as in participation in exhibitions and trade fairs.

BSB opportunities and EU programmes
Enterprise Europe Network

The Enterprise Europe Network is a European initiative, aimed at providing innovation and business support to all businesses across the European Union and beyond. The EEN comprises of around 600 partners in more than 60 countries offering a wide range of services to businesses.

Starting from 2016, the Small and Medium Entrepreneurship Development National Center of Armenia in consortium with the National Academy of Science of the Republic of Armenia, hosts the Enterprise Europe Network in Armenia.

The activities of EEN in Armenia are directed to the internationalization of Armenian entrepreneurship and to development of their capacity for entering the European market. Main services offered by the EEN Armenia include:

- Sharing information on European legislation, policies, standards, possible sources of financing, business cooperation opportunities and other EU issues,
- Supporting SMEs to identify potential business partners and to establish new business cooperation in the European market,
- Dissemination of business and technological profiles of Armenian businesses in foreign countries,
- Provision of information and consultation on intellectual property rights and further commercialization issues,
- Organization of business cooperation events and support in organization of meetings with potential partners.

In order to promote the international cooperation, the Enterprise Europe Network periodically organizes regional, national and European level events. Information on these events can be found here: http://een.ec.europa.eu/tools/services/EVE/Event/ListEvents.

Detailed information on EEN activities in Armenia can be found on the official website of the project "Enterprise Europe Network Armenia" http://eenarmenia.am/.

Implementing organisations: SME Development National Center of Armenia
Duration: since 2016
Location: All regions/marzes of Armenia

EU4Business – Eastern Partnership: Ready to Trade

The overall objective is to enhance the international trade of SMEs from the six Eastern Partnership countries, in particular with the EU, strengthening SME competitiveness and building up value chains in each country.

The project helps small and medium-sized enterprises from Eastern Partnership countries integrate into global value chains and access new markets with a focus on the European Union. The intervention will assist SMEs in producing value-added goods in accordance with international and EU market requirements; while linking them with buyers from global value chains and markets. As part of this process, the assistance will improve sector specific services to SMEs along the selected value chains by strengthening the capacity of local business support organisations.

In Armenia, the project primarily supports the agro-processing sector, focusing on **processed fruits and vegetables, dried fruits and vegetables**, **and herbs/teas**, assisting exporting and export-ready SMEs along the whole value chain. The support will be directed to helping companies access the EU market through targeted capacity-building, advisory services and market access activities.

Activities of the project include, but not limited to:

Total budget: € 6 000 000
Implementing organisation: International Trade Centre
Duration: 2017 – 2020
Location: All marzes/regions of Armenia

European Fund for Southeast Europe (EFSE)

Implementing organisation: Kreditanstalt fur Wiederaufbau (KfW), Finance in Motion GmbH
EU contribution: *€ 5 100 000*
Duration: **2009 – 2021**
Location: **All marzes/regions of Armenia, Eastern Partnership countries**

The Fund aims to foster economic development and prosperity in the Southeast Europe and in the European Eastern Neighbourhood regions through the sustainable provision of additional development finance, notably to micro and small enterprises and private households, via qualified local financial institutions.
The fund provides small loans, including in local currency, and assistance to micro (fewer than 10 employees) and small (fewer than 50 employees) enterprises, as well as to low-income private households. Support is available to MSEs in sectors such as agriculture, industry, trade and services.
The EFSE operates through local partner lending institutions, including commercial banks, microfinance banks, microcredit organisations and non-bank financial institutions such as leasing companies. Partner organisations in Armenia are:

- ACBA Credit Agricole Bank CJSC
- Araratbank CJSC
- Inecobank CJSC
- "ACBA Leasing" Credit Organization CJSC

Detailed information and country contacts can be found at https://www.efse.lu/

Women in Business
Implementing organisation: European Bank for Reconstruction and Development
Total budget: *€ 5 035 000*
Duration: *2012 – 2022*
Location: *All marzes/regions of Armenia, other Eastern Partnership Countries*

The objective of the programme is to promote women's entrepreneurship and access to finance, and more broadly women's participation in business, by facilitating access to finance and advice for women-led SMEs.
Programme is specifically focused on women-led SMEs - businesses with fewer than 250 employees and less than €50 million in annual turnover or with a balance sheet total of less than €43 million. For a business to qualify for this programme, overall operational management responsibility for the company should be held by a woman, who may also partially or wholly own the business.
The Women in Business programme helps women-led small and medium-sized enterprises to access the finance and the know-how they need to grow. The EBRD provides access to finance through credit lines to local banks dedicated to develop women-led SMEs, alongside business advice to help businesses become more competitive. The programme also offers training, mentoring and other support to enable women entrepreneurs to share experiences and learn from each other.
The Programme is active in two main areas:

1. Access to finance
   - Dedicated credit lines to participating financial institutions for on-lending to eligible women-led SMEs. Partner financial institutions in Armenia are ACBA-Credit Agricole Bank CJSC, Ameriabank CJSC, Araratbank CJSC, Armeconombank CJSC
2. Access to know-how
   - Business advisory and coaching
   - Training in key entrepreneurial skills
   - Online business diagnostic tool Business Lens
   - Mentoring
   - Networking seminars

There is almost no sector limitation: and women-led businesses in almost every sector and industry can apply for the assistance. The only exception are businesses in banking or financial services, military products or services, gambling or tobacco.
For more detailed information please visit http://www.ebrdwomeninbusiness.com

3.4. Qudruple helix approach in agriculture field

Qudraple helix approach has been identified as an innovative system for the research work to identify the preparedness level of smart farming in Armenia and enhance the active participation and collaboration all of the parties from the four helixes: business, academia, government and civil society. In fact, the success of digital transformation requires active involvement and collaboration of many different parties. While digital large international companies predominantly use transformation in a business context, it also affects other organizations such as governments, public sector agencies and entities, which are involved in tackling societal challenges such as rural livelihood, youth unemployment and agrifood entrepreneurs, by leveraging one or more of these existing and emerging digital technologies. At the farm level, digital agriculture has the potential to contribute to a more economically, environmentally and socially sustainable agriculture and meet the agricultural goals of a country.

To investigate preparedness level of smart farming in Armenia stakeholders mapping has been conducted based on different research methods to define specific investigations and needs. In general, we have collected 103 stakeholders' data from the relevant quadruple helixes based on different research methods to elaborate their data and work profiles.

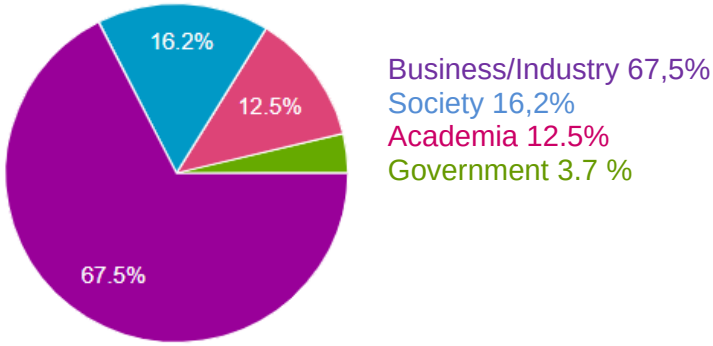


Fig. 22. Quadruple Helix approach in Armenia

The interconnections within the different helixes has been identified during the work. In addition, future interested stakeholders were defined to elaborate survey data and to identify ways for future collaborations. In fact, 47% were identified as registered businesses whereas 33% were unregistered local farmers (Fig. 24). It is one of the country's agriculture peculiarities, to conduct farming without state registration. Overall, the both comprise 80% of the mapped stakeholders within the project. Business Helix comprises almost all-different type of organizations such as local farmers (unregistered), IE (individual entrepreneurs), LLC, CJSC and Cooperatives (Fig. 23).

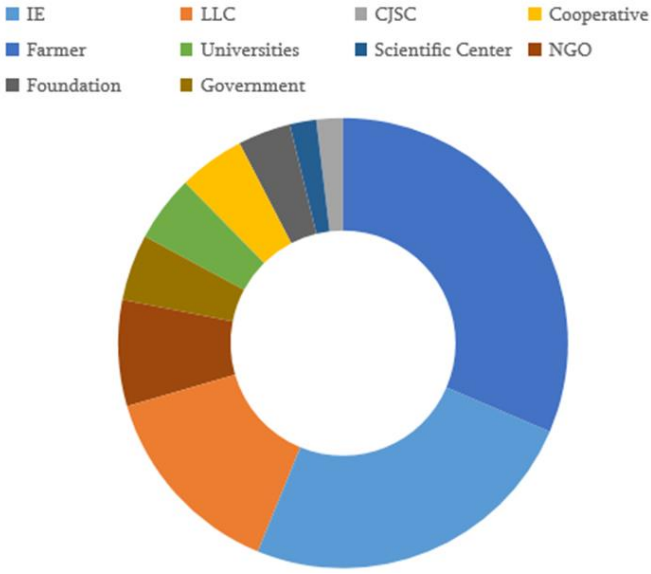


Fig. 23. Digital agriculture map in Armenia

In the total number of civil society to comprise 10%, the NGO is 8% and Foundations to apt at civil society are 2% (Fig. 23 and Fig. 24). In addition, 2% of the Foundations are relevant to the academia (*see* Fig. 24*).* The universities or scientific centres in Armenia are allowed to register as a foundation except the university to keep different form of making their activities and profiles work to be possible and more versatile.

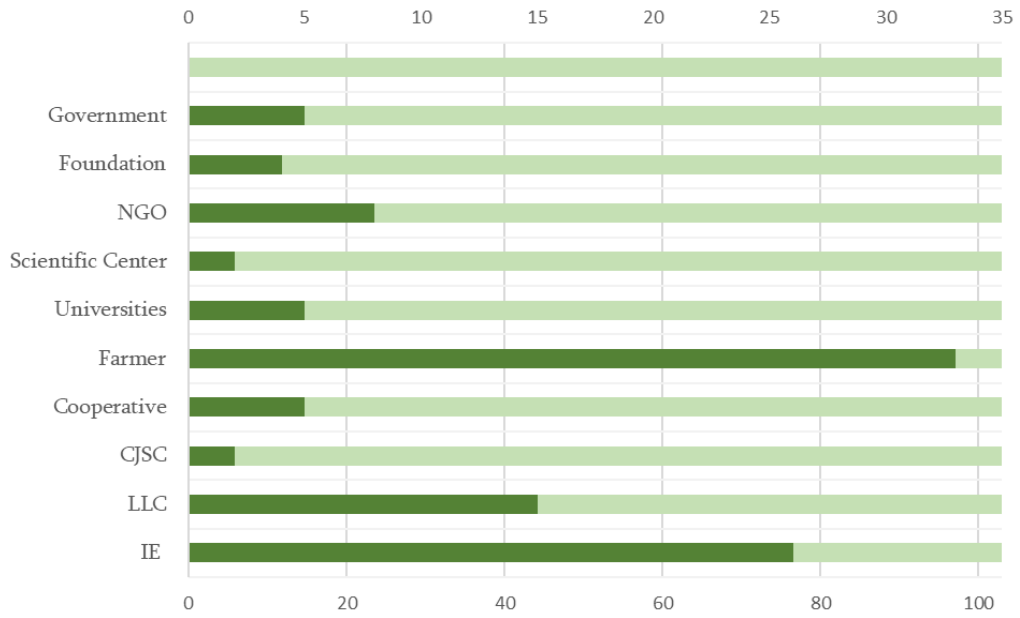


Fig. 24. Distribution of digital agriculture stakeholders in Armenia

Research academia helix requires 5% participants in respect to the project. However, the percentage of academia helix is 7% to encompass 3 higher education institutions, 2 highly tech developed and internationally recognized STEM education centers, and 2 scientific centers (Fig. 22 and Fig. 23).

Also, it has been defined 2 Ministries, Ministry of Economy and Ministry of High Tech Industry of the RA to collaborate and enhance a policy for smart farming development in Armenia. Too, 3 local authorities, communities and municipalities has been involved within the mapping.

The survey form requires at least 50 stakholders to identify the the level of preparadness of smart farming in Armenia. However, 87 organizations took part in the survey. 78.2 % of them are private organizations and just 21.8 % are public. 67, 8 % from all organizations are non-commercial and 32, 2 % are commercial. Only 13, 8 % of total surveys belong to non-governmental organizations. The organizations that participated in the survey are mainly involved in the following areas:

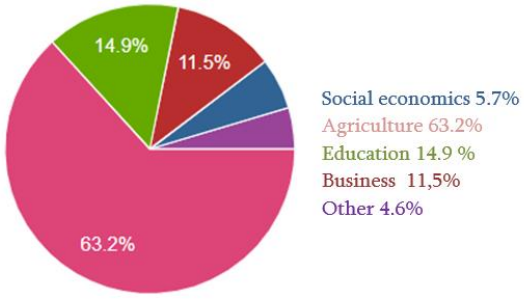


Fig. 25. Field of activity

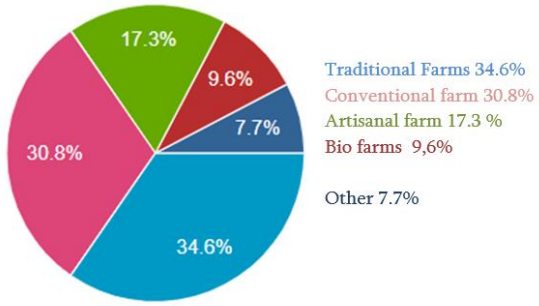


Fig. 26. Type of farm

As can be seen from the diagram, the majority of participants (63.2 %) are involved in agriculture work. 69.9 % of total surveys is farm, from which 41.3% are unregistered farms and 28.6 % are registered farms. Different types of farms were involved: 34.6 % traditional farms, 30.8 % conventional farms, 17.3 % artisanal farms, 9.6 % bio farms and etc. All of these farms also differed in size. Large farms (>10 ha) are a small part of the total, only 3%. Majority of farms (36.4%) are marginal and have a very small area, less than 1 ha.

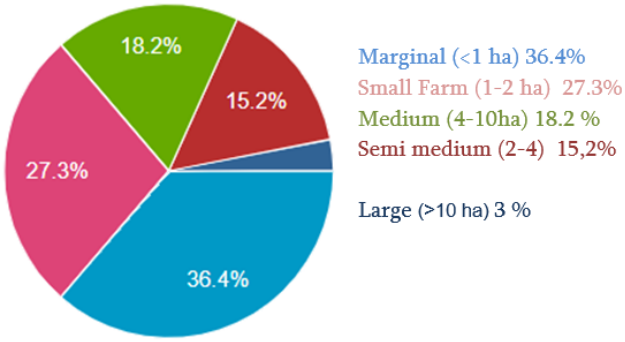


Fig. 27. Farm sizes

3.5. Smart and IoT technologies existent in Armenia

Smart Technologies provided assessment show that just a few farmers apply smart technologies. Local public authorities are mainly municipalities and also local agencies and servicies. Regional and national public authorities had not been included.
According to the representatives of the scientific-educational sphere, most of the respondents were Education/Training Centers, than Higher education organizations. Have been done investigation on level of preparedness for smart farming. Surveys show that participants are well informed about smart farming applications, such as: water deficit detection and control, climate conditions monitoring, crop menegment, pests and diseases detection, cattle monitoring etc.

Results show that already we have applied smart technologies in different farms. These include automated systems, data or images from sensors, digital maps, and global positioning systems and, most interestingly, drones. 85.9 % of all participants think that smart farming is increasing productivity, 78.8% - that it gives us high quality products, 75.3% - increased profit etc.
Here is som example of smart and IoT technologies in the country.

Revalcon –Integraded irrigation system. The company develop digtal app and web projects to controle irrigation system.
Garoon tech – The Company presented interesting digital platform for agricultural extention in the country.
Smart farm experimental center at Stepanavan, Lori Regions in Armenia. The smart farm aims to decrease the inventory capital and increae the cattle growing profits with milk and mieat production up to 30-50%. The farm was set up by the financial support of CARD and ADA.
The interview and desc research has defined that Smart technologies and IoT tools has been widely applied in Greenhouses since 2010. For instance, Priva Connext digital controle is one of them.

Overview of ICT infrastructure in Armenia
In respect with the International Telecommunication Union (ITU) Measuring the Information Society Report 2017, 64.7 % of households had computers, 60.5 % had Internet access, and 62 % of individuals used the Internet in Armenia. In addition, according to Social Snapshot and Poverty in Armenia (2018), published by the Statistical Committee of the Republic of Armenia, in 2017 96.7 % of the population had mobile phones and 88.8 % had access to a mobile Internet connection. Armenia was one of the first countries to launch LTE in the CIS region. It has a high level of mobile-broadband coverage: 3G is available to almost 100 %of the population and LTE coverage is above the CIS region average. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population is 4.42 on a scale of 7. Armenia is ranked sixty-first in terms of the Global Competitiveness Index indicator “Future orientation of government” (with a value of 3.84 on a scale of 7).

Services, applications, knowledge sharing
The main body behind the organization of e-governance tools in Armenia is Ekeng CJSC (e-Governance Infrastructure Implementation Unit), which is responsible for planning, developing and maintaining e-governance solutions. At present, ICTs are used for e-governance purposes in the land registry, taxation, health and many other sectors (such as law and art), with several of the services being offered for more than eight years. There is as yet no centralized electronic system, but solutions exist in the agricultural sector (agro.am, minagro.am, social media groups, start-ups, among others). The Ministry of Economy is planning to introduce an e-marketing platform that can be used to sell locally produced fresh and processed agricultural products. The e-marketing platform should simplify procedures, promote exports and heighten awareness of Armenian products. In the second half of 2018, the EU-funded FAO ENPARD project, “Technical Assistance to the Ministry of Agriculture of the Republic of Armenia”, which is being implemented with the technical cooperation of FAO, supported government efforts to develop a vision for the national e-agriculture strategy. In the framework of the programme, “Developing the Capacity of Digital Agriculture Strategy in Armenia”, implemented by the FAO, an action plan was developed for three outcomes of Priority 7 (Promote Digital Agriculture and Technology Innovation) of the Sustainable Agricultural Development Strategy (Vision 2029). The digital agriculture strategy and action plan are to be implemented during 2020. FAO continues to support the development of the action plan for digital agriculture in 2020.

3.6. Agricultural needs of the rural communities in Armenia

An analysis of the agricultural field by sectors was also carried out. Almost all farmers involved in agriculture are engaged in crop production. More than half are involved in livestock production. Small part is involved in agricultural economics and engineering.

From Crop production, sector farmers mainly cultivate fruits and nuts. Vegetable plants, then grapes and grains occupy the second place. Analysis of Livestock production sector shows as that main type of livestock are cattles, then poultries, pigs. A small number of farmers are engaged in sheep breeding. The main directions of the agricultural economics sector are development of economy, development of rural communities and agrobusiness.

Agricultural engineering includes workshops, energy & energy efficiency, farm equipment, agricultural machinery etc.

About question, do farmers from their territory would like to adopt smart farming technologies, there is no one participant who thinks that they would not like to apply them. All confidently think that these are applicable technologies and they should be applied in crop and livestock production.

In the crop production field it's mainly connected with irrigation systems, fertilisations and crop protection, soil and field analyses, prycision mechanical weeding. Farmers are less motivated to use drones, due to its high cost.

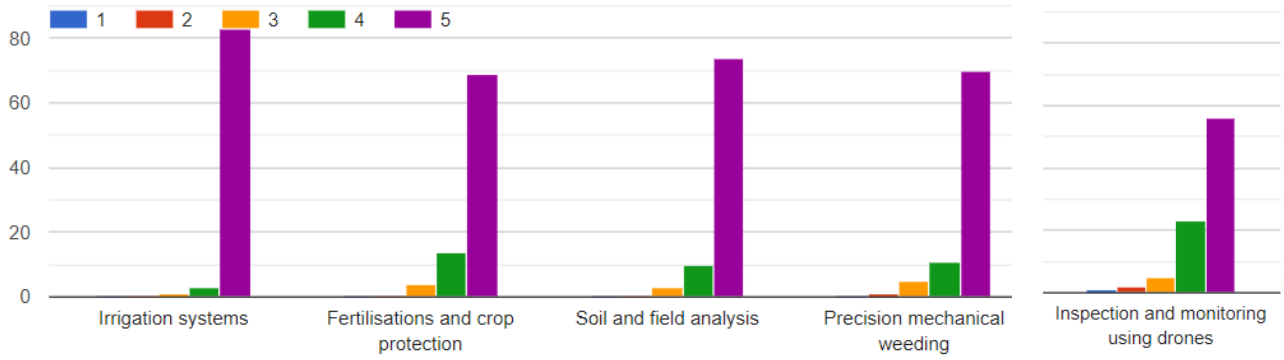


Fig. 28. Needs of Smart Farming technologies in the Crop production, scale from 1to 5

In the livestock production field it include cattle/sheep health monitoring, feeding or drinking control, milking automated systems and etc. The results shows that farmers have more needs on cattle health monitoring, feeding control, milking automated systems rather than animal indoors tracking or barn monitoring.

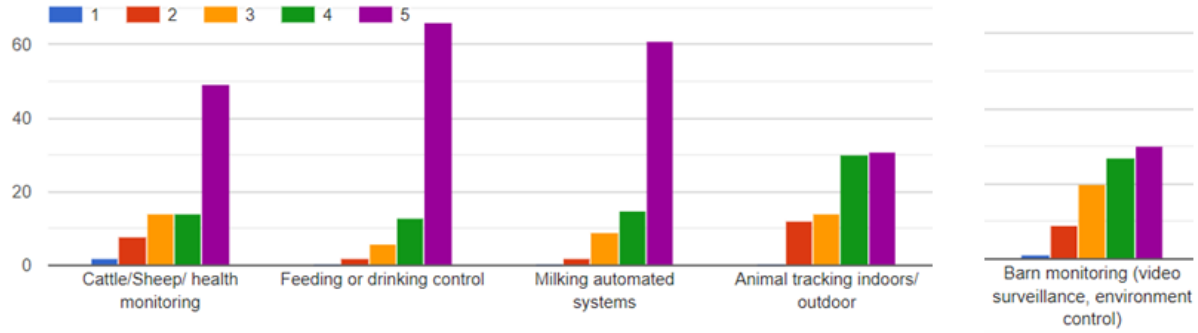


Fig. 29. Needs of Smart Farming technologies in the livestock production, scale from 1 to 5

In the Agriculrural, economic specific field the main emphasis is on Commodity Trading/Markets.

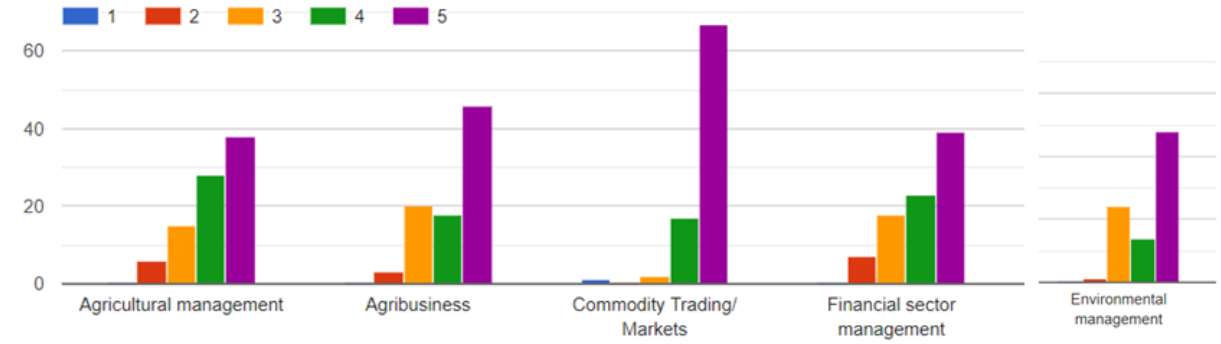


Fig. 30. Needs of Smart Farming technologies in the Agriculrural economic, scale from 1to 5

Finnaly, in the Agriculture engineering field are important IoT and sensors, Automation and robotic systems, Machine to machine communication, predictive analytics tools and systems, cloud computing and big data analysis and processing.

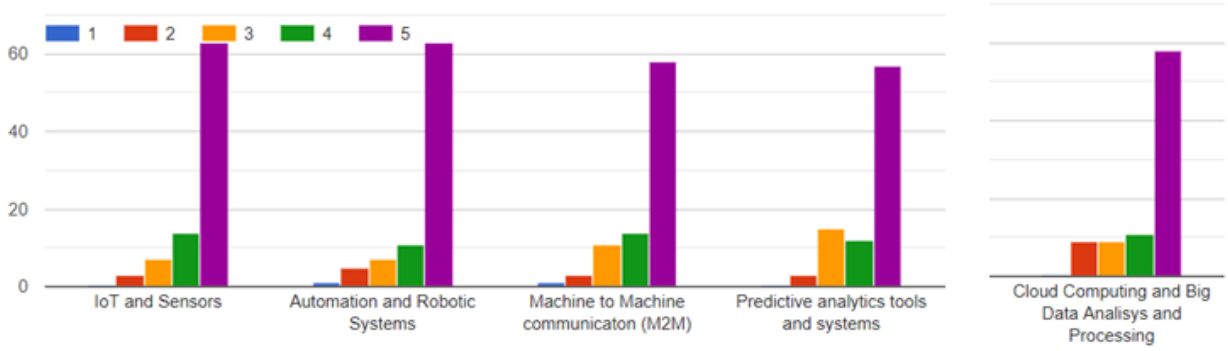


Fig. 31. Needs of Smart Farming technologies in the Engineering, scale from 1to 5

60,9 % of participants think that smart technologies and IoT can lead to proper management of the agriculture field and answer to other main socio-economic challenges, such as the brain drain, youth unemployment and brain waste.
Best practices exchange between farmers, training activities and on-farm demonstration are acceptable by participants to promote smart farming within the farming community in the territory. Information campaigns and online events (workshops, webinars) are not much encouraged.

3.7. Conclusions and recommendations

Smart farming solutions may lead to the development of agricultural sector in Armenia including all value chains of involving diverse processing and fields. Although the research study reveals the ICT infrastructure of Armenia is relatively high, however the farmers have weak knowledge in usage of IoT and ICT. Partially due to the aging problem, in agriculture the average age is above 35 years, which limits elder people to access IoT and ICT tools.

The project will give an oppertunity through the workshops, on cite vists or/ and field excursions to exchange their knowldge and skills on smart technologies and IoT tools. The increased capacities of farmers, as well as the large application of smart technologies will enable to solve the aging problem in the farming system. In its turn, this will decrease the shrinking populations from rural ares to the urban areas.

The study shows that most interesting parties within the serveys were farmers with small lands. Thus it is essential to create some IoT solutions for generating communties, or increasing social enterprises within agroecosystems.

There is need to create digital farmer register, digital systems for counting and registering livestock, development and application of a centralized database of technical and economic performance indicators and standards in the agricultural sector etc.

In fact, the great aim of this study is to identify ways of covering knowldge and information gaps between different partties of agricultural field. Quadruple Helix approach is used first time in Armenia and definately will enhance the successful widespreading of smart technologies and IoT tools implemantions within the country's agriculture.

Chapter 4. Romania's regional analysis

4.1. Romania's background / situation

Romania is a country located at the crossroads of Central, Eastern, and South-eastern Europe. It shares land borders with Bulgaria to the south, Ukraine to the north, Hungary to the west, Serbia to the southwest, and Moldova to the east and has its opening to the Black Sea. The area is of 238,391 km^2 and comprises: 61.3% agricultural land (approx. 14,6 mil. ha, of which 64.2% arable land, 32.9 % meadows and natural grasslands and 2.7% plantations of trees and vineyard); 28.3% forests and other forestry vegetation lands; 10.4% the built area of the localities, waters, roads, railways and unproductive lands. From the point of view of its area, Romania is an average country in EU 27 (5.41% of the area EU27). The territory of Romania includes 5 bio-geographical regions (steppe, Black Sea, Pannonia, continental and alpine) of the 11 European bio-geographical regions. Out of the total area of the country, around 87.1% is the rural area (according to the definition from the national legislation) that comprises communes, as administrative-territorial units, together with its component villages, and on this territory 45.0% of the Romanian population lived in 2012. The allocation per geographical area is balanced: 33% plain area (up to 300 m altitude), 37% hill area (300- 1000 m) and 30% mountain area (over 1000 m altitude).

The economy of Romania is a fast developing, high-income[1] mixed economy with a very high Human Development Index and a skilled labour force, ranked 12th in the European Union by total nominal GDP and 7th largest when adjusted by purchasing power parity[2]. Romania's economy ranks 35th in the world, with a $585 billion annual output (PPP). In recent years, Romania enjoyed some of the highest growth rates in the EU: 4.8% in 2016, 7.1% in 2017, 4.4% in 2018, and 4.1% in 2019[3]. In 2019 its GDP per capita in purchasing power standards reached 69% of the European Union average, up from 44% in 2007, the highest growth rate in the EU27[4]. According to the European Commission, Eurostat, and Directorate General for Economic and Financial Affairs, Romania has the following main figures.

Romania Main figures - 2019		
Population (1st January)	19 414 458	persons
Area*	238 398	km^2
Currency	RON	leu
Nominal GDP at current prices	223 335	million EUR
GDP per capita at current prices	11 504	EUR
GDP per capita at purchasing power	21 579	PPS
Harmonised index of consumer prices	3.90%	change over previous year
Unemployment rate	3.9	% of labour force
Exports (goods & services)	90119	million EUR (current prices)
Imports (goods & services)	98733	million EUR (current prices)

[1] "World Bank Country and Lending Groups". datahelpdesk.worldbank.org. World Bank. Retrieved 1 July 2020.
[2] "World Economic Outlook Database October 2018 -- WEO Groups and Aggregates Information". Retrieved 28 April 2019.
[3] "World Economic Outlook Database, April 2020". IMF.org. International Monetary Fund. Retrieved 16 April 2020.
[4] "GDP per capita in PPS". ec.europa.eu/eurostat. Eurostat. Retrieved 30 April 2020.

Romania Main figures - 2019		
Balance (goods & services)	-8615	million EUR (current prices)
Exports of agricultural products	7196	million EUR
Imports of agricultural products	8379	million EUR
Current account balance	-4.6	% of GDP
General government balance	4.3	% of GDP
General government gross debt	35.2	% of GDP

Romania is a traditional agricultural country and plays a unique and important part in European agriculture. The soil is fertile and the climate is favourable for agriculture, animal husbandry and horticulture. With a total area of 238.000 sqm, Romania is one of the countries of the most pronounced agrarian profile in the European Union. Having about 15 million ha of farmland, of which more than 9 million ha devoted to arable crops, Romania owns almost 1/3rd of the total agricultural land in the EU (33.5% of all EU farms - EU Commission updates, April 2017). Within a geographical, administrative and socio-economic predominantly rural space, the agriculture has been and continues to be a sector of prime importance in Romania, 66% of Romanian territory being taken up by agriculture with 46% of the population living in predominantly rural regions. At the same time the sector's contribution to the economy and the share of employment play a significant role in the overall Romanian economy[5].

According to the same European Commission, Eurostat, and Directorate General for Economic and Financial Affairs, Romania's macroeconomics rely on the data presented in the following table.

Table 4. Macroeconomics

Population (new European Commission methodology)			
Total population (number of persons), of which:	2019	19 414 458	4.4%
in predominantly rural regions (PR)	2019	53.2%	20.5%
in intermediate regions	2019	34.9%	39.1%
in predominantly urban regions	2019	11.9%	40.4%
Population in PR regions (number of persons)	2019	10 328 508	11.4%
GDP			
In EUR (current prices): total (million EUR)	2019	223 335	1.6% 31
GDP per capita (EUR/person)	2019	11 504	094
GDP per capita (PPS/person)	2019	21 579	31 744
Real GDP growth rate (% change over previous year)	2019	4.1%	1.5%
Gross value added			
Agriculture, forestry and fishing (% of total GVA)	2019	4.5%	1.8%
Financial aspects			
Agricultural expenditure			
Total expenditure (million EUR), of which:	2019	3 031.7	5.6%
Direct payments (%)	2019	60.9%	70.0%
Market measures (%)	2019	1.4%	4.5%
Rural development (%)	2019	37.7%	25.5%
Economic accounts of agriculture			
Agricultural output			

[5] Agriculture in Romania, Flanders Investment & Trade Market Survey, 2017

Agricultural goods output (million EUR), of which:	2019	17 641.2	4.4%
Crop output, of which:		75.5%	6.2%
Cereals (including seeds)		26.6%	10.0%
Industrial crops		8.7%	8.5%
Forage plants		8.8%	6.6%
Vegetables and horticultural products		16.9%	5.2%
Potatoes		6.7%	8.5%
Fruits		6.1%	4.1%
Wine		1.6%	1.3%
Olive oil		0.0%	0.0%
Animal output, of which:		22.6%	2.5%
Cattle		1.2%	0.7%
Pigs		5.4%	2.4%
Sheep and goats		1.0%	4.3%
Poultry		2.8%	2.5%
Milk		5.9%	1.9%
Eggs		4.3%	8.5%
Gross value added at basic prices (million EUR)	2019	8 980.2	5.1%
Agricultural input			
Total intermediate consumption (million EUR)	2019	10 147.8	4.3%
Agricultural income			
Indicator A (% change over previous year)	2019	10.2%	2.4%
Farm structure			
Holdings			
Total (No), of which:	2016	3 422 030	33.3%
UAA < 5 ha (%)	2016	91.8%	66.6%
Economic size < 4 000 €	2016	84.6%	54.9%
Holder < 35 years (%)	number	3.1%	5.1%
Holder > 64 years (%)	number	44.3%	32.8%
UAA per holding (ha)	Total	3.7	15.2
Labour force			
AWU (No)	2016	1 640 120	18.6%
Female farm holders (%)	2016	33.8%	30.7%
Male farm holders (%)	2016	66.2%	68.8%
Agriculture in % of total employment	2019	19.1%	4.1%

In 2019, the Romania's situation, in the predominantly rural regions, intermediate and predominantly urban regions, in terms of population, territory, Gross Asset Value - GAV (Million EUR) and employment (persons), is presented in figure 1.

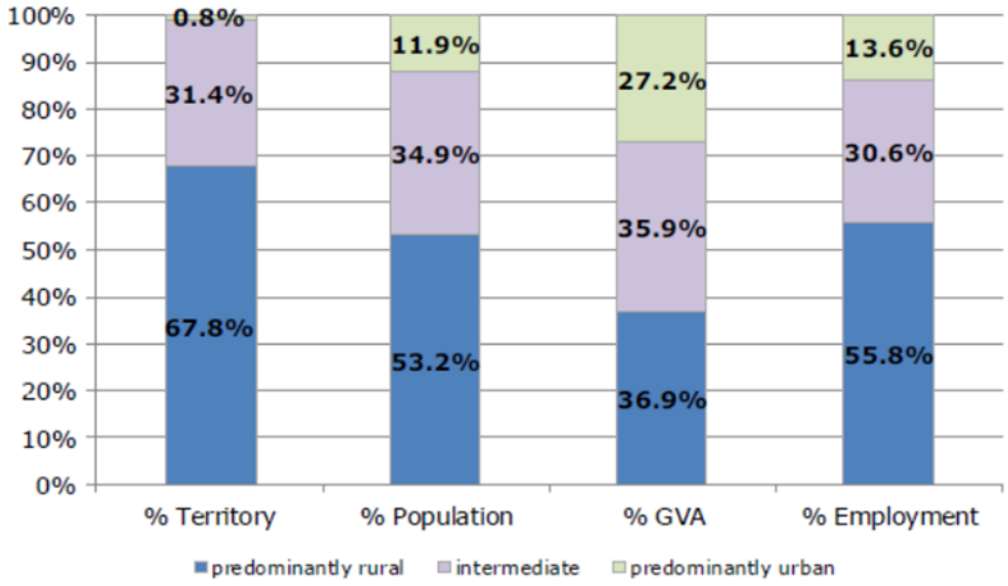


Fig. 32. Importance of rural areas

From the point of view of financial aspects, in terms of Common Agricultural Policy (CAP) expenditures from 2019, the *direct payments* (olive oil, textile plants, fruit and vegetables, wine sector, promotion, other plant products/measures, milk and milk products, beef and veal, sheep meat and goatmeat, pig meat, eggs, poultry and other school schemes), *market measures* and *rural development*, the distribution of Romania in comparison with the EU27 is presented in figure 2.

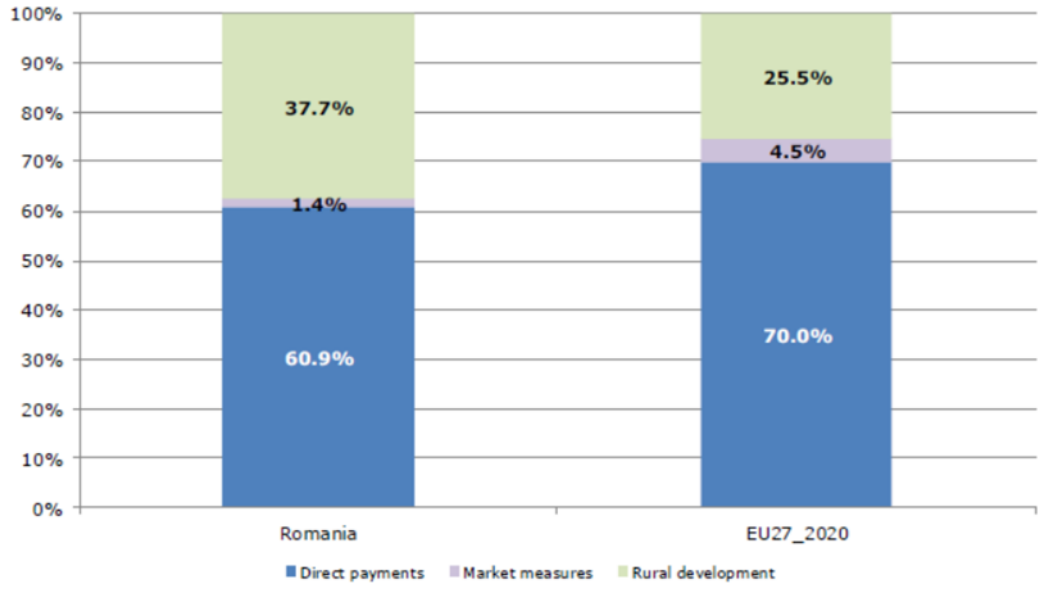


Fig. 33. Distribution of CAP expenditure

In 2018, the distribution of direct aids to the producers is presented in figure 2.

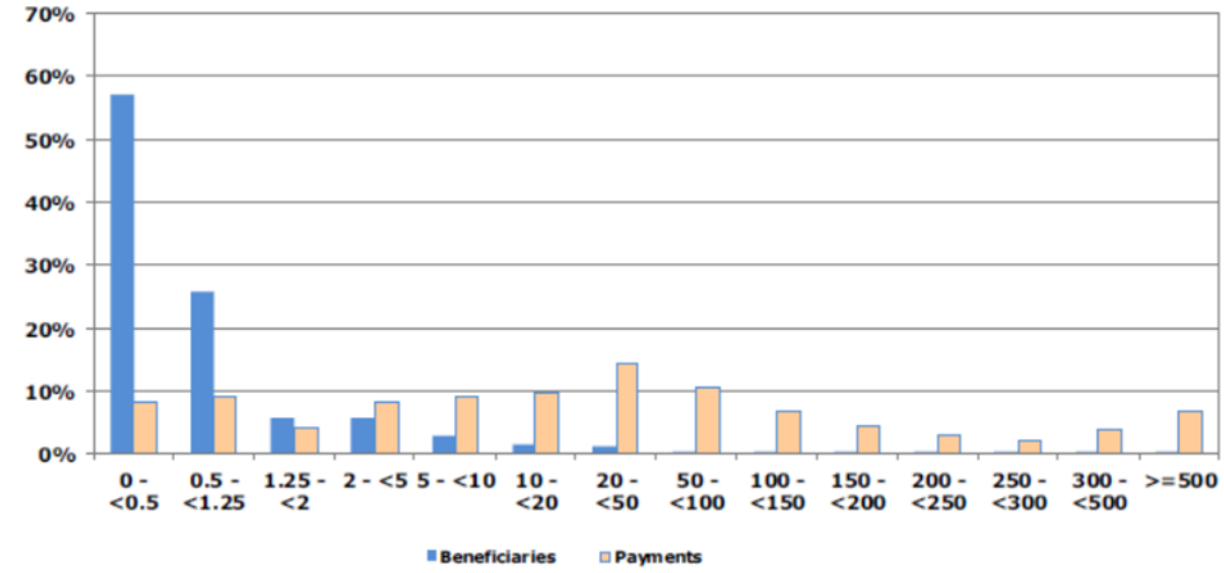


Fig. 34. Indicative figures on the distribution of direct aid by size-class of aid (1 000 EUR)

From the agricultural inputs, outputs and income, point of view the Romania's agriculture economical accounts can be resumed in the following tables.

Table 5. Agricultural output

Output components (constant prices)	2017	2018	2019		
	Million EUR		Million EUR	% of total	% of EU27_2020
Cereals:	**3519**	**1073**	**3728**	**27.10%**	**8.90%**
Wheat and spelt	1248	1245	1212	9%	6.10%
Rye and meslin	3	3	4	0%	0.40%
Barley	281	277	287	2%	3.70%
Oats and summer cereal mixtures	68	60	45	0%	3.80%
Grain maize	1874	2442	2137	16%	22.80%
Rice	8	8	8	0%	1.00%
Other cereals	36	37	35	0%	1.90%
Industrial crops:	**1563**	**1408**	**1220**	**8.90%**	**7.60%**
Oil seeds and oleaginous fruits	1353	1261	1037	8%	12.30%
Protein crops	147	91	128	1%	11.90%
Raw tobacco	1	1	1	0%	0.20%
Sugar beet	29	23	31	0%	0.90%
Other industrial crops	32	33	31	0%	0.80%
Forage plants	**1140**	**1208**	**1227**	**8.90%**	**5.80%**
Vegetables and horticultural products	**1894**	**2035**	**2369**	**17.20%**	**4.50%**
Potatoes	**766**	**737**	**851**	**6.80%**	**7.50%**
Fruits	**919**	**1200**	**227**	**2.00%**	**3.50%**
Wine	**277**	**301**	**227**	**2.00%**	**1.10%**
Other crop products	**32**	**22**	**15**	**0.00%**	**0.70%**
Crop output	**10110**	**10985**	**10573**	**77.00%**	**5.40%**
Animals:	**1666**	**1481**	**1449**	**10.50%**	**1.70%**
Cattle Pigs	252	229	166	1.20%	0.70%
Equines	810	692	756	5.50%	2.10%
Sheep and goats	27	8	6	0.00%	0.70%
Poultry	410	39 2	3 86	2.80%	2.20%
Animal products:	**1843**	**1676**	**1713**	**12.50%**	**2.90%**

Output components (constant prices)	2017	2018	2019		
	Million EUR		Million EUR	% of total	% of EU27_2020
Milk	933	775	825	6.00%	1.70%
Eggs	601	588	605	4.40%	7.50%
Other animal products	309	313	283	2.10%	11.70%
Animal output	**3 509**	**3157**	**3161**	**23.00%**	**2.20%**
Agricultural goods output	**13169**	**14141**	**13734**	**100.00%**	**4.00%**

Table 6. Agricultural input

Input components	2017	2018	2019	2018/2017	2019/2018
	Million EUR			% Change	
Seeds and planting stock	690.7	685.2	686.7	-0.8%	0.2%
Energy	1 625.9	1 955.2	1 697.0	20.3%	-13.2%
Fertilisers and soil improvers	586.6	517.9	535.1	-11.7%	3.3%
Plant protection products	284.7	283.4	232.2	-0.5%	-18.1%
Veterinary expenses	212.6	210.2	192.3	-1.1%	-8.5%
Feeding stuffs	2 314.7	2 206.6	2 205.2	-4.7%	-0.1%
Maintenance of materials	605.5	657.9	502.4	8.6%	-23.6%
Maintenance of buildings	89.5	94.6	90.8	5.7%	-4.1%
Agricultural services	179.6	220.7	266.3	22.8%	20.7%
Other goods and services	1 598.8	1 687.7	1 621.1	5.6%	-3.9%
Total intermediate consumption	**8 216.8**	**8 545.9**	**8 053.6**	**4.0%**	**-5.8%**
Fixed capital consumption	**2 266.1**	**2 347.6**	**2 308.7**	**3.6%**	**-1.7%**

Table 7. Agricultural income

Values at basic prices	2017	2018	2019	2018/2017	2019/2018
	Million EUR			% Change	
Output of the agricultural "industry":	**14 912.6**	**15 494.5**	**15 180.6**	**3.9%**	**-2.0%**
Crop output	10 110.3	10 984.6	10 573.0	8.6%	-3.7%
Animal output:	3 508.6	3 156.7	3 161.4	-10.0%	0.1%
Animals	1 665.6	1 481.1	1 448.9	-11.1%	-2.2%
Animal products	1 843.0	1 675.6	1 712.5	-9.1%	2.2%
Agricultural services	179.6	220.7	266.3	22.8%	20.7%
Secondary activities	1 114.0	1 132.5	1 180.0	1.7%	4.2%
- Intermediate consumption	**8 216.8**	**8 545.9**	**8 053.6**	**4.0%**	**-5.8%**
= Gross value added at basic prices	**6 695.8**	**6 948.6**	**7 127.0**	**3.8%**	**2.6%**
- Consumption of fixed capital	2 266.1	2 347.6	2 308.7	3.6%	-1.7%
- Taxes	18.8	17.8	16.6	-5.6%	-6.8%
+ Subsidies	2 167.9	1 997.8	2 035.1	-7.8%	1.9%
= Factor income	**6 578.8**	**6 580.9**	**6 836.8**	**0.0%**	**3.9%**
Agricultural income* (2010=100)	**136.6**	**139.3**	**153.4**	**1.9%**	**10.2%**

From the incomes generated by the Romania's agricultural sectors, the distribution on each category is presented in figure 4.

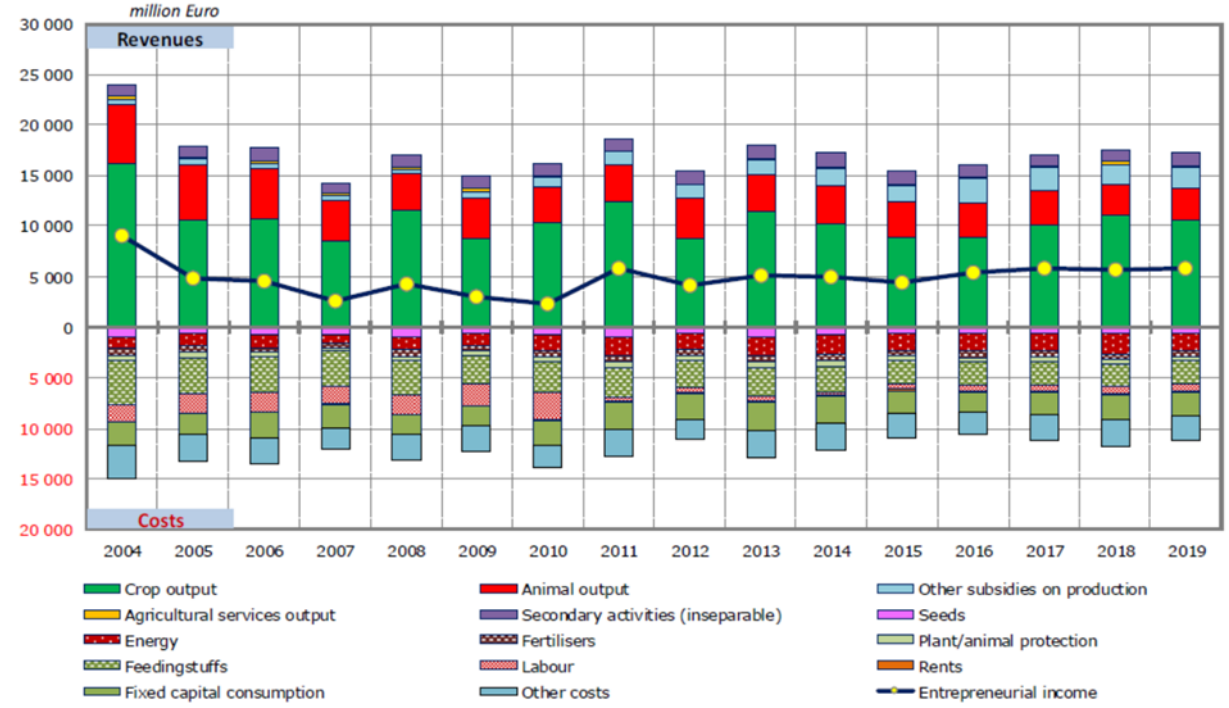


Fig. 35. Agricultural income (real prices)[6]

The generally upward development of agricultural factor income per annual work unit since a low in 2007 continued in 2019, increasing slightly (+1.0 %) to a new peak. The output value of the agricultural industry rose (+2.2 %) in 2019 to EUR 19.0 billion; more than two thirds (70.0 %) of this total value came from crop products.

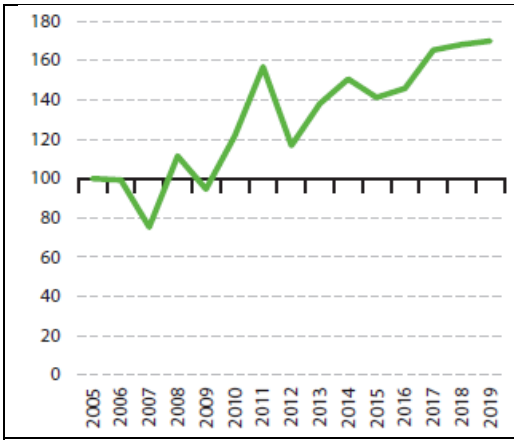
The total cereals harvest in 2019 was lower (−3.6 %) than in 2018, as a fall in grain maize and corn-cob-mix (−6.6 %) outweighed smaller increases for other large crops; this was the first contraction in the cereals harvest since 2015. Most other crops also experienced a fall in harvested production: oilseeds (−6.9 %, again the first contraction since 2015), fresh vegetables (−8.9 %), root crops (−11.4 %), plants harvested green (−12.2 %) and fruits (other than citrus fruits and grapes), berries and nuts (−18.4 %).

There was a sharp fall in the production of pig meat (−6.2 %) in 2019, in contrast to increased poultry meat production (+6.6 %). Whereas the price for pigs increased (+9.6 % in real terms), prices for cattle (−1.7 %) and poultry (−1.3 %) fell. Production of raw milk declined further (−2.3 %), the level in 2019 being 464 000 tonnes less than in 2014 in part reflecting the fact that the dairy herd declined by 50 000 head during the same period. The average real-terms price of milk in 2019 was higher than a year earlier (+3.3 %).

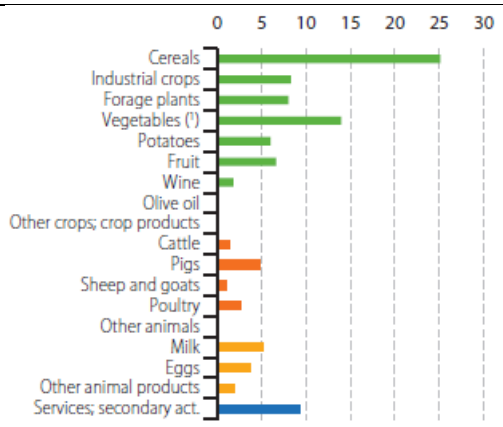
The slight fall (−0.3 %) in output prices in real (deflated) terms for cereals as a whole in 2019 was principally due to a fall for grain maize (−3.2 %). The decrease (−3.4 %) for oilseeds reflected relatively large falls for soya (−8.1 %) and sunflower seeds (−5.0 %). Most of the other major crops that had lower levels of production in 2019 experienced higher prices, for example, potatoes (+47.7 %), grapes (+16.3 %), fresh fruit (excluding citrus fruit and grapes; (+11.3 %), and fresh vegetables (+8.1 %).

[6] Directorate General for Agriculture and Rural Development, based on COMEXT data

Key Information	Year	Value	Unit	Share of EU-27 total (%)
Population on 1 January	2019	19.4	million	4.3
Land area	2016	234 270	km²	5.7
Farmland	2016	125 025	km²	8.0
Share of farmland in land area	2016	53.4	%	–



Index of agricultural factor income per annual work unit, 2005-2019 (2005 = 100)
Note: index rescaled from 2010 = 100 to 2005 = 100.
Source: Eurostat (online data code: aact_eaa06)



Output value of the agricultural industry, 2019 (% of total output, at basic prices)
(1) Including also horticultural plants.
Source: Eurostat (online data code: aact_eaa01)

The key indicators for Romania is presented in the table 5, in terms of farms and farmland, farmers, economic performance of agriculture, economic performance of agriculture, agri-environmental, forestry, fisheries indicators.

Table 8. Key indicators for Romania's agriculture

Farms and farmland	Year	Value	Unit	Share of EU-27 total (%)
Farmland: utilised agricultural area (UAA)	2016	12 503	thousand hectares	*8.0*
Farms (agricultural holdings)	2016	3 422 030	number	*33.3*
Share of very small farms (with <EUR 8 000 of standard output)	2016	94.6	%	-

Farmers	Year	Value	Unit	EU-27 average/ total
Employment in agriculture as a share of total employment	2017	22.8	%	*4.5*
Total labour force in agriculture	2019	1 402.0	thousand annual work units	*8 739.7*
Young farmers (under 40 years old) as a share of all farm managers	2016	7.4	%	*10.7*

Economic performance of agriculture	Year	Value	Unit	Share of EU-27 total (%)
Contribution of agriculture to gross domestic product	2019	3.9	%	-
Gross value added (at basic prices)	2019	8 786	EUR million	4.8
Value of agricultural industry output (production value at basic prices)	2019	18 964	EUR million	4.5
Value of crop output	2019	13 269	EUR million	6.0
Value of animal output	2019	3 925	EUR million	2.4
Annual change in agricultural factor income per annual work unit (indicator A)	2019	1.0	%	-

Economic performance of agriculture	Year	Value	Unit	Share of EU-27 total (%)
Area under organic farming as a share of the UAA	2018	2.4	%	8.0
Area under conversion to organic farming as a share of the UAA	2018	1.2	%	4.8
Change in the harmonised risk indicator 1 for pesticides compared with the average for 2011-2013	2018	-52	%	-17

Agri-environmental indicators	Year	Value	Unit	Share of EU-27 total (%)
Cereals (including rice)	2019	30 412	thousand tonnes	10.2
Root crops	2019	3 798	thousand tonnes	2.3
Fresh vegetables	2019	2 384	thousand tonnes	3.9
Permanent crops	2019	2 406	thousand tonnes	3.4
Milk	2019	4 340	thousand tonnes	2.7
Bovine meat	2019	44	thousand tonnes	0.6
Pig meat	2019	343	thousand tonnes	1.5
Poultry meat	2019	482	thousand tonnes	3.6

Forestry	Year	Value	Unit	Share of EU-27 total (%)
Forest and other wooded land	2020	6 945	thousand hectares	3.9
Persons employed in forestry and logging	2017	47.8	thousand annual work units	9.9
Gross value added (at basic prices)	2017	1308	EUR million	5.0
Roundwood (under bark)	2018	10 436	thousand cubic meters	2.8

Fisheries	Year	Value	Unit	Share of EU-27 total (%)
Fishing fleet	2019	1 529	gross tonnage	0.1

Persons employed in fishing and aquaculture	2017	2.0	thousand	1.2
Total catches (major fishing areas)	2019	7 149	tonnes live weight	0.2
Total aquaculture production (quantity)	2018	12 298	tonnes live weight	1.1
Total aquaculture production (value)	2018	34	EUR million	0.9

Source: Eurostat (online data codes: ef_m_farmleg, nama_10_a64_e, aact_ali01, ef_m_farmang, nama_10_gdp, aact_eaa01, aact_eaa06, org_cropar, farm structure survey — 2016, aei_fm_salpest09, aei_pr_gnb, apro_cpnh1, apro_mk_farm, apro_mt_pann, for_area, for_awu, for_eco_cp, for_remov, fish_fleet_alt, fish_ca_main and fish_aq2a) and Food and Agriculture Organization of the United Nations — Global Forest Resources Assessment, 2020

Romania, as member state of the European Union, has experienced a steady growth in the number and size of large farms over the past years. Commercial farms of over 100 hectares represent 0.4% of Romania's farms and altogether control almost 6 million hectares or 47.8% of the country's total farmland. Meanwhile, micro- and subsistence farms of up to 10 hectares account for 97% of farms and operate only 26% of farmland. Top 10 Romanian agroholdings ranging from 15,000 hectares to 57,000 hectares in size control about 2.6% of the country's farmland while 8 companies of this list have foreign owners. The sources of agroholdings' capital include private investors funds from Great Britain, Lebanon, the Netherlands, Italy, etc. Recently, the Romanian government openly supports farmland consolidation by incentivizing smallholders to sell or lease their farmland. The official EU statistics reports that, in 2008-2016, the share of large farms with annual output of over EUR 50,000 rose from 2% to 12% while the volumes of public support allocated to these large farms more than doubled – from 18% to 38% in the structure of total agricultural subsidies in Romania[7,8].

Table 9. Structure of agricultural holdings

Holdings		2010		2016	
		Total	%	Total	%
By UAA (*)	< 5 ha	3 593 830	93.1%	3 140 770	91.8%
	5-10 ha	182 440	4.7%	194 200	5.7%
	10-20 ha	43 610	1.1%	50 210	1.5%
	20-30 ha	9 730	0.3%	10 990	0.3%
	30-50 ha	8 210	0.2%	7 530	0.2%
	50-100 ha	7 480	0.2%	6 010	0.2%
	> 100 ha	13 730	0.4%	12 310	0.4%
By economic size (**)	< 4 000 €	3 424 380	88.7%	2 895 780	84.6%
	< 8 000 €	312 180	8.1%	340 280	9.9%
	< 15 000 €	76 090	2.0%	114 160	3.3%
	< 25 000 €	21 240	0.6%	35 630	1.0%
	< 50 000 €	12 620	0.3%	19 490	0.6%
	< 100 000 €	6 150	0.2%	7 730	0.2%
	< 250 000 €	3 990	0.1%	5 180	0.2%
	< 500 000 €	1 430	0.0%	2 180	0.1%
	≥ 500 000 €	950	0.0%	1 610	0.0%
By LSU (***)	0	1 032 420	26.8%	861 790	25.2%
	0-5	2 688 710	69.7%	2 430 100	71.0%

[7] Feshchenko A., Development of Large-Scale Farming in Romania: The Role of Policies and Reforms, 2020, https://www.largescaleagriculture.com/home/news-details/development-of-large-scale-farming-in-romania-the-role-of-policies-and-reforms/

[8] Hajdu A.,Certan I., Gagalyuk T., Post-transition development of farm structure and implications for Romania. IAMO Forum 2018: Large-Scale Agriculture – For Profit and Society?,2018

Holdings		2010		2016	
		Total	%	Total	%
	5-10	88 150	2.3%	75 380	2.2%
	10-15	19 430	0.5%	19 490	0.6%
	15-20	9 460	0.2%	11 020	0.3%
	20-50	15 680	0.4%	18 790	0.5%
	50-100	3 530	0.1%	3 940	0.1%
	100-500	1 350	0.0%	1 240	0.0%
	> 500	310	0.0%	270	0.0%
By age of holder	< 35 years	280 440	7.3%	105 590	3.1%
	35-44 years	609 610	15.8%	399 850	11.7%
	45-54 years	636 370	16.5%	632 780	18.5%
	55-64 years	868 910	22.5%	765 450	22.4%
	> 64 years	1 463 720	37.9%	1 515 570	44.3%
	not applicable	-	-	2 800	0.1%
Total		**3 859 050**	**100%**	**3 422 040**	**100%**
UAA in 1 000 ha		:		12 503	
UAA (ha) per holding		#N/A		3.7	

According to Eurostat, Farm Structure Survey, updated in June 2020, the structure of agricultural holdings in terms of utilised agricultural area UAA(*), economic size (**) and Livestock units - LSU(***) is presented in table 6. The standard output of an agricultural product (crop or livestock), abbreviated as SO, is the average monetary value of the agricultural output at farm-gate price, in euro per hectare or per head of livestock. There is a regional SO coefficient for each product, as an average value over a reference period (5 years, except for the SO 2004 coefficient calculated using the average of 3 years). The sum of all the SO per hectare of crop and per head of livestock in a farm is a measure of its overall economic size[9], expressed in euro. The LSU is equivalent to a dairy cow. The number of animals (heads) is converted into LSU using a set of coefficients reflecting the feed requirements of the different animal categories.

4.1.1. South-East regional level

At macroeconomic level[10], in the reference period 2014-2017, the Gross Domestic Product related to the South-East Region of Romania, registered a sustained growth trend, representing in 2017 10.26% of the national GDP (ranking the region on the 6th position) and 0.12% of the European Union's GDP (EU28). A similar evolution was observed in terms of the degree of competitiveness of the Region's economy, the Gross Value Added for the analysed period reflecting a similar growth rate. However, a comparative analysis of these indicators revealed that the South-East Region was, over the time, outperformed by the North-East, North- West and Central Regions. The sectors with the highest contribution to regional GVA in the case of the South-East Region are agriculture, forestry and fishing (6,701.3 million lei GVA - placing the region on the 2nd place at national level) and construction (with 5,229.8 million lei GVA).

At the level of 2019, the labour resources at national level amounted to 12.1 million people, of which 1.4 million people in the South-East Region (representing 12% of the national value). Most of the labour resources from the South-East Region, respectively 431 thousand people, were concentrated in Constanta County, and the smallest part in Tulcea County, respectively 118 thousand people.

[9] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Economic_size
[10] The Smart Specialization Strategy for the South-East Development Region, 2014-2020

At regional level, the active population (employed population and registered unemployed persons) reached the value of 956 thousand people, resulting in an activity rate of 67.7%, which ranks the South-East Region on the 5th place, after the South-West Oltenia Region (69.2%). The agricultural sector has the highest share of the employed population in the region (25% in 2019), followed by the manufacturing industry (17%) and the wholesale and retail sector (15%). The Information and Communication sector accounts for 9.8% of the employed population in the region, registering a decreasing trend in the period 2015 - 2017. At the level of 2019, the South-East Region ranked on the 6th position in terms of the human resources employment rate (64%), registering higher values only compared to the Central Region (63.9%).

The number of employees in the region places the South-East region on the fifth place at national level, with an average number of 554,174 employees. With the exception of Braila County, all other counties have seen an increase in the number of employees. The analysis of the economic sectors reveals that the highest average number of employees is found in the sector of water distribution, sanitation, waste management and decontamination activities, with a total number of 15,443 people. In 2019, the field of agriculture, forestry and fishing registered 19,138 employees, and the branch of HORECA services was also an important one for the region. Regarding the gender of employees, it is noted that the only county in which there are more women than men employed is Vrancea. The average salary in the South-East Region is increasing, but below the values of the leading regions (Bucharest-Ilfov Region, with 3,947 lei, West Region, with 2,879 lei, North-East Region, with 2,781 lei, South-East Region, with 2,551 lei). Analysing the evolution over time of the labour productivity in each economic activity, it is observed that, at the level of the South-East Region, between 2013 and 2017, this indicator was on a positive trend for all economic activities, except construction, where the productivity between 2013 and 2017 decreased with 15%.

The investments in the South-East Region are among the lowest compared to other development regions, totalling 4.2% in 2018 (compared to Bucharest-Ilfov - 60.7%, Centre Region - 9%, etc.).

The comparative advantages of the South - East Region present Constanta as the county with the highest value of exports, and Tulcea with the lowest value; the same situation is also valid for the imports. At the regional level, the groups of base metals products, mineral products, vegetables, textiles and food have the highest value of exports.

The analysis of the comparative advantage index reveals that the South-East Region registers comparative advantages with RCA> 1 for the sections: live animals and animal products, animal or vegetable fats and oils, mineral products, base metals and correspondent articles (for the 2017 - 2019 period).

4.1.2. Agri-food and biotechnology field at South-East regional level

In 2018, in the South-East Region there were 3,729 local units active in agriculture, forestry and fishing, most of them operating in Constanta County (980). The region also ranks second at national level in terms of the share of crop production and first in terms of the area under fruitful vineyards. In 2019, the region had the highest total grape production in the country, representing 42% of the total production.

The South-East region has an increased potential for rice cultivation, given the fact that in 1990 there were 15,477 ha of rice in the region, so that in 2019 they numbered only 7,427 ha. Through the South-East Region, at the level of which the Danube is also present, Romania is considered the country with the greatest development potential in the field of rice.

Among the arguments for supporting the need for the development of biotechnologies in the region can be listed: agri-food biotechnologies contribute to the conservation of natural resources, to reduce CO_2 emissions, to improve soil quality and high productivity; agri-food biotechnologies can provide products of increased quality and safety under more efficient use of resources and environmental protection; the economic contribution of biotechnology to agriculture at EU level is 36%; the use of biotechnology is estimated at 2030 to contribute to about 50% of agricultural production; environmental biotechnologies are effective in sustainable development based on reducing pollution; biodiversity must be conserved through biotechnologies; there is great potential for clustering in the field of environmental protection; the superior recovery of biodegradable waste and by-products by biotechnological processes can lead to increasing the level of well-being in the region, by creating new jobs and improved living conditions.

Most agricultural companies are registered in the South-East Region. The demand for organic products is growing internationally, and at the regional level it is well developed. The research-innovation activities at the level of the region are carried out through the existing local companies, research stations and universities. Availability of qualified human resources in the field. At the level of the region, in 2019, 13.7% of the employed people worked in the fields of agriculture, forestry and fishing. However, the average monthly salary was only 2,133.00 lei (445E). Nevertheless, studies show a chronic need for qualified staff and highly trained specialists in the field.

4.1.3. Aquaculture and fishing field at South-East regional level

At the level of the South-East Region the largest areas for aquaculture (65% of the national area) are concentrated. The fishing sector includes marine fishing activities on the Black Sea, and in inland waters (on the Danube and in the Delta area), aquaculture is included. In terms of infrastructure, although it has been funded through the various dedicated operational programs, the infrastructure of fishing ports with specialized berths and storage facilities as well as the locations for organizing the first sale of fish are completely missing. The fishing fleet is also in an advanced stage of wear and tear.

The amount of fish consumed at national level has increased in the recent years, but studies show that only 12% of national consumption is covered by domestic production. It is, therefore, an extraordinary development potential for this field. The total quantity of fish sold in Romania is 120,000 tons, annually. Out of these, 100,000 come from imports and only 20,000 are local production. From domestic production, 12,800 tons are obtained from aquaculture, 2,000 tons from the Black Sea and about 4,000 tons from inland waters.

Innovation in the field is low, but there are options to finance it through the Fisheries and Maritime Affairs Operational Program 2014-2020. In March 2019, the National Fisheries Network was operationalized, this being the structure that could boost the research-development and innovation activity in the field.

Availability of qualified human resources in the field. At national level, 4,574 professional fishermen and 2,968 fish farmers are active in the fishing field. Out of the total number of fishermen, 1,720 work in the Danube Delta, 2,215 on the Danube River, 168 on the accumulation lakes and 471 on the Black Sea. The lack of vocational, high school and post-high school institutions is causing a shortage of specialists in the region.

4.1.4. Research and development in agriculture in South-East regional level

The most important fields of activity for research[11], development and innovation sector are agriculture, services, industry, constructions and tourism. These mentions are the result of the opinions expressed by the economic agents that are currently active, but who, in 68,1% of cases, have not invested in RDI activities. Thereby, the indicated areas may result from the analogy with the current turnover and the capacity to face the economic crisis. In regional agricultural field, at the level of the South-East Region, there are the following research and development institutes and research stations subordinated to the "Gheorghe Ionescu Siesta" Academy of Agricultural and Forestry Sciences:

- Constanta Research and Development Plant for Fruit Growing;
- Agricultural Research and Development Resort Valu Traian;
- Braila Agricultural Research and Development Centre;
- The Potato Culture Development Centre, Tulcea county;
- The Bujoru Viticulture and Wine Development Research Station, Galati county;
- The Murfatlar Viticulture and Wine Growing Development Station, Constanta county;
- Odobesti Viticulture and Wine Production Development Station, Vrancea county;
- Buzau Vegetable Research and Development Station, Buzau county (Public institution with full financing from own incomes (extra budgetary);
- Dulbanu Cattle Growth Research Station, Buzau county;
- Research and Development Institute for Palatinate and Goat Growing, Constanta county;
- Research and Development Institute for Aquatic Ecology, Fisheries and Aquaculture Galati.

4.2. Agriculture policies in Romania

A functional and effective agricultural advisory system is an important element for the development of agriculture and rural areas in Romania. In the 2014-2020 programming period, the actions of advisory services and information provided by the national public agricultural advisory system play an essential role in the successful implementation of the Common Agricultural Policy (CAP) in general, but also in complementing the actions that NRDP 2014-2020 supports[12].

The Romanian public agricultural advisory system aims at helping farmers to better understand and meet the EU's mandatory basic requirements on environment, public health and animal welfare and GAEC and SMR, as set out in art. 93 and Annex II of the R (EU) 1306/2013.

The current advisory system supports farmers and helps them to comply with the obligations at the level of agricultural holding from the regulatory requirements in terms of management, but also provides specific advisory related to production techniques and technologies.

In addition to the public services provided by the national system, the advisory services implemented under NRDP will be carried-out after selecting the providers of advisory services and will aim at farm modernisation, strengthening competitiveness, sectoral integration, association and short supply chain, innovation, market orientation and promotion of entrepreneurship in rural areas, aspects (in business plans) related to the implementation of certain environmental criteria which need to be respected by farmers (such as those imposed by the Water Framework Directive), as well as the implementation of the commitments concluded for the environment and climate measures (agri-environment, organic farming).

The public agricultural advisory service provides provision of technological transfer, information and vocational training in agriculture. The technical and methodological coordination of this national service is done within the Ministry of Agriculture and Rural Development by the

[11] The Smart Specialization Strategy of the South-East Development Region, Romania, 2014-2020
[12] National Rural Development Programme, NRDP 2014-2020

Department for Advisory, Extension and Vocational Training. At territorial level, the public agricultural advisory service operates in all 41 counties within the county councils and at local level (NUTS5) in approximately 450 local centres that ensure direct links with farmers. The service has 850 advisers specialized in agriculture and related rural development sectors, including technological improvements and innovation actions. This service provides free advisory to farmers taking into account their specific needs. The public advisory system operates in accordance with Law 329/2009 and Government Decision 1609/2009. It is targeted especially to small and medium farms, family farms, that are registered with the paying agency (PIAA) (over 1 million farmers) as well as micro-enterprises in rural areas.

Periodically, they benefit from formation and training related to GAEC, SMRs, minimum requirements for use of fertilizers and plant protection products, code of good agricultural practices, etc. In addition to these training and advisory programmes, the public advisory service, via qualified advisers provide individual advisory services to farmers on production and livestock techniques and technologies, organic farming and traditional products. Besides the public advisory service there are over 360 private advisory service providers, registered at the Trade Register in Romania, most of them being involved in elaborating projects on a fee-paying basis for large farms, enterprises, companies and associations. In addition, there are numerous private companies promoting and providing technical advisory related to farm inputs, for example, seeds and planting material, breeding material, etc. The responsibilities of the public and the private sectors are set up and clearly stipulated in the current legislation, namely the public sector is mainly targeted towards the categories of small and medium farmers who represent the largest share in Romanian agriculture (80%) and have no financial power to ensure the counter value of their services, while the private advisory sector addresses a restricted category of farmers who may bear the costs of services, especially for the preparation of projects for companies, associations and large agricultural companies.

4.3. Funding initiatives in Smart Farming from SE of Romania

In Romania, the main programme that finance the agricultural sector is the National Rural Development Program 2014 - 2020 (NRDP). The program grants non-reimbursable funds from the European Union and the Government of Romania for the economic and social development of the rural area in Romania. The programme for Romania was formally adopted by the European Commission on 26 May 2015 and last modified on 28 April 2020, outlining Romania's priorities for using the nearly € 9.5 billion of public money that is available for the 7-year period 2014-2020 (€ 8.1 billion from the EU budget, including € 112.3 million transferred from the CAP direct payments, and € 1.34 billion of national co-funding). NRDP responds to three of the development challenges set out in the Partnership Agreement:

- Competitiveness and local development
- People and society
- Resources

The NRDP finance 14 rural development measures with a financial allocation of 9.336 billion Euros, of which 8.015 billion EAFRD and 1.347 billion national contribution. The NRDP (funded by the European Agricultural Fund for Rural Development) supports the strategic development of rural areas by strategically addressing the following objectives:

- OS1.Restructuring and increasing the viability of agricultural holdings
- OS2.Sustainable management of natural resources and climate change
- OS3.Diversification of economic activities, job opportunities, infrastructure and services to improve the quality of life in rural areas

The main rural development priorities for the 2014-2020 programming period were the following:

- Modernization and increase of viability of agricultural holdings by consolidating and opening to the market and processing of agricultural products;

- Encouraging the rejuvenation of generations of farmers by supporting the establishment of young farmers;
- Development of basic rural infrastructure as a precondition for attracting investments in rural areas and creating new jobs and implicitly for the development of rural areas;
- Encourage the diversification of the rural economy by promoting the creation and development of SMEs in non-agricultural sectors in rural areas;
- Promoting the fruit sector, as a sector with specific needs, through a dedicated subprogram;
- Encourage local development placed in the responsibility of the community through the LEADER approach. LEADER's cross-cutting competence improves competitiveness, quality of life and diversification of the rural economy, as well as combating poverty and social exclusion.

In order to achieve strategic objective 1, the following categories of intervention were financed through NRDP measures:

- Establishment, extension and modernization of farm facilities (buildings, access roads, irrigation, technologies to reduce pollution and production of energy from renewable sources, storage, marketing and processing facilities, including in the context of short chains, etc.);
- Investments in processing and marketing, including energy efficiency, marketing, storage, conditioning, adaptation to standards, etc .;
- Support for the farm's restructuration, especially small ones, and the rejuvenation of farmers generations;
- Risk management in the agri-food sector;
- Advisory and training activities, including through producer groups.

In order to achieve strategic objective 2, the following categories of intervention were financed through NRDP measures:

- Actions for afforestation of agricultural and non-agricultural lands, as well as the realization of forest curtains on these lands;
- Compensatory payments to farmers who voluntarily make agri-environmental commitments;
- Compensatory payments to farmers who voluntarily undertake to adopt or maintain practices and methods specific to organic farming;
- Compensatory payments to farmers who voluntarily undertake to continue working in areas designated as areas facing natural or other specific constraints.

In order to achieve strategic objective 3, the following categories of intervention were financed through NRDP measures:

- Support for investment in micro and small non-agricultural enterprises in rural areas;
- Improving local infrastructure (water supply systems, sewerage, local roads), educational, medical and social infrastructure;
- Restoration and conservation of cultural heritage;
- Support for locally generated strategies that provide integrated approaches to local development;

In Romania, the Agency for Financing Rural Investments (AFIR) is the institution that ensures the technical and financial implementation of the NRDP 2014 – 2020.

Based to the information available on the site of the Ministry of Agriculture and Rural Development and NRDP site, the situation of the projects submitted/selected for financing on March 11, 2021 is presented in the table below.

Table 10. Projects submitted/selected for financing from NRDP

Sub measures	Public allocation PNDR 2014-2020 (RON)	Funding applications submitted		Selected funding applications	
		No.	Value (RON)	No.	Value (RON)
Sub-measure 1.1 "Support for vocational training and the acquisition of skills"	5,910,092	478	37,704,742	257	20,896,436
Sub-measure 1.2 "Support for demonstration and information activities"	360,000	53	1,719,207	52	1,599,207
Sub-measure 2.1 "Support for assistance to benefit from the use of counselling services"	3,670,000				
Sub-measure 3.1 "Support for participation for the first time in quality schemes"	500,000	0	0	0	0
Sub-measure 3.2 "Support for information and promotion activities carried out by producer groups in the internal market"	5,581,232	0	0	0	0
Sub-measure 4.1 "Investments in agricultural holdings"	841,878,522	4,061	2,237,642,206	1,886	1,051,912,167
Sub - measure 4.1 "Investments in agricultural holdings" - ITI Danube Delta	33,000,000	133	56,160,669	52	25,153,553
Sub-measure 4.1a "Investments in fruit holdings"	296,680,886	1,182	677,769,187	564	310,817,806
Sub-measure 4.1a "Investments in fruit holdings" - ITI Danube Delta	5,000,000	9	4,923,015	8	4,358,466
Sub-measure 4.2 "Support for investments in the processing / marketing of agricultural products"	382,748,167	748	620,946,964	466	430,935,334
Sub - measure 4.2 "Support for investments in the processing / marketing of agricultural products" - ITI Danube Delta	10,600,000	7	11,489,693	6	10,959,866
Sub-measure 4.2 "GBER State aid scheme"	95,500,000	239	157,034,082	163	117,790,038
Sub-measure 4.2 "De minimis scheme"	5,500,000	98	1,619,848	92	1,566,341
Sub-measure 4.2a "Investments in processing / marketing of fruit products"	35,429,439	84	41,790,963	65	31,552,028
Sub-measure 4.3 "Investments for the development, modernization or adaptation of agricultural and forestry infrastructure - irrigation"	433,978,719	625	618,074,659	425	419,336,878
Sub-measure 4.3 "Investments for the development, modernization or adaptation of agricultural and forestry infrastructure - irrigation" - ITI Danube Delta	7,000,000	7	6,798,482	7	6,794,520
Sub-measure 4.3 "Investments for the development, modernization or adaptation of agricultural and forestry infrastructure - agricultural access infrastructure"	130,298,233	441	418,451,214	81	78,989,370

Sub measures	Public allocation PNDR 2014-2020 (RON)	Funding applications submitted		Selected funding applications	
		No.	Value (RON)	No.	Value (RON)
Sub-measure 4.3 "Investments for the development, modernization or adaptation of agricultural and forestry infrastructure - agricultural access infrastructure" - ITI Danube Delta	3,000,000	4	3,452,793	4	3,347,047
Sub-measure 4.3 "Investments for the development, modernization and adaptation of agricultural and forestry infrastructure - forestry infrastructure"	99,271,119	104	146,722,415	65	91,277,869
Sub-measure 4.3 "Investments for the development, modernization and adaptation of agricultural and forestry infrastructure - forestry infrastructure" - ITI Danube Delta	1,700,000	2	1,462,698	2	1,421,820
Sub-measure 5.1 "Support for investments in preventive measures to reduce the effects of natural disasters, adverse climatic events and probable catastrophic events"	24,775,003	374	29,639,450	285	21,784,238
Sub-measure 5.2 "Investment support for the restoration of agricultural land and production potential affected by natural disasters, adverse environmental conditions and catastrophic events"	3,677,431	1	198,284	0	0
Sub-measure 6.1 "Support for the installation of young farmers"	466,754,112	14,893	612,350,000	10,620	435,950,000
Sub - measure 6.1 "Support for the installation of young farmers" - ITI Danube Delta	10,000,000	233	9,510,000	204	8,300,000
Sub-measure 6.2 "Support for the establishment of non-agricultural activities in rural areas"	106,583,304	6,098	345,300,000	1,895	111,510,000
Sub-measure 6.2 "Support for the establishment of non-agricultural activities in rural areas" - ITI Danube Delta	5,000,000	235	15,250,000	74	5,000,000
Sub-measure 6.3 "Support for the development of small farms"	246,471,271	20,618	309,240,000	13,892	208,380,000
Sub-measure 6.3 "Support for the development of small farms" - ITI Danube Delta	5,000,000	227	3,405,000	188	2,820,000
Sub-measure 6.4 "Investments in the creation and development of non-agricultural activities"	156,503,969	2,518	424,560,139	986	162,689,274
Sub-measure 6.4 "Investments in the creation and development of non-agricultural activities" - ITI Danube Delta	10,000,000	92	17,380,057	54	10,297,223
Sub-measure 6.5 "Scheme for small farmers"	6,000	22	63,296	3	4,882
Sub-measure 7.2 "Investments in the creation and modernization of small-scale basic infrastructure - water / wastewater infrastructure"	1,108,947,145	501	726,335,354	335	476,597,571
Sub-measure 7.2 "Investments in the creation and modernization of small-scale basic infrastructure - water /		12	16,111,717	11	14,471,443

Sub measures	Public allocation PNDR 2014-2020 (RON)	Funding applications submitted		Selected funding applications	
		No.	Value (RON)	No.	Value (RON)
wastewater infrastructure" - ITI Danube Delta					
Sub-measure 7.2 "Investments in the creation and modernization of small-scale basic infrastructure - road infrastructure of local interest"		973	1,003,987,456	489	510,942,432
Sub-measure 7.2 "Investments in the creation and modernization of small-scale basic infrastructure - road infrastructure of local interest" - ITI Danube Delta		31	29,715,764	29	27,694,510
Sub-measure 7.2 "Investments in the creation and modernization of small-scale basic infrastructure - educational and social infrastructure"		444	168,742,693	325	121,037,443
Sub-measure 7.2 "Investments in the creation and modernization of small-scale basic infrastructure - educational and social infrastructure" - ITI Danube Delta		11	3,781,866	9	2,818,286
Sub-measure 7.6 "Investments associated with the protection of cultural heritage"	188,010,999	913	304,818,329	661	211,735,295
Sub-measure 7.6 "Investments associated with the protection of cultural heritage" - ITI Danube Delta	9,000,000	27	8,405,738	27	7,871,245
Sub-measure 8.1 "Afforestation and creation of forested areas" *********	46,786,653	117	21,704,316	96	16,766,382
Sub-measure 9.1 "Establishment of producer groups"	16,836,313	44	16,181,007	38	14,015,305
Sub-measure 9.1a "Establishment of producer groups in the fruit sector"	3,200,811	6	2,683,870	5	2,183,144
Measure 10 "Agri-environment and climate"	835,317,262				
Measure 11 "Organic farming"	247,038,159				
Measure 13 "Payments for areas facing natural or other specific constraints"	1,522,717,575				
Measure 14 "Animal welfare"	792,480,077				
Sub-measure 15.1 "Payments for forestry and climate commitments" *********	90,147,754	648	97,623,204	628	96,496,674
Sub-measure 16.1 "Support for the establishment and operation of operational groups (GOs), for the development of pilot projects, new products" - Stage I - expression of requests for interest ****	6,723,721	117	49,067,192	24	8,376,817
Sub-measure 16.1 "Support for the establishment and operation of operational groups (GOs), for the development of pilot projects, new products" - Stage II - submission, evaluation and selection of the detailed project of the GO *****		19	6,351,760	16	5,156,169

Sub measures	Public allocation PNDR 2014-2020 (RON)	Funding applications submitted		Selected funding applications	
		No.	Value (RON)	No.	Value (RON)
Sub-measure 16.1a "Support for the establishment and operation of operational groups, development of pilot projects, products and processes - fruit trees" - Stage I - expression of requests for interest ****	5,819,040	73	31,125,190	17	7,206,293
Sub-measure 16.1a "Support for the establishment and operation of operational groups, development of pilot projects, products and processes - fruit trees" - Stage II - submission, evaluation and selection of the detailed GO project *****		11	4,766,823	11	4,680,030
Sub-measure 16.4 "Support for horizontal and vertical cooperation between actors in the supply chain"	12,385,582	266	25,300,939	126	11,801,919
Sub-measure 16.4a "Support for horizontal and vertical cooperation between actors in the supply chain"	6,428,560	79	7,586,850	41	3,993,442
Sub-measure 17.1 "Crop, animal and plant insurance premiums" ******	23,699,076	7,807	15,821,770	6,671	12,606,927
Sub-measure 19.1 "Preparatory support for the development of local development strategies"	1,990,183	180	2,435,307	175	2,379,233
Sub-measure 19.2 "Support for the implementation of actions under the local development strategy"	495,641,759	8,200	443,288,644	7,270	408,395,788
Sub-measure 19.3 "Preparation and implementation of the cooperation activities of the Local Action Group" - Component A "Preparatory technical assistance for LAG cooperation projects"	16,986,768	69	260,439	69	260,439
Sub-measure 19.3 "Preparation and implementation of the cooperation activities of the Local Action Group" - Component B "Implementation of the cooperation activities of the selected LAGs" ********		47	11,016,102	30	6,488,413
Sub-measure 19.4 "Support for running costs and animation"	123,013,164				
Measure 20 "Technical assistance" **	176,692,820				
Measure 21 "Specific measure granting exceptional temporary support under the EAFRD in response to the COVID epidemic" *******	182,500,000				
Financial instruments ***	93,973,930				
TOTAL	**9,438,714,849**	**74,151**	**9,796,652,809**	**49,458**	**5,533,836,454**

* NOTE: Unfinished contracts from the 2007-2013 programming period that are paid from funds related to the 2014-2020 programming period.
** NOTE: The M20 Technical Assistance payment also includes direct expenses incurred.
*** NOTE: The amount paid represents 75% of the value of the contract concluded with the European Investment Fund on November 28, 2017, regarding the granting of financial instruments under sub-measures 4.1, 4.1a, 4.2, 4.2a and 6.4.
**** NOTE: Regarding sM16.1 / 16.1a stage I, the applications for expressing interest were submitted and selected, and in stage II the selection of projects will be made. The total number of selected projects does not contain the number of IECs selected

***** NOTE: Regarding sM16.1 / 16.1a stage II, the submission, evaluation and selection of the detailed project of the GO selected in stage I will be carried out. The total number of selected projects also contains the number of GO projects selected for financing from stage II .
****** NOTE: With respect to sub-measure 17.1, the selected projects represent submitted applications declared eligible for the conclusion of the Financing Decision.

******* NOTE: Session of applications for support opened between September 25 and October 23, 2020. 122,986 sole farmers applied for support, requesting the amount of 182.5 million euros.
******** NOTE: If a selected partnership consists of several LAGs authorized by MADR, AFIR concludes financing contracts with each of the partners
********* NOTE: The value of support requests is the total value; the measure involves multi-annual commitments that go beyond the 2014-2020 framework.
Value of 1.00 Euro = 4.89 RON (March 2021).

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

A detailed database of stakeholders from the quadruple helixes of the agricultural sector and connected sectors in the regions has been elaborated trying to encompass the most representative entities for the four helixes in rural development (public authorities, industry, academia, citizen/civil society). The Romania's list of stakeholders contain more than 125 organisations, and was achieved by a thorough investigation of the main actor in agriculture of the South-East region, eligible in the BSB programme. In Fig. 36, the distribution of the stakeholders from the four helixes for private and public sector is presented.

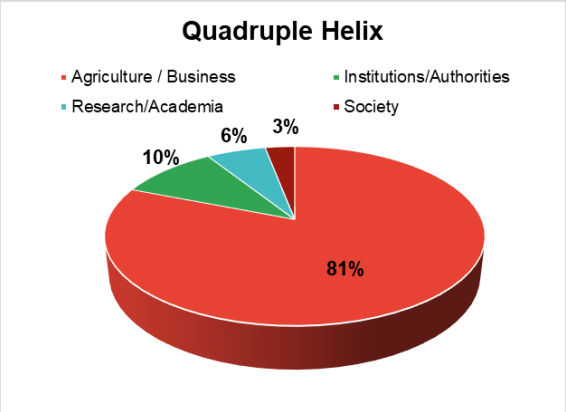


Fig. 36. Stakeholders from the four helixes

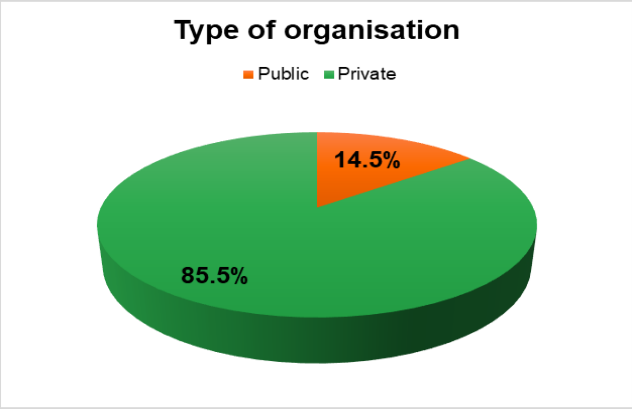


Fig. 37. Key stakeholders' type of organisation

From the whole stakeholders' list, 55 key stakeholders responded to the questionnaire. In Fig. 37, is presented the type of organisation and in the Fig. 41 organizations type of activities as according to the sector they belong to, profit or non-profit and governmental or non- governmental.

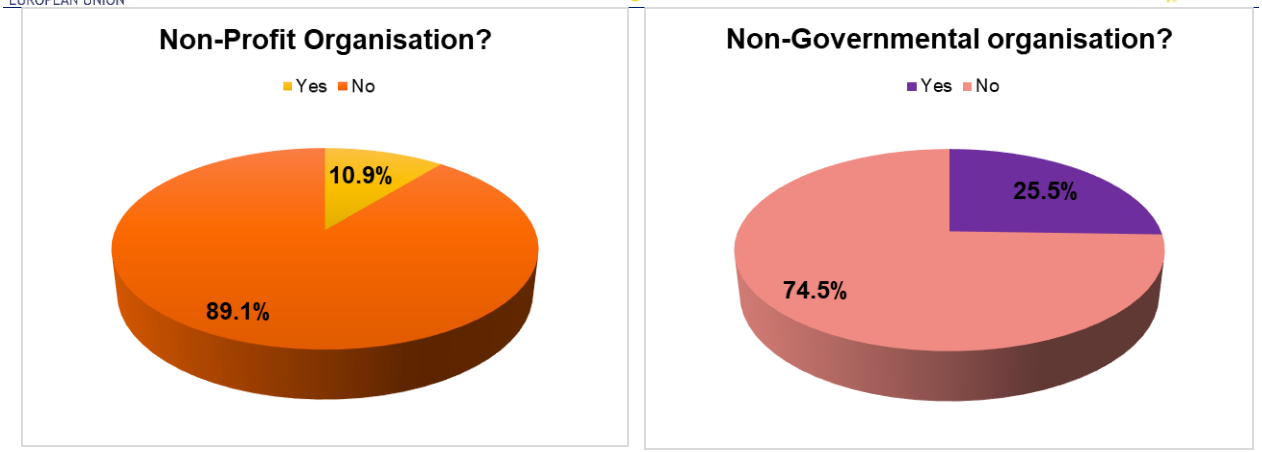


Fig. 38. Key stakeholders' type of activity of the organisation

There is a variety of fields of activities that the interviewed stakeholders' entities belong to (Fig. 41). The majority of them (78.2%) come from agricultural sector, the 3.6% of the interviewed were related to education, 5.5% from technology and 7.3% to business, 1.8% was connected to socio-economical field while the rest of 5.5% are related to other fields. As for the quadruple helix innovation system of the key stakeholders, the 73.1% of the interviewed are from business/industry helix, 7.7% from research/academia helix and 7.7% from society, while the rest 11.5% is related to the government (Fig. 40).

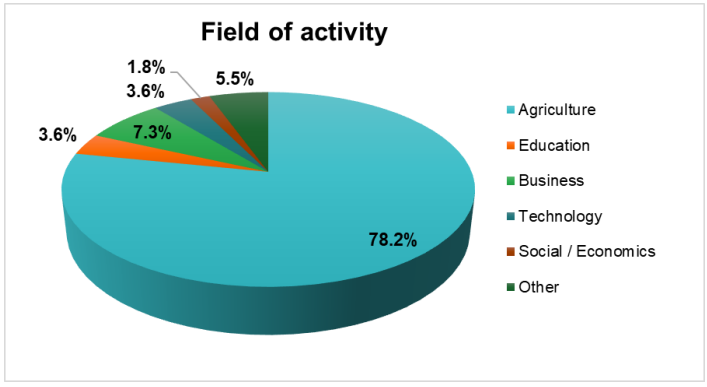


Fig. 39. Key stakeholders' field of activity

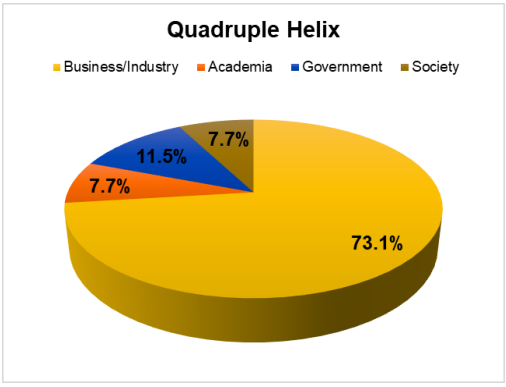


Fig. 40. Key stakeholders' quadruple helix

The interviewed stakeholders' profiles were structure also base to the type of organisation specific to their activity. The following picture (Fig. 41) shown the organisation's distribution: 67.4% farms/farmers (registered or non-registered), 9.10% Technology providers, 3.60% Local public authority, 3.60% Higher Education or Research Institutes, 1.80%Education/Training Centre or School, 1.80% Sectoral Agencies, 1.80% Infrastructure and service provider, 5.50% Interest groups including NGO's and 5.40% Business Support Organisation (Clusters, Chamber of Commerce etc.).

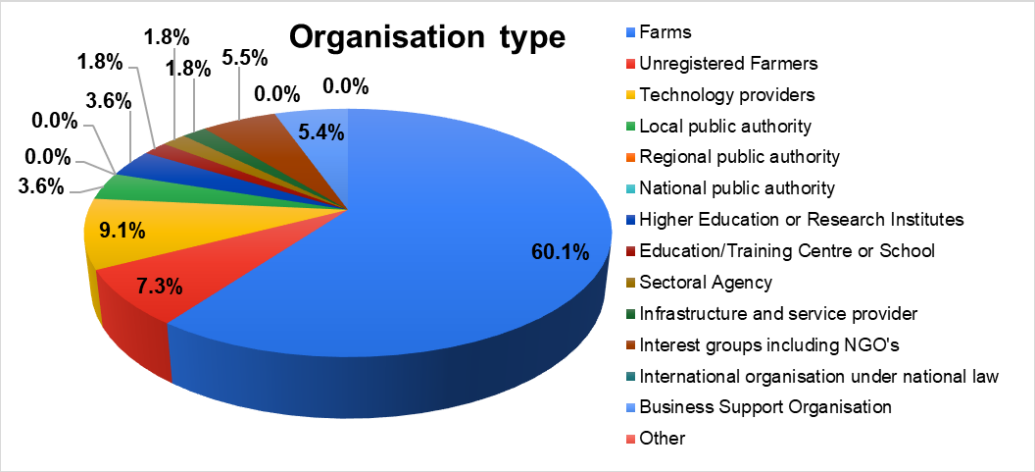


Fig. 41. Stakeholder's type of organisation

4.5. Smart and IoT technologies existent in SE of Romania

Smart Farming represents the application of modern Information and Communication Technologies (ICT) into agriculture, aiming to increase the quality and quantity of agricultural products. Smart farming includes aspects such as Internet of Things (IoT), data management, soil scanning, the access to GPS and other smart technologies.

In order for Romania to increase the value of its agricultural production, it should mechanize a large part of the agricultural field . This is difficult to do, because of the he nature of the properties (extremely fragmented in Romania), when an average area of a farm is about 3.7 hectares. Over 50% of Romanian farmers work on farms with an area of less than one hectare.

In Romania, at least half of the agricultural workers practice a subsistence agriculture. It's about a million people who are torn from modernity, along with their families. By contrast, the approximately 30 agricultural holdings with legal personality in Romania have, on average, about 200 hectares. Thus, they are much easier to work mechanically, and the owners can invest in state-of-the-art equipment, for an agriculture worthy of the 21st century.

Fortunately, factories that assemble tractors reappear in Romania, and this year TAGRO was launched, the first 100% Romanian tractor, produced at IRUM Regain. This tractor is intended primarily for small and medium-sized farms and will be sold on the domestic market as well as on foreign markets. TAGRO will have all the necessary equipment for a modern tractor, including radio commands and air conditioning. Prior to the launch, the tractor was tested in Romania and Italy, and by the end of this year the homologation process will be completed by the Romanian Auto Car Registry[13]. If the government devises a strategy to support farmers to buy such tractors, we will see spectacular increases in production, doubling them in less than a decade.

However, this cannot be enough for a proper strategy for the agricultural mechanisation and automation. At the moment, autonomous combines and seedling robots in Romania are still not implemented, and we probably won't be for a period. But the technological revolution is coming upon us, and the process of mechanization and modernization of Romanian agriculture should be a continuous process.

[13] Lazar V., 100% Romanian Tractor Launched By IRUM Reghin, https://www.romaniajournal.ro/top_news/100-romanian-tractor-launched-by-irum-reghin/

That's why in depth analysis should be achieved in order to understand better the real condition, particulars in the South-East part of Romania.

For the investigation related to the level of preparedness for Smart farming in BSB South-East part of Romania, a questionnaire was elaborated and sent to the key stakeholders identified from the quadruple helix. The results of the investigation, related to the level of awareness about the smart and IoT technologies are presented in the following.

The first question was related to the smart farming applications that the stakeholder's are aware, and they replied by "Yes" or "No" to the following examples give in the questionnaire: the water deficit detection and control, cattle monitoring and management, crop management, weed detection and control, climate conditions monitoring, pest and diseases detection and rural property management. In the picture below is depicted the number of replies to the above mentioned question (Fig. 42).

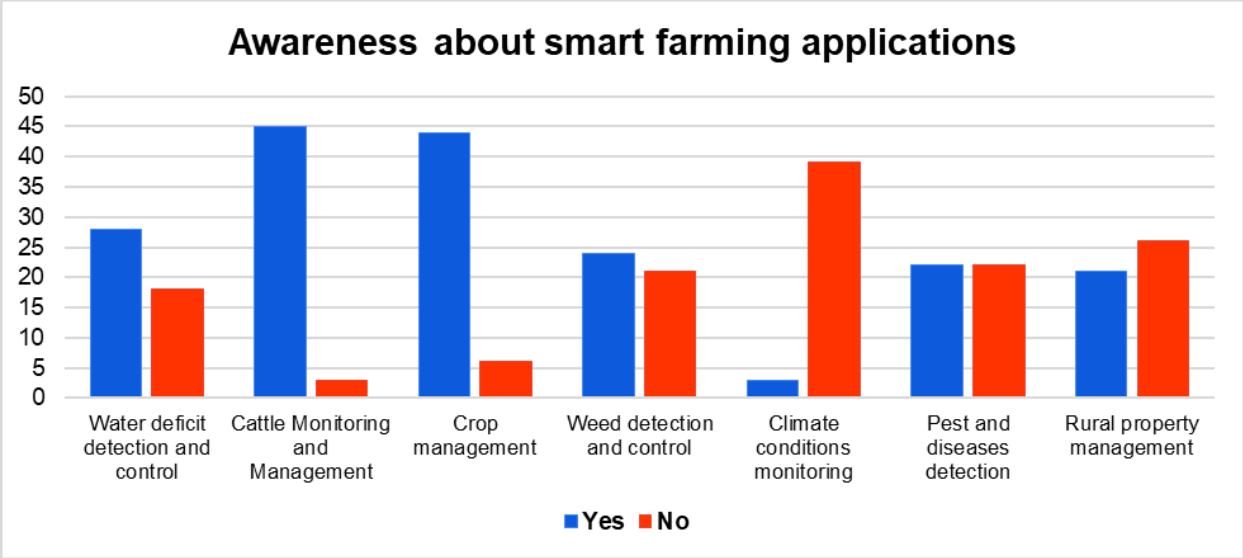


Fig. 42. Stakeholder's awareness about smart farming application in the SE Region of Romania

The second question was related to the smart farming technologies in South-East region from Romania that the stakeholder's are aware, and they replied by "Yes" or "No" to the following examples give in the questionnaire: data or images from sensors, digital maps, Global Positioning Systems, automated systems, robotic systems, drones and software and applications for farm management. In the picture below is depicted the number of replies to the above mentioned question (Fig. 42).

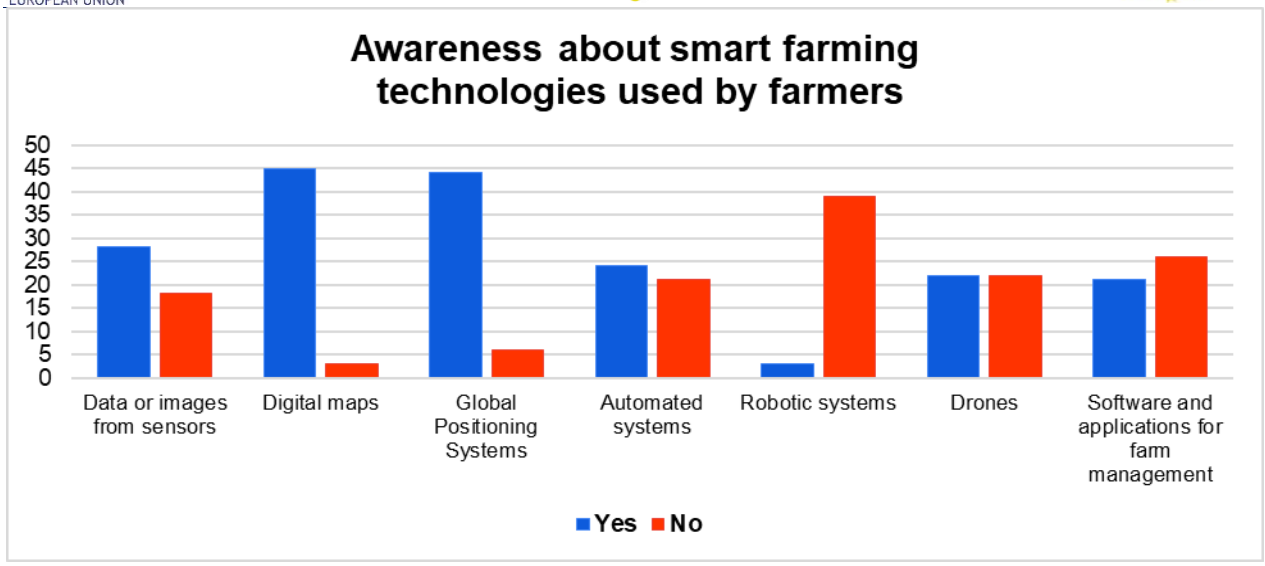


Fig. 43. Stakeholder's awareness about smart farming technologies in the SE Region of Romania

The next question was related to the awareness about the advantages provided by using smart farming. The 90.9% of the stakeholders appreciated that can increase productivity, 60.0% considered the reducing of the environmental impact, 69.1% thought that can lead to high quality products, 72.7% appreciated that can lead to cost reduction and 83.6% in an increased profit, 60.0% considered that can improve activity planning and 85.5% appreciated that can increase labour efficiency.

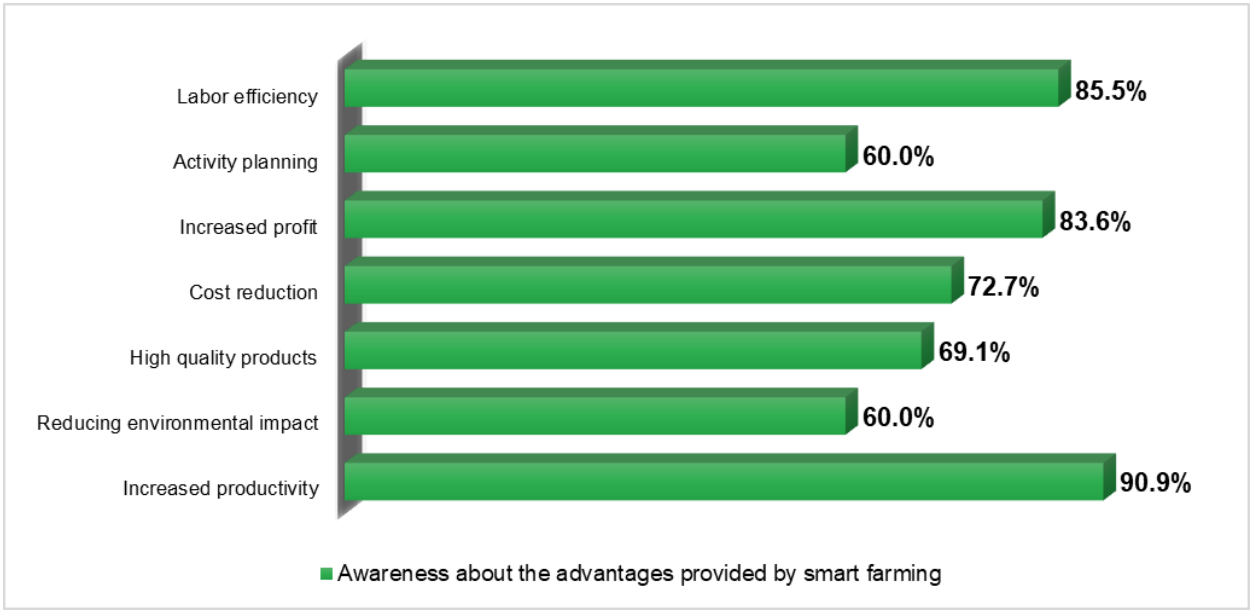


Fig. 44. Stakeholder's opinion about the advantages provided by using smart farming in the SE Region of Romania

Another question was related to the awareness about the agricultural fields that need smart farming technologies in SE Region of Romania.

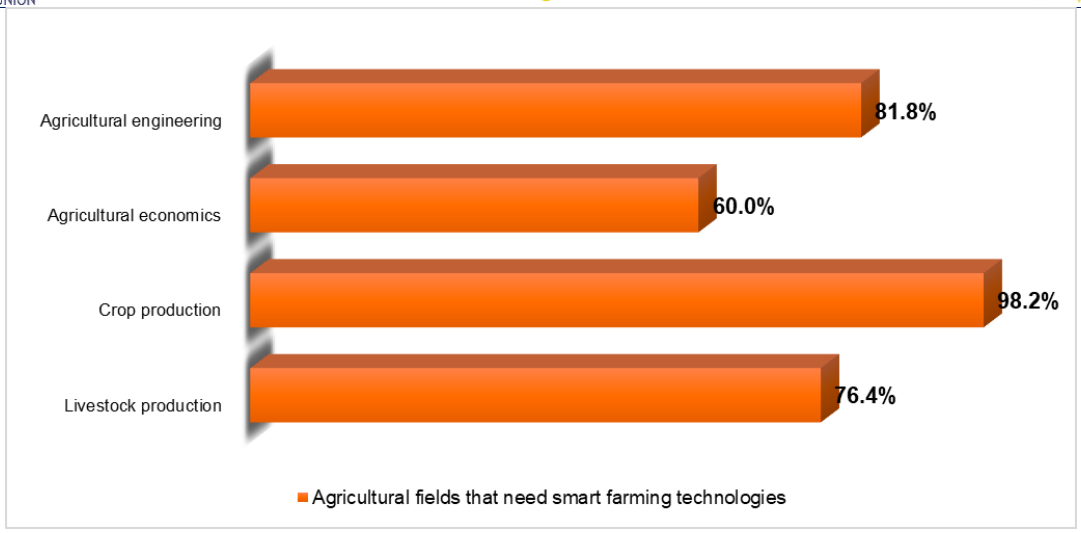


Fig. 45. Stakeholder's opinion about the agricultural fields that need smart farming technologies

The stakeholders considered in a percentage of 98.2% that crop production needs smart farming technologies, 81.8% in agricultural engineering, 76.4% in livestock production and 60% in agricultural economic field.

More specifically, the stakeholders were asked to specify the need (to a scale from 1 to 5) to adopt smart technologies in livestock production systems. Their replies first ranked, with maximum points 5 was, in milking automated systems, second place on feeding or drinking control, third on cattle/sheep/ health monitoring, forth on barn monitoring (video surveillance, environment control) and fifth on animal tracking indoor/outdoor (Fig. 46).

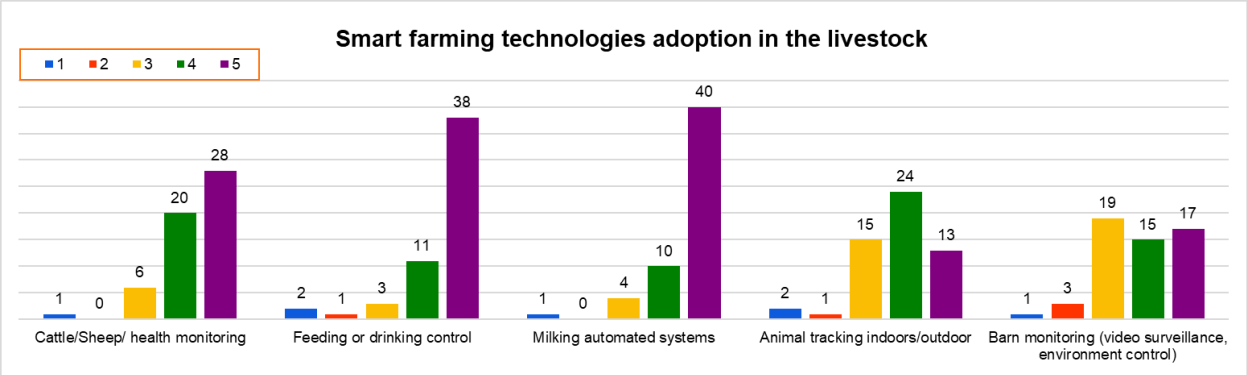


Fig. 46. Stakeholder's opinion about need of smart farming technologies in livestock

Moreover, the stakeholders were asked to specify the need (to a scale from 1 to 5) to adopt smart technologies in crop production systems (Fig. 47). Their replies first ranked, with maximum points 5 was, in irrigation systems, second place on soil and field analysis, third on fertilisations and crop protection, forth on precision mechanical weeding and fifth on inspection and monitoring using drones.

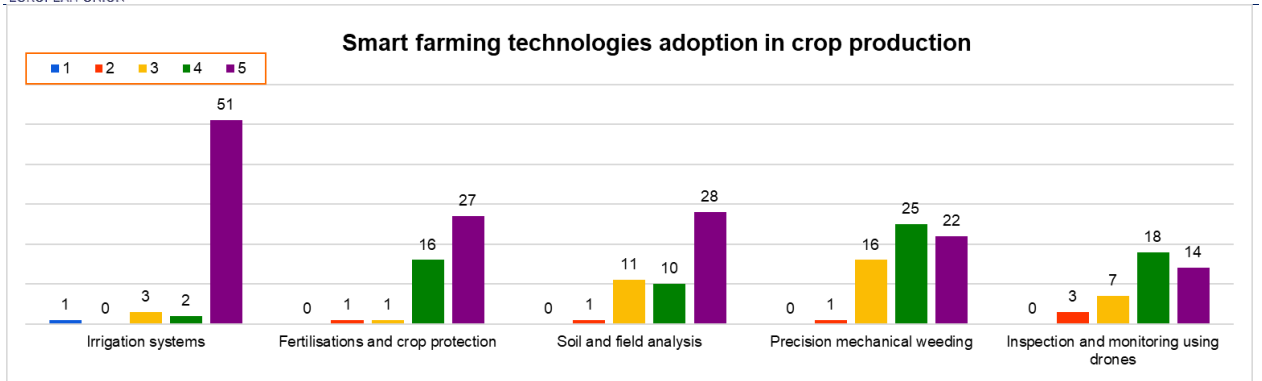


Fig. 47. Stakeholder's opinion about need of smart farming technologies in crop production

To continue the agriculture fields, the stakeholders were asked to specify the need (to a scale from 1 to 5) to adopt smart technologies in agricultural engineering sector. Their replies first ranked, with maximum points 5 was, in IoT and Sensors, second place on automation and robotic systems, third on predictive analytics tools and systems, forth on Machine to Machine communication (M2M) and fifth on Cloud Computing and Big Data analysis and processing (Fig. 48).

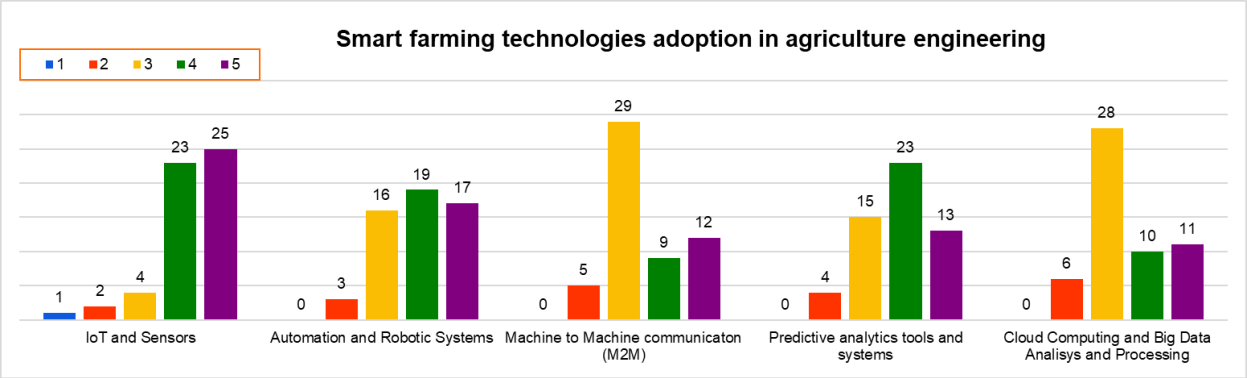


Fig. 48. Stakeholder's opinion about need of smart farming technologies in agriculture engineering

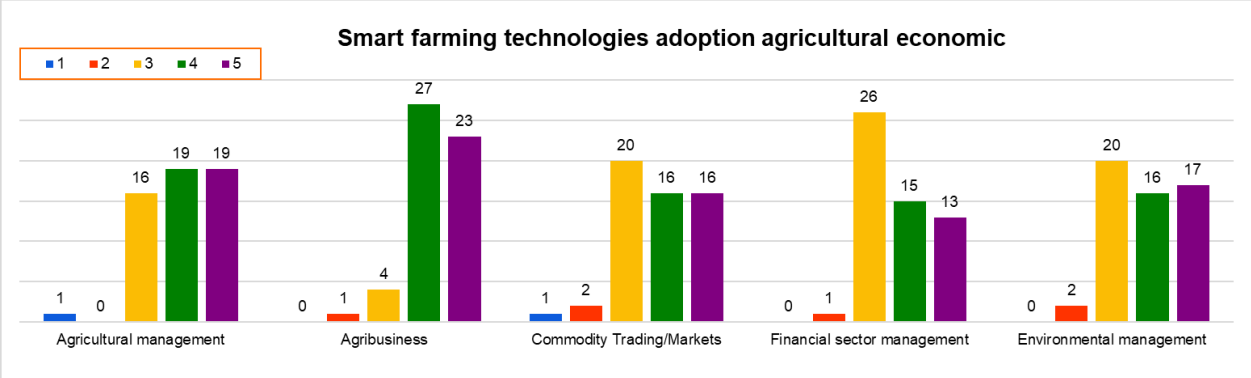


Fig. 49. Stakeholder's opinion about need of smart farming technologies in agricultural economics

In the end, the stakeholders were asked to specify the need (to a scale from 1 to 5) to adopt smart technologies in agricultural economic specific field (Fig. 49). Their replies first ranked, with maximum points 5 was, in agribusiness, second place on agricultural management, third on

environmental management, forth on commodity trading/markets and fifth on financial sector management.

The last question was related to the awareness if farmers from SE Region of Romania would like to adopt smart farming technologies. As predicted, the percentage of 93 of the stakeholders that replied “yes” at this question is eloquent about the need of adopting smart farming technologies.

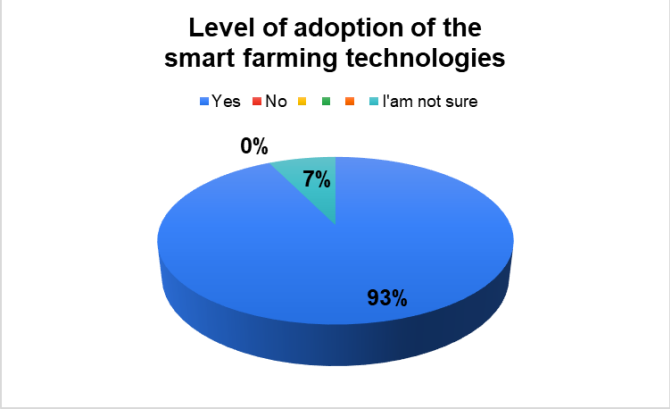


Fig. 50. Stakeholder’s opinion about farmers adoption of smart farming technologies in SE of Romania

4.6. Agricultural needs of the rural communities in SE region of Romania

Agricultural production in the South-East part of Romania is significant, representing 15.86% of national production. Agriculture holds an important share in the region's economy, 40.4% of the region's employed population is in this sector. The agricultural land owns 65% of the total area of the region. The private sector holds the largest share of agricultural land and also produces most of the agricultural production.

The South-East region ranks first in the country, in terms of the area of fertile vineyards, holding 40.3% of the country's vineyard area mostly located in Vrancea County. The region is recognized, both internally and externally, by the quality of wines from famous vineyards, which are found throughout the region: Panciu, Odobesti, Pietroasele, Nicoresti, Niculitel, Murfatlar, Insuratei.

Crops are a main feature of the region, occupying a top position in the production of corn, production of wheat, legumes, vegetables and the in the production of sunflower.

Horticulture is well developed in the entire region (especially in Galati County) which is the first county in Romania, in terms of vegetable production.

Fishing and aquaculture, along with fish processing and trade in fish and fish products, are traditional activities in the South East Region. In some isolated areas, such as the Danube Delta and Meadow, the Danube area, fishing is one of the main activities, which provides jobs and sources of income for the local population. The fisheries sector in the South East Region includes:

- marine fishing activities on the Black Sea, practiced along the Romanian coast;
- fishing activities in inland waters, which are practiced on the Danube as well as in the Danube Delta area;
- Aquaculture. In the South-East Region there are at least 120 fish farms registered in the Register of Aquaculture Units, of which about 35 nurseries and 90 breeders. The largest number of fish farms is located in Tulcea County and Constanta County).

Based on the results of the stakeholder's questionnaire, as presented in Fig. 51, in the agriculture sector revealed that the 43.20% farmers have large farms (more than 10 ha), 43.20% medium farms (4-10 ha), 8.10% have semi-medium farms (2-4 ha) and 5.40% have small farm (1-2 ha). Is must be noticed that the investigation is still undergoing, and more data from stakeholders should be gathered.

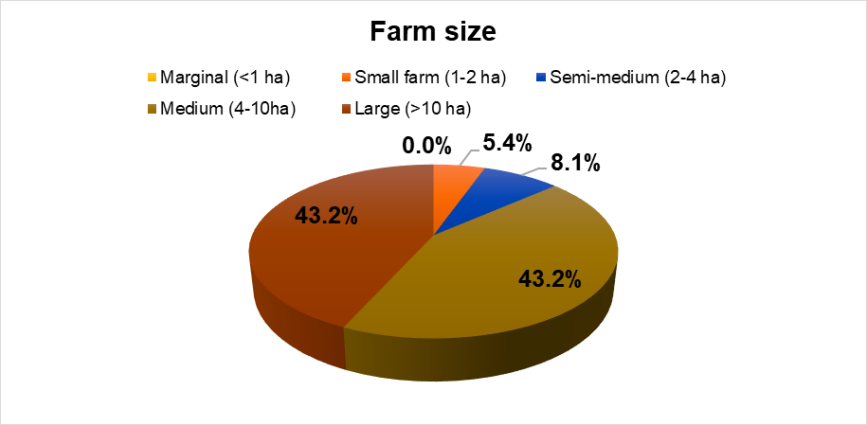


Fig. 51. Farm sizes

The questionnaire revealed that the type of farm of the respondents are concentrated at 63% on conventional farms, 21.6% Traditional Farms, 5,40% Bio farms and 8.10% other type of farms.

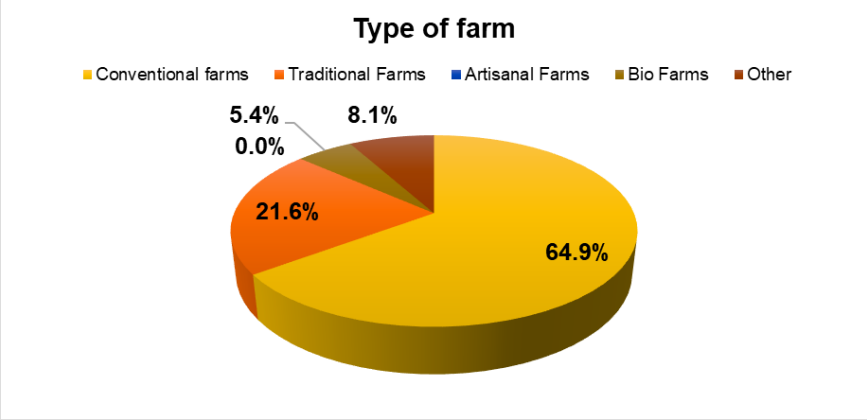


Fig. 52. Type of farm

Moreover, the farmers were asked about their field of activity. Their profiles revealed that the main field of activity are in livestock and crop production and a small amount is involved in agricultural engineering or economics (Fig. 53). Other fields included distribution of the materials and equipment for weed control, pest and diseases detection.

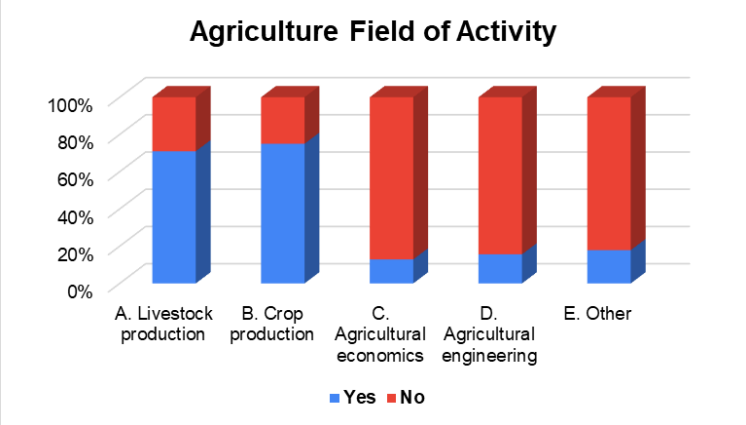


Fig. 53. Agricultural field of activity

In the below picture, from the total number of respondents from the livestock production, is presented the distribution of Cattle, Pigs, Poultry and Sheep farmers (Fig. 54).

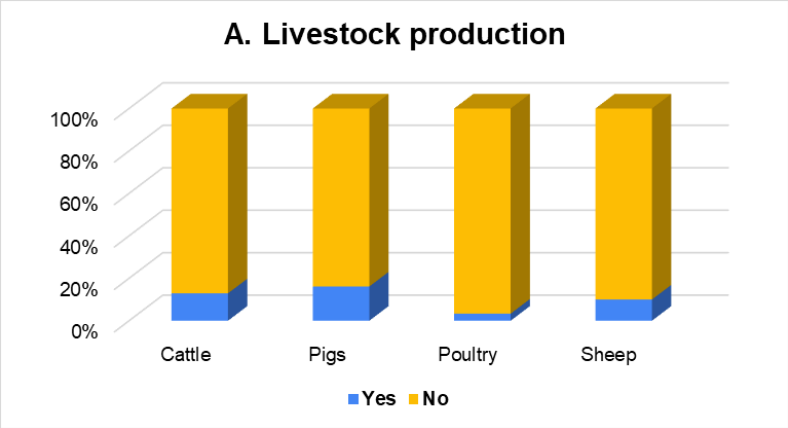


Fig. 54. Livestock production

From the total number of respondents from the crop production, in the below picture is presented the distribution of farmers involved in grains, fruits and nuts, viticulture, vegetable and mixed farmers (Fig. 55).

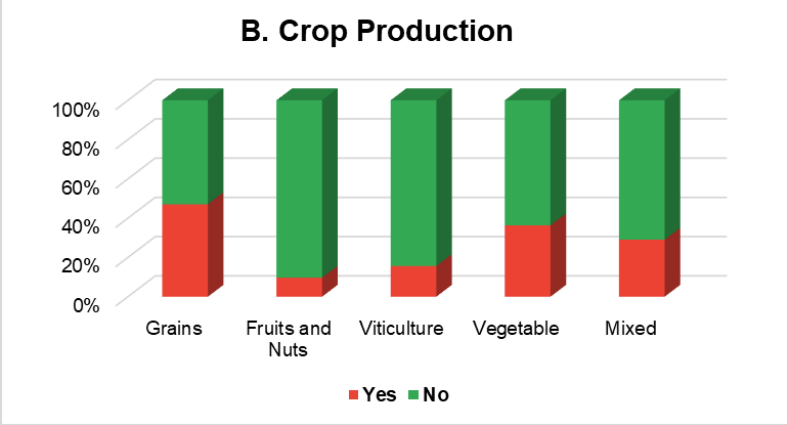


Fig. 55. Crop production

In the below picture, from the total number of respondents from the agricultural economics, is presented the distribution of agrarian system, agribusiness, agricultural extension, agricultural

marketing, custom harvesting, economic development and rural community development (Fig. 56).

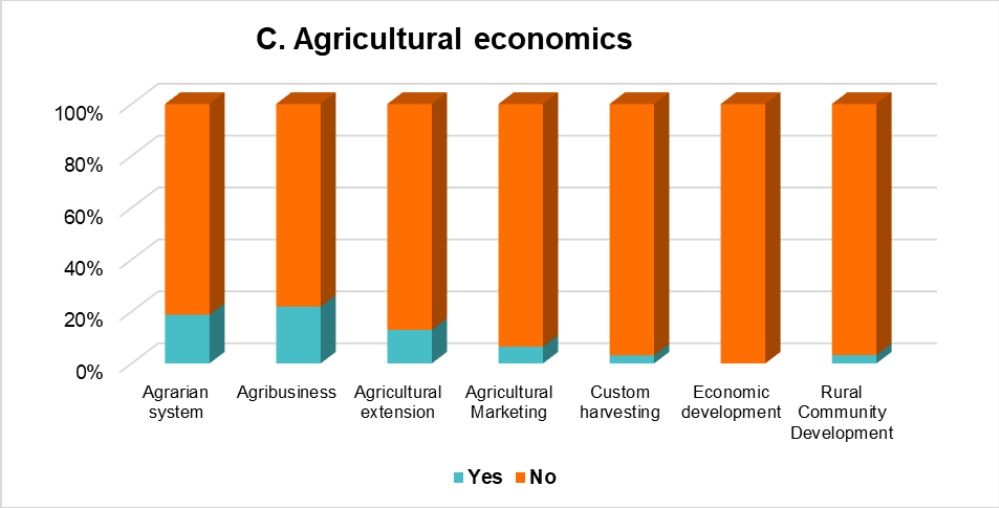


Fig. 56. Agricultural economics

From the total number of respondents from the agricultural engineering, in the below picture is presented the distribution of farmers involved in agricultural machinery, bioprocess engineering, energy & energy efficiency, electronics, farm equipment, food engineering, natural resources, system engineering and workshops (Fig. 57).

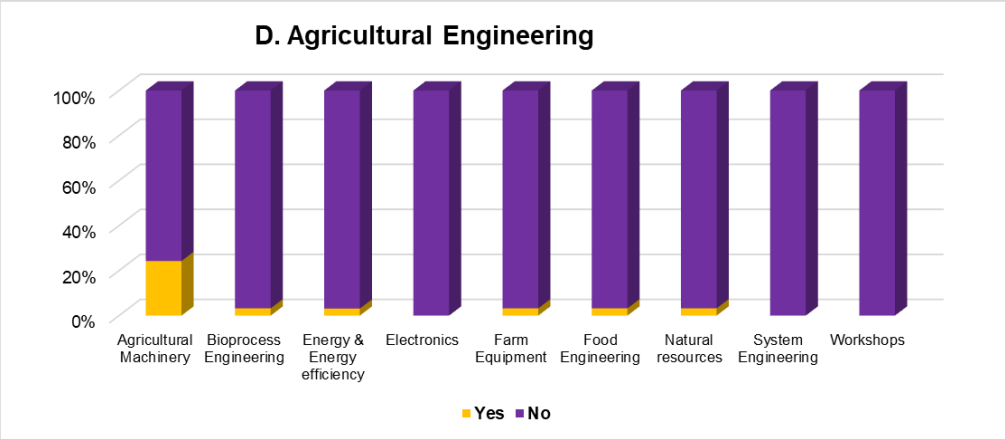


Fig. 57. Agricultural engineering

Another question was related to the stakeholder's awareness about the type of initiatives suitable to promote smart farming within the farming community in South-East region of Romania. The stakeholders considered in a percentage of 98.2% considered that training activities are suitable, 27.3% in information campaigns, 45.5% on online events (workshops, webinars, etc.), 92.7% on demonstrations on-farm and 80% on best practices exchange between farmers (Fig. 58).

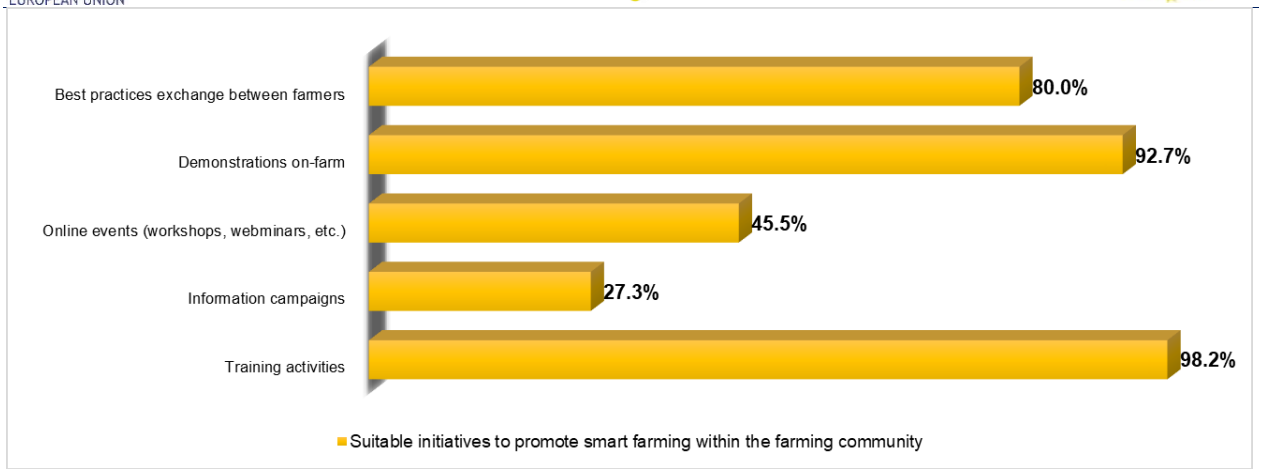


Fig. 58. Type of initiatives are suitable to promote smart farming

The last question was related how the smart technologies and IoT can lead to proper management of the agriculture field and answer to other main socio-economic challenges in your area, such as the brain drain, youth unemployment and brain waste. Figure below depicts the responses of the stakeholders.

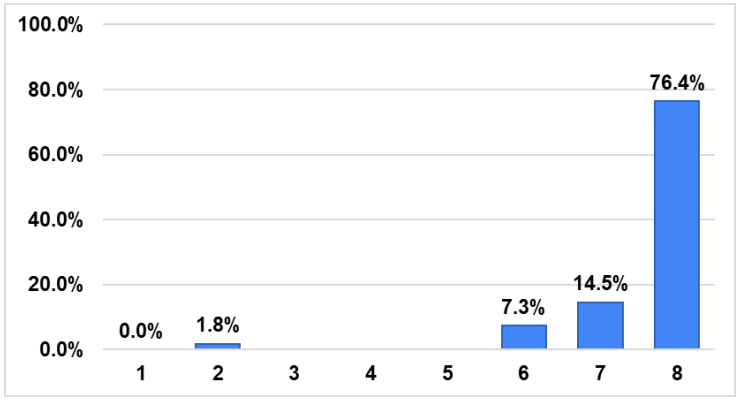


Fig. 59. Smart technologies and IoT and proper management of the agriculture field

4.7. Conclusions and recommendations

Given the present regional analysis of South-East region of Romania, a set of conclusions and recommendations can be drawn, as follows:

- Increase access to technology / information / e-learning etc., by introducing a sustainable ITC infrastructure;
- Increasing receptivity at the level of agricultural holdings to innovative technologies
- Portfolio of results of agricultural research, which are / can be made available to farmers in order to introduce them in the market, in order to increase their competitiveness;
- Development of communication, relationship and leadership skills of stakeholders from agricultural sector;
- The rapid increase and development of e-commerce and the e-business market;
- Increasing the receptivity at the level of farmers and researchers to collaborate in partnership;
- Increasing the degree of access to national / European funding programs dedicated to the innovation and research;

- Development of a system to support effective information / training and support for farmers;
- Adapting training / information / research / consultancy requirements to the needs of farmers;
- support for the promotion of quality products, organic farming, investment in sustainable farms, innovation and livestock welfare;
- Improving the quality of agricultural products obtained from animals that benefit from improved welfare conditions, with benefits on consumer health and food safety;
- Increasing the responsibility of farmers towards the CAP on providing high quality, safe and healthy food, ensuring the welfare of farm animals and protecting the environment and tackling climate change;
- Economic efficiency of extensive / mixed traditional and environmentally friendly agricultural practices.

Chapter 5. Georgia regional analysis

5.1. Georgia's background / situation

5.1.1. Introduction

Georgia, or how we call it "Sakartvelo", is located at the eastern shores of the Black Sea on the southern flanks of the main crest of the Greater Caucasus Mountains. It is bordered by Russia from the north and northeast, Azerbaijan from the east and southeast, Armenia and Turkey from the south. The capital of Georgia is Tbilisi. Georgia is a country of ancient civilization. Its territory was populated 1.7-1.8 million years ago. The archaeological excavations in the south eastern Georgia resulted in a discovery of the human remains the oldest inhabitant of Eurasia and referred to as the "First European".Georgia has very old and rich culture, country has its own, unique alphabet and language, spoken only in Georgia. Georgia is known to be the oldest wine region in the world. The fertile valleys of the South Caucasus, are believed by many archaeologists to be the source of the world's first cultivated grapevines and Neolithic wine production, over 8,000 years ago.Famous trade route, "Silk Road", which connected India and mid Asia with Europe crossed the territory of ancient Georgia, bringing contrasting civilizations and cultures in one place.At the height of its power, Kingdom of Georgia, ruled by warrior Queen Tamar, stretched from shores of Black Sea in the west to shores of Caspian Sea in the east and was one cultural and economic hub of the region. Other notable Kings are David IV the Builder and Giorgi V the Great.The first republic of Georgia (1918-1921) was very progressive and in many way ahead of its time. Georgia was one of the first states in the world which granted women the right to vote. Georgia was occupied by Soviet Russia in 1921, becoming part of the Soviet Union as the Georgian Soviet Socialist Republic. The current republic of Georgia has been independent since 1991. Since regaining independence the country suffered from the political and economic crisis for a while, but since 2000s has been developing steadily.Today, Georgia is a member of the United Nations, the Council of Europe, the World Trade Organization, the Organization of the Black Sea Economic Cooperation, the Organization for Security and Cooperation in Europe, the Community of Democratic Choice, the GUAM Organization for Democracy and Economic Development, and the Asian Development Bank.

Georgia covers a territory of 69,700 square kilometres and its population is about 3.75 million. Georgia is a unitary, semi-presidential republic, with the government elected through a representative democracy. Georgia has a two-level administrative structure of governance – central and local governments.Local self-governance is present in municipalities – self-governing towns and communities. At this point, local self-government is in force in 76 municipalities, including 64 self-governing communities and 12 self-governing cities. Municipalities have their own powers, as well as the statutory powers delegated by the central government. Local self-governance in municipalities is implemented by the local legislative (Sakrebulo- city assembly) and executive (Gamgeoba - municipal government) institutions.

Located in the Caucasus region, on the coast of the Black Sea, Georgia is geographically well-positioned as a gateway between Europe and Asia. The country is perfectly situated for easy access to most major European, Central Asian and Middle Eastern markets and has free trade agreements (FTAs) with most of them. In this way, Georgia already boasts the majority of the preconditions required to become a regional financial and business center. Georgia is a member of WTO and has Most-Favored-Nation (MFN) status with member countries. Georgia has GSP agreements with the US, Canada, Switzerland, Norway and Japan. Georgia has a free trade

agreement with Turkey and Ukraine and preferential access to most countries of the former Soviet Union. Georgia also has a Deep and Comprehensive Free Trade Area Agreement (DCFTA) with the EU, which implies that agricultural products exported from Georgia will freely reach the EU market. In keeping with the European Union–Georgia Association Agreement that came into force in July 2016, the Government plans to harness the gains of deeper integration by promoting the reallocation of capital and labor to more productive industries, building supporting firms to comply with the harmonization of the legal and regulatory frameworks, and upgrading state institutions to improve trade facilitation, reduce technical barriers to trade, protect intellectual property rights, and develop the country's human capital.

Georgia is the birthplace of wine according to a number of the world's competent experts. The mention of the ancient traditions of vine growing and high quality wine growing in Georgia (or Colchis and Iberia, as it was known in ancient times) can be found in the works of Homer and Apollonius of Rhodes. Even the unique Georgian alphabet is modeled after the shape of the vines curly offshoots. Up to 500 indigenous grape varieties are still cultivated here. Wine is part of Georgian heritage including architecture, poetry, and songs, and is associated with celebrations, holidays, rituals and most importantly with Georgia's religion the Christian Orthodox Church. Georgia has an 8000 years history of continuous wine making tradition, which is evidenced by numerous archaeological discoveries. Winemaking remained the basis of the Georgian economy for centuries. Through the long history of the Georgian nation, the vine has gained iconic significance in Georgia. It is a symbol of regeneration, of wealth and plenty.

Georgia is rich with various ecosystems, habitats and their associated species, including the types of species, which are used for or can be potentially used for food or other products. Georgia's biodiversity insures the provision of ecosystem services that are necessary for human life. These services include timber and non-timber forest resources, clean water supply, prevention of erosion, and landslides and the mitigation of their impacts, recreation, tourism, livestock food supply, food and medicinal plants and traditional livestock keeping. Georgia has a very rich flora and fauna. Approximately 4,100 plant species are represented throughout the country, among which, 800 are endemic species. It should be noted that some of these species have nearly disappeared and are now included on the country's Red List. Many species of animal that are in Georgia are very rare globally and are included on the Red List of International Union for Conservation of Nature (IUCN). Georgia is one of the centres of cultural plant origin and diversity. With regard to conservation, especially noteworthy is that there are plants that are cultivated from ancient times (endemic species and local varieties/landraces) and their wild relative species (as a source of cultivation of local species). Many excellent varieties of vines, cereals, and fruit and so on were formed in our country.

Georgia's strong record of economic reforms and improved living standards is being threatened by the impact of COVID-19. The country's economy grew robustly at 5.3 percent per annum between 2005 and 2019, despite major shocks. Poverty declined from 30 percent in 2005 to 14 percent in 2019 (using the US$3.20 purchasing power parity [PPP] 2011 international poverty line). The COVID-19 pandemic, however, will reverse some of these past gains. The country is expected to slip into a deep recession in 2020 (a 6 percent contraction), with severe job and income losses, which could push poverty up by 2.8 percentage points.

The country has a sound macroeconomic framework, an attractive business environment, and robust public financial management arrangements that are expected to support the post-COVID recovery. Georgia's governance indicators typically exceed Europe and Central Asia and upper-middle-income country averages (World Governance Indicators). The country also remains one of the most business friendly countries globally, placing seventh out of 190 countries in the World Bank's Doing Business 2020 rankings.

The country has a shared consensus on national priorities, including participation in Euro-Atlantic integration, more efficient government, stronger growth, and a better functioning welfare state. This has paved the way for the signing of an Association Agreement with the European Union (EU) in 2016, including a Deep and Comprehensive Free Trade Area preferential trade regime. The latest progress report, adopted by the European Parliament on September 17, 2020, confirmed Georgia's continued progress on the implementation of the agreement. Free trade agreements with major trade partners, such as the EU and China, position Georgia well to attract foreign direct investment (FDI).
Today, Georgia has a strong investment offer - It has a stable and growing economy, thriving cities, and competitive costs for operating business. The country is making huge amounts of investments in infrastructure and education to support tomorrow's demands of large-scale impact investments. When combined with the country's strategic location, it's attractions are clear to international investors. Since emerging from the collapsing Soviet Union and regaining independence in 1991, effective reforms in economic policies and governance have earned Georgia a reputation as the top regional and global reformer.

Georgia has diversified GDP structure which is well-positioned for sustainable growth. Due to the devaluation of GEL to USD, the total GDP pointed in USD shows a drop in 2015 but actually GDP real growth rate in 2015 was 3.0%. The GDP compound annual growth rate from 2015 to 2018 reached 4.8 % and Georgia is widely expected to maintain steady growth for the years to come.

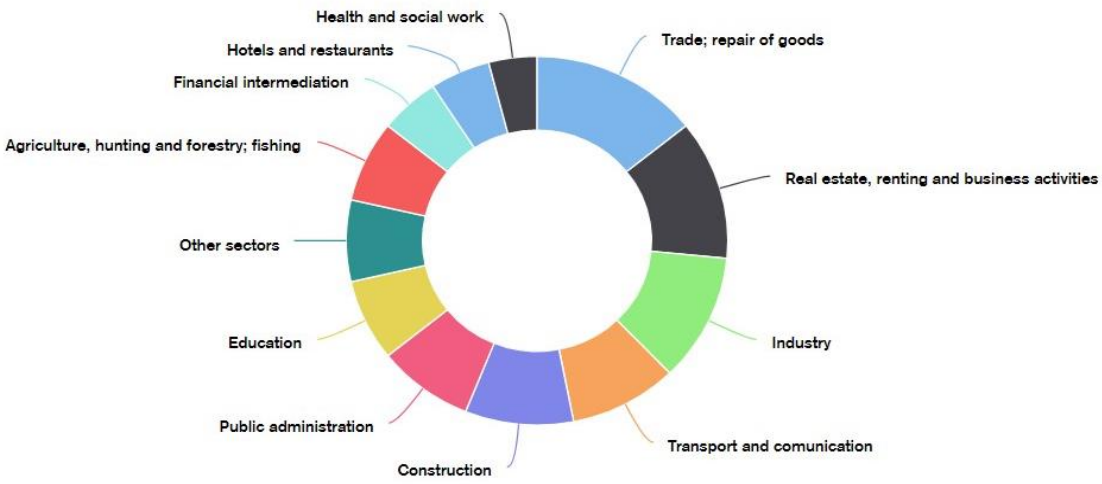


Fig. 60. Diversified GDP structure

5.1.2. Brief description of Georgia agriculture and history

Georgia is rich in agricultural tradition, which is an integral part of its history, mentality and cultural heritage. Agriculture played an important role in the formation of Georgian statehood and contributed much to its economic development. 43.4% (more than 3 million hectares) of the whole territory of Georgia is designated as agricultural land, which also includes pastures and meadows. 43% of the remaining area is covered with forest. Georgia has a wide variety of ecological and climatic zones conducive to the growth of temperate climate and subtropical crops. Those crops include cereals, early and late vegetables, melons and gourds, potato, technical crops, grapes, subtropical crops, fruit varieties etc. As mentioned above Agriculture is a major source of employment and income for Georgia's rural population. Currently, 43% of the total workforce is engaged in agriculture, while 97% of those people are self-employed. There are few opportunities for finding alternative employment in rural areas. In 2015, added value in agriculture (state GDP) amounted to 2,507.6 million GEL, while real growth was 1.5%. According to 2015 data, agriculture

made up 9.1% of Georgia's GDP. 48% of the added value generated in primary production comes from cattle-breeding, while 21% is derived from the production of fruits and nuts, as well as from agricultural crops used for the further production of drinks and spices. The added value created in food processing in that period was about 1,827.8 million GEL, contributing 6.7% to overall GDP. Approximately 39% of the added value created in food processing came from household-based food processing. The production of spirits also makes up a significant share. Agricultural land, including pastures, is spread over more than 3 million hectares in Georgia (43.4% of the territory), while 43% of the rest of the territory is covered by forests. According to the 2014 Agricultural Census, approximately half of the land (47.9%) possessed by households is arable land, 30% of which is uncultivated. One of the main obstacles in the development of agriculture and increasing its competitiveness is land fragmentation caused by land reforms made during the country's most difficult political period (1992-1998). According to the 2014 census, 73.1% of landowners possess land of up to 1 hectare, 25.5% of landowners own land as large as 1 - 5 hectares, and only 1.5% of landowners possesses more than 5 hectares of land. The problem is compounded by the fact that 1 hectare of land owned by a single household is usually divided into 2-3 separate plots. Therefore, the development of a profitable and economically-viable agriculture sector without land consolidation is impossible.

From climatic zones perspective, Georgian biosphere is very diverse and is determined by the existence of 12 different zones and 49 types of soils. Many endemic species create a perfect source for the development of plant growing and cattle breeding. The country is rich in amelioration and potable water resources.From the farming industry standpoint, the diversity is accompanied with difficulties like temperature swings, active erosion and excessive precipitation in some regions. The existing situation takes specific measures to be addressed. Given specific features of its terrain, Georgia is characterized by altitudinal zonality. Only 39% of arable land is located at an elevation of 500 meters above the sea level, 29% - 500-1000 meters above the sea level, 21%- 1000-1500 meters and 11% is located over 1500 meters above the sea level. Georgia has favorable climatic and natural conditions conducive to development of agriculture. However, within the past decades Georgian agriculture and food production has been lagging well behind other sectors of the economy.Rural development has an important role to play in the sustainable development of Georgia. Evidence from the experience of European Rural Development Programmes confirms the role that rural development can play in terms of increasing the welfare of rural populations and reducing the economic imbalance between rural and urban areas.

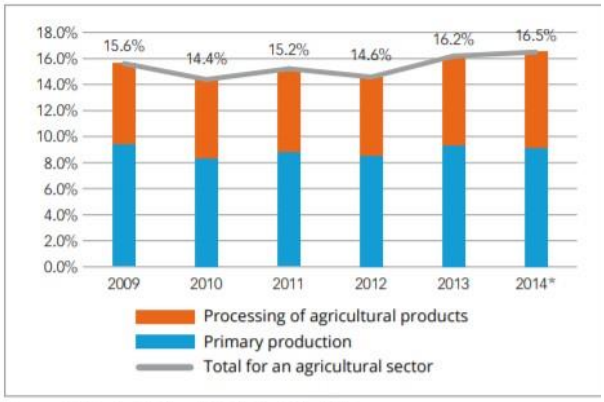
Georgia traditionally has well-developed livestock and plant production. The country is characterized by its complex landscape and diversity of soil conditions. The country is divided into 13 zones, each with specialized agriculture oriented at viticulture, horticulture,fodder production, livestock production, beekeeping, suburban agriculture, tea growing, subtropical crops and even tobacco production. The major industries are viticulture, livestock and fruit (especially citrus) production. Vines and wheat are of especial interest, as Georgia is considered to be the origin of vines. Scientists believe that Transcaucasia is the place of origin of wheat, some 12 species and 30 subspecies of wheat, of which two, Makha and Zanduri, are found only in Georgia.

More than 3 million hectares of the land in Georgia is agricultural. According to the 2014 Agricultural Census, approximately one-fourth (788 thousand hectares) of the land is privatized, i.e. owned by agricultural holdings, while 99.65% of those holdings are households.

5.1.3. Georgian Agriculture in Numbers

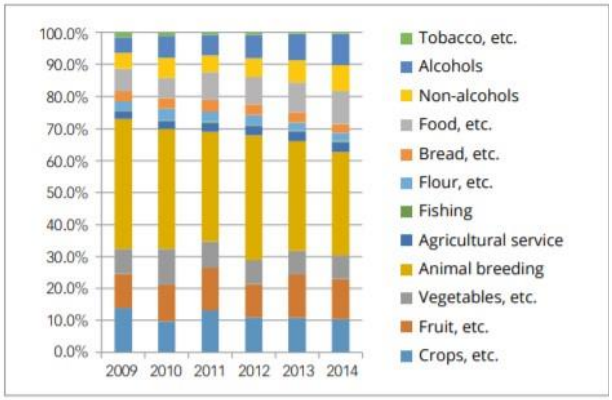
The export of agricultural products amounts to 30% of overall export. Among the important export products are hazelnut, wine, mineral and fresh water, cattle, non-alcoholic sparkling beverages, sheep and citrus. Furthermore, the important export partner countries are Russia, Ukraine, Azerbaijan, Kazakhstan, Germany, Armenia and Italy. The major imported agricultural products

are: wheat, tobacco, poultry meat, sugar, alcoholic beverage, pork, flour-based confectionery, food additives, vegetable oil and fish. The most important importing countries are Russia, Ukraine, Turkey, Brazil, Germany, USA and Armenia.



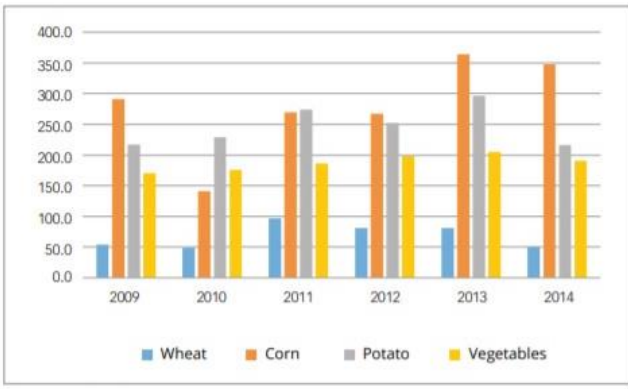
Source: Office for National Statistics, Calculations

Fig. 61. Share of agriculture and Food in GDP



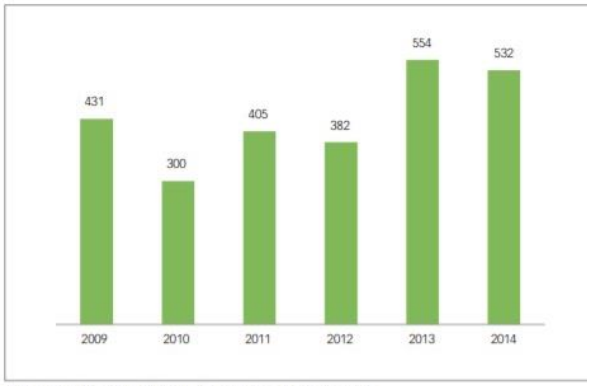
Source: Office for National Statistics, Calculations

Fig. 62. Share of industries in GDP of Food and Agriculture Sector



Source: Office for National Statistics

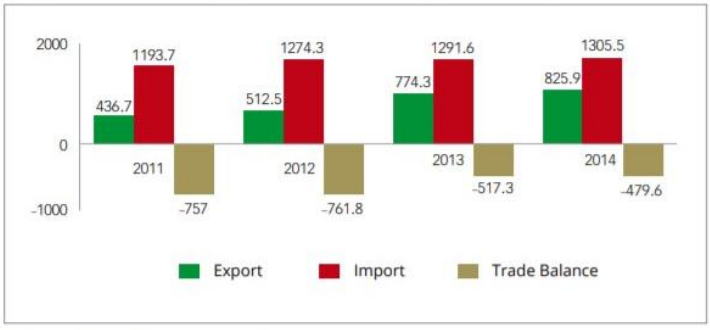
Fig. 63. Pruduction of annual crops, 1000 tones



Source: Office for National Statistics, Calculations

Fig. 64. Production of perennial crops, 1000 tons

In recent years the export and import of agricultural products has been characterized by growth trend. The agricultural products' export growth rate was always higher than import.



Source: Office for National Statistics, Calculations

Fig. 65. Trade with Agricultural products, million USD

5.2. Agriculture policies in Georgia

Agriculture, tourism and rural development are of great importance for the sustainable economic development and inclusive economic growth of the country. Since 2012, the Government of Georgia has taken important and unprecedented steps for the country for agriculture and rural development, which is reflected in large-scale state investments in these areas. Nevertheless, Georgia's rural area still faces many challenges. The implementation of the Agriculture and Rural Development Strategy 2021-2027 will address the existing challenges and make a significant shift in the direction of socio-economic development in rural areas.

Maximum utilization and targeted use of Georgia's agricultural potential is vital for the country's economy. That is why the first guarantee of achieving positive results will be the development of a clearly defined, competitive production policy and the promotion of financial resources in this sector of the economy. At the same time, the issue of ensuring the country's food security and food safety is especially important, which is a key responsibility of the Government of Georgia. The development of rural areas in Georgia is important for solving such tasks as: food security, environmental protection, economic development, creating a high standard of living and state security.

The introduction of integrated natural resource management practices in the country plays an important role in rural development, in particular the sustainable management of forest resources, which "ensures continuous direct or indirect benefits and resources for the country's population and the functioning of various sectors of the economy, human well-being." Eradicating poverty and creating an environment conducive to the sustainable development of the country.

The 2021-2027 Agriculture and Rural Development Strategy is based on the experience and results of existing strategies, the reforms implemented and the experience of the European Union. The strategy is developed based on the analysis of the agricultural sector and the current situation in Georgia and it reflects the existing assessments, implemented and ongoing programs. The strategy envisages the priorities of the Government of Georgia and sectoral or multi-sectoral development directions, which are related to agriculture and rural development.

Evidence from the experience of European Rural Development Programmes confirms the role that rural development can play in terms of increasing the welfare of rural populations and reducing the economic imbalance between rural and urban areas. The rural potential to deliver innovative, inclusive and sustainable solutions for current and future societal challenges such as economic prosperity, food security, climate change, resource management, and social inclusion should be better recognised. Rural and agricultural policies should build on the identity and tendencies of rural areas through the implementation of integrated strategies and multi-sectorial approaches. They should promote diversification and foster entrepreneurship, investment, innovation and employment. These policies should also add value to rural identity and enhance sustainability, social inclusion and local development, as well as increase the resilience of farms and rural communities.

An integrated and strategic approach to energising the rural areas of Georgia would consist of a package of measures, which would improve the livelihoods of rural populations, while at the same time protecting and enhancing their cultural heritage and the natural environment within which they live. Such measures might include the promotion of diversified economic activities, the development of new economic opportunities for the local population, and the uptake of innovations and modern technologies in agriculture, the support for an increase in the production and promotion of agriculture products, the increase in thecompetitiveness of the farming sector, and help enable the sustainable management of forest and natural resources. Social inclusion

and the active participation of the local population in the identification of solutions to address their needs is also of outmost importance. At this point, Georgia has no integrated rural development policy. However, rural development policies and programmes are successfully being implemented among EU member states, as well as in many other countries throughout the world.

According to Chapter 10 (Agriculture and Rural Development) of the Association Agreement between Georgia and the EU signed on June 27, 2014, Georgia has an obligation to adopt an agriculture and rural development policy that is compliant with EU policy and European best practices. Georgia also has an obligation to harmonize the country's legislation with European legislation and expand the power of the central and local governments in order to comply with policy planning and evaluation frameworks that meet European standards. "The Parties shall cooperate to promote agricultural and rural development through the progressive convergence of policies and legislation" (Article 333, Association Agreement). The EU's, six priorities for rural development through 2020 address economic, social and environmental challenges: 1. Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas 2. Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests 3. Promoting food chain organisation, including the processing and marketing of agricultural products, animal welfare and risk management in agriculture 4. Restoring, preserving and enhancing ecosystems related to agriculture and forestry 5. Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors 6. Promoting social inclusion, poverty reduction and economic development in rural areas.

The Regional Development Programme of Georgia is a medium-term government document setting out main goals in Georgia's regional development and determining priorities and measures for the period 2018–2021. The Programme follows up on the national planning documents: the Social-economic Development Strategy of Georgia ("Georgia 2020), the State Strategy for Regional Development 2010-2017 and the Regional Development Programme 2015-2017. The Programme's strategic vision and delivery modalities are in line with the European Union recent approaches to social-economic cohesion policy, including territorial integrated interventions and focus on the exploitation of territorially differentiated potentials. The Programme provides a coherent framework for public and private investments promoting regional development, enabling all stakeholders to concentrate resources along a single, common strategy in order to maximise the effectiveness and efficiency of intervention.

In 2012, in order to promote the development of agriculture, the Agriculture Projects' Management Agency (APMA) was established under the Ministry of Agriculture of Georgia. The agency implements projects initiated by the Ministry of Agriculture. Currently, RDA(Rural development Agency), is administering the following state programmes:

- Plant the Future - Aims to use agriculture lands effectively by planting perennial crops
- Produce in Georgia - (agriculture component) Aims to develop production-oriented enterprises, create new enterprises and promote the development of existing ones in order to ensure the production/processing of agriculture products
- Agro Insurance - Aims to develop the insurance market in the agricultural sector, promote rural activities, maintain the income for people engaged in those activities and reduce the risks
- Co-financing of Agro Processing and Storage Enterprises - Aims to facilitate the development of agriculture processing, as well as storage facilities and services
- Preferential Agro Credit Program - Aims to encourage primary agricultural production, its processing and the storage-sale processes ,by providing farmers and entrepreneurs engaged in agriculture with access to long-term preferential financial resources

- Georgian Tea Plantation Rehabilitation Program - Aims to effectively use the potential of tea plantations already existing in Georgia, promote and facilitate the production of local tea (including bio-tea), increase the level of domestic supply and enhance export capabilities.
- Program of Agri-Production Promotion
- Young Entrepreneur-The program supporting young entrepreneurs in rural area, - "Young Entrepreneur" is designed for young people being residents of Georgia and desiring to conduct a business activity in Georgia.
- Program of Co-financing of Agricultural Machinery-The aim of the Program of co-financing harvesting agricultural machinery is to increase the access to harvesting agricultural machinery (any type of harvesting equipment, both self-propelled and trailers, except for grape harvesting equipment).
- Farms/Farmers Registration Project-The "Project of registration of farms/ farmers" regulates a system of the united registry of farmers/farms which will consolidate information on the entities employed in the agricultural activities, their agricultural-economic activities and agricultural assets existing in their ownership/maintenance in the united electronic database.
- Agro-diesel support program-Under the program, individuals and legal entities owning a 0.25 to 100 hectare of agricultural land plots registered with the National Agency of Public Registry will be able to purchase diesel at a discounted price.
- Program of Stimulating Agricultural Land Owners-The program provides subsidies for the cost of agricultural goods and plowing services. In order to receive the subsidy provided by the program, individuals and legal entities need to own a plot of agricultural land registered in the Public Registry.
- State Programme of Dairy Modernization and Market Access (DiMMA)-The goal of the State Program of Modernize the dairy industry and Market access is to develop the rural economy by promoting the establishment of a competitive, diversified and sustainable dairy industry.

in June 2014 the Ministry of Economy and Sustainable Development of Georgia, together with the Ministry of Agriculture, launched a new government program "Produce in Georgia." The program's objective is to promote an entrepreneurial culture throughout the country by stimulating the establishment of new enterprises and supporting the expansion of existing operations. Enterprise Georgia is the key implementing partner of "Produce in Georgia" and is responsible for business support, export promotion and investment in Georgia sectors. The Business division of the agency promotes entrepreneurial activity in Georgia by supporting entrepreneurs - assisting with the creation of new enterprises as well as the expansion and refurbishment of existing enterprises. The Export division promotes the export potential of the country by increasing the competitiveness of local products and the overall volume of goods directed towards international markets. The Invest division's primary role is to attract, promote and develop direct foreign investment in Georgia. As the moderator between foreign investors and the Government of Georgia, the Invest division ensures access to updated information, provides an efficient means of communication with Government bodies, and serves as a "one-stop-shop," supporting investors throughout the investment process.

- Produce in Georgia – a) A business component aimed at supporting entreprises – both new and existing ones – and providing them with new equipment, assisting in the growth of their competitiveness and enhancing export potential through improving access to the private sector and finance, property and technical assistance. b) A hotel development component, which aims to support entrepreneurs in constructing new hotels and/or developing existing infrastructure in the regions (except Tbilisi and Batumi). It also attracts international operators to enter the Georgian market and provides local operators the opportunity to obtain an international franchise (Management Contract).

- Facilitation of Micro and Small Entreprise development - This programme falls within the framework of the 'Produce in Georgia' programme, and is aimed at facilitating the growth of entrepreneurship in economically vulnerable regions of Georgia, and provide financial and technical aid to micro and small enterprises, support micro and medium business start-ups, support the quality enhancement of products and promote the diversification of local products on regional markets.

5.2.1. Supporting innovation

In order to facilitate the development of innovations and modern technology, in 2014 the Agency for Innovations and Technologies was established under the Ministry of Economy and Sustainable Development of Georgia. The agency aims to provide incentives for the development of innovations, advanced technology, the promotion of research and development (R&D), and to support their commercialization and use. The agency also sets out to support establishment of innovative start- up companies and enhancement of their competitiveness. Currently, the agency is carrying out infrastructure projects in the regions that support innovation and technology development. Industrial innovation labs, regional hubs and innovation centers are being established, with the goal of raising the skills of the local population in the field of technology and innovation, encouraging innovative ideas, and facilitating their replication and commercialization.

5.2.2. Rural infrastructure

Rural infrastructure – particularly local and small-scale rural infrastructure – can be improved through well-targeted rural development interventions. Active participation and consultation with rural stakeholders is crucial in this process. As such, the Government of Georgia is implementing major projects in this regard.
These projects include:

- Rural Support Program. In order to develop rural infrastructure and meet other needs, the Rural Support Program was set up in 2009. The programme contributes to the financing of priority state infrastructure projects. The programme also allows for the provision of information and consultation with the local population regarding the projects. Funds allocated by the programme should be spent on construction, rehabilitation and/or improvement of the local infrastructure, providing equipment for public buildings, and/or the purchase of technology for long-term use. In addition, it must have a positive social and economic impact for the majority of the population.
- Fund for Projects Implemented in Regions. The Fund for Regional Projects finances both local and regional projects, including roads, underground utilities, sidewalks, the repair of water supply/sewage systems, bridges, the installation/repair of outdoor lighting; construction of drinking water wells, management of sewage systems and municipal waste management, and the repair/rehabilitation of residential and public buildings.

5.2.3. Providing the Agricultural Extension Service

Purpose of the activity: to support farmers and rural population engaged in agriculture in growing the agricultural crops, introducing new technologies and innovations for storing and processing the harvest, to enhance knowledge and to share experience, to promote the implemented and ongoing projects of the agency.

Ways of providing the consultations:
- Consultations at offices (legal entities, natural persons)
- Telephone conversations, text messages
- Visits of interested individuals (farmers) to land parcels
- Group meetings with farmers in the villages

- Meetings at community centers of the Ministry of Justice
- Emails and social networks

5.2.4. Technical Assistance

Introduction of international standards
Project beneficiaries: all the beneficiaries, who are financed with the purpose of setting up the processing enterprises within the framework of the project for co-financing the processing and storage enterprises, are obliged to implement ISO-22000 or HACCP international standards.

5.2.5. Georgian Amelioration

Given the climate conditions of Georgia, the issues of land amelioration, construction of irrigation and drainage systems, their operation and management are important, which should create all the necessary conditions for the intensive and effective agricultural production. Georgian Amelioration Ltd is a company supplying irrigation and drainage services to agricultural lands. The company provides the following services: to supply water to hydropower stations, enterprises and ponds. The company provides services to the entire country through its 20 service centers. With the purpose of increasing the fund of ameliorated agricultural lands, Georgian Amelioration Ltd carries out large-scale works for the rehabilitation of amelioration infrastructure that has been out of service for decades. Organizing the amelioration systems will significantly develop the agricultural sector. Average yield per hectare will improve and increase. In this respect, there have been significant breakthrough and achievements. The area of ameliorated lands increases every year, which creates an additional incentive for the rural population to get back to land cultivation.

The National Food Agency is the only agency in the country that carries out the state control in the areas of food safety, veterinary and plant protection, main function of which is to ensure the protection of human life and health through providing safe food products. The agency carries out its activities in all the regions of Georgia. The local population are able to enjoy the services provided by the National Food Agency for ensuring food safety, veterinary and phytosanitary reliability. State control of food safety aims at protecting human life, health and consumer interests, which is implemented based on the risk through the following mechanisms: inspection, supervisions, monitoring, sampling, and document review.

The Scientific-Research Center of Agriculture Carries out its activities in the following directions: to develop the agrarian science, agriculture and food production, namely: to preserve agro-biodiversity of plants and animals, to support artificial insemination of animals and breeding activities, to test plant species and to revive the selection activities, to elaborate the standards and certification systems for seed and planting materials, to disseminate new technologies, to ensure risk assessments in the field of veterinary and plant protection, to elaborate bio methods, to develop bio farming and to support the extension of agricultural entities.

Main area of activities of the LEPL National Wine Agency is to support the development of viticulture and winemaking. To this effect, the National Wine Agency implements the following programs:

- Activities to support the promotion of Georgian wine
- Vintage support activities
- Activities for viticulture development
- Research and promotion of Georgian vine culture
- Laboratory research of wine

5.3. Funding initiatives in Smart Farming from Georgia

The Government of Georgia is implementing state programmes for local economic development and promoting access to financial resources, physical infrastructure and modern technologies for the local population. Since 2013, the Agricultural And Rural Development Agency has been implementing the following projects with state co-financing and technical support:

1. Preferential Agri-Credit Project
2. Co-financing of Agri Processing and Storage Enterprises
3. Agri-insurance
4. Plant the Future
5. Tea Plantations Rehabilitation Program
6. Program of Agri-Production Promotion
7. Young Entrepreneur
8. Program of Co-financing of Agricultural Machinery

5.3.1. Preferential Agri-Credit Project

The project has been implemented since 2013. The project goal is to support the primary agricultural production, processing, storage and sales of agricultural output through promoting access to finances for agricultural producers. Within the framework of the project, farmers and enterprises engaged in primary agricultural production, processing and storage-sale, get preferential agri-credit and agro-leasing from financial institutions for their fixed and current assets. There is a subcomponent for the agricultural mechanization added to the project's fixed assets component, within the frameworks of which the preferential agro-credits will be issued only for the purchase of agricultural machinery and/or implements. Credits/leasing are issued by commercial banks/financial institutions involved in the project (12 banks and 3 leasing companies), and the agency provides co-funding for loan interest rates/leasing fees. It should be mentioned that making the banking/leasing sector interested in the agricultural sector is one of the most important achievements of the project, which promotes the agricultural development.

The following interest rates apply based on the loan amount and purpose:
Agricredit for fixed assets, in case of the fixed interest rate:

from 20,000 GEL to 150,000 GEL, inclusive	no more than 16%
from 150,001 GEL to 600,000 GEL, inclusive	no more than 15%
from 600,001 GEL to 1,500,000 GEL, inclusive	no more than 14%

Agri credit for fixed assets, in case of the floating interest rate:

From 20,000 GEL to 150,000 GEL, inclusive no more than 8% added to the refinancing rate set by the National Bank
from 150,001 GEL to 600,000 GEL, inclusive no more than 7% added to the refinancing rate set by the National Bank
From 600,001 GEL to 1,500,000 GEL, inclusive
no more than 6% added to the refinancing rate set by the National Bank

The agency provides the interest rate co-financing in the amount of 11%, for no longer than 66 months. For the grape processing enterprises, for which the total residual amount of their current preferential agrocredit(s) under the subcomponent ranges between 1,500,001 GEL to 5,000,000 GEL, the Agency provides co-financing of interest rate in the amount of 10%, for no longer than 24 months.

Agri-credit for agricultural mechanization, in case of the fixed interest rate:

from 20,000 GEL to 150,000 GEL, inclusive	no more than 16%
from 150,001 GEL to 600,000 GEL, inclusive	no more than 15%
from 600,001 GEL to 1,500,000 GEL, inclusive	no more than 14%

Agri-credit for agricultural mechanization, in case of the floating interest rate:

From 20,000 GEL to 150,000 GEL, inclusive no more than 8% added to the refinancing rate set by the National Bank
from 150,001 GEL to 600,000 GEL, inclusive no more than 7% added to the refinancing rate set by the National Bank
From 600,001 GEL to 1,500,000 GEL, inclusive
no more than 6% added to the refinancing rate set by the National Bank

The Agency co-finances the interest rate in the amount of 11%, for no longer than 66 months.

Preferential agro-credit - interest rates within the agricultural framework of the state program Enterprise Georgia
From 1,500,000 GEL to 3,000,000 GEL, inclusive no more than 6% added to the refinancing rate set by the National Bank
from 3,000,001 GEL to 5,000,000 GEL, inclusive no more than 5% added to the refinancing rate set by the National Bank

The agency co-finances the interest rate in the amount of 10%.

Since the beginning of the Preferential Agri-Credit Project (March 2013) until 2019, inclusive, the following loans were disbursed throughout Georgia:
For current assets: 11,843 loans with the value of 534,229,056 GEL
For fixed assets: 28,386 loans with the value of 1,749,792,079 GEL. 7
In total, 40,124 loans with the amount of 2,260,082,131 GEL and 105 leasings with the amount of 23,939,004 were disbursed during 2013-2019.
There were 12,600 new jobs created since launching the Preferential Agri-Credit Project in 2013 until December 2018, inclusive. The number of actual employees is in fact more, because the obtained data is received only according to the indicators of beneficiaries who are registered as taxpayers.

5.3.2. Project - Co-Financing of Processing and Storage Enterprises

The project is comprised of two components:
- Processing enterprises co-financing component;
- Storage facilities co-financing component.

Processing enterprises and storage facilities are co-financed through the following sources:
- Co-financing by the Agency - no more than 50% of the total project value, but no more than 600,000 GEL;
- Preferential credit/leasing - no more than 1,500,000 GEL;
- Co-participation of beneficiaries and/or alternative funding source for project financing.

5.3.3. Program of Agri-Production Promotion

The program is implemented within the framework of Agriculture Modernization, Market Access and Resilience Project (AMMAR). The program is funded by the International Fund for Agricultural Development (IFAD) and the Global Environment Facility (GEF). The program started in 2016 and it is implemented by the Agricultural and Rural Development Agency. Primary processing component Program beneficiaries: farmers and commercial legal entities, which intend to upgrade existing orchards or to plant new ones, to arrange/upgrade greenhouse farming, to purchase agricultural machinery, to purchase anti-frost and anti-hail systems, to purchase the equipment required for primary treatment/processing of harvest and to arrange the infrastructure required for primary warehousing of their harvest. Main conditions of the program: a beneficiary gets co-financing from the state in the amount of 40% of the total project value; the beneficiary co-participation is 60%. For agricultural cooperatives, the maximum amount of state co-financing is the GEL equivalent of 150,000 USD and for other entities - the GEL equivalent of 15,000 USD. Component of processing enterprises and storage facilities Program beneficiaries: commercial legal entities, which are willing to modernize the existing processing/storage enterprises, or to set up new processing enterprises/storage facilities. Main conditions of the program: a beneficiary gets co-financing from the state in the amount of 40% of the total project value; the beneficiary co-participation is 60%. Maximum amount of state co-financing is the GEL equivalent of 100,000 USD.

5.3.4. Tea Plantation Rehabilitation Program

Goal of the program is to rehabilitate the state-owned and private tea plantations, to maximize the tea potential, to create modern tea processing enterprises and to promote the local tea (among them bio-tea) production. The program has been implemented since 2016. Within the framework of the program, legal entities (except the agricultural cooperatives), which own land parcels, will receive 60% of the funds needed for the plantation rehabilitation, and in case of leasing the land plots, the co-financing volume will increase up to 70%. If the agricultural cooperatives own their land, they will receive 80% of the money required for plantation rehabilitation, and in case of leasing the land parcel - 90%. After the plantation rehabilitation, agricultural cooperatives will receive all the equipment and appliances required for primary tea processing from the state for free.

Program for Supporting Young Entrepreneurs in Rural Areas – “Young Entrepreneur” The program has been initiated by the Ministry of Environmental Protection and Agriculture of Georgia, and it has been implemented since 2018 by the N(N)LE Agricultural and Rural Development Agency, with the funding of the donor organization Danish International Development Agency (DANIDA). Program beneficiaries: individual entrepreneurs willing to start up a new business in the regions, aged 18- 35 in case of men, and aged 18-40 in case of women; agricultural cooperatives, founders/shareholders and board chairpersons/director(s) of which are men aged 18-35 and/or women aged 18-40. Basic terms and conditions of the program: within the frameworks of the program, funding is provided both for agricultural and non-agricultural business activities. The state co-finances no more than 40% (no more than 60,000 GEL) of the investment value of the project described in the business plan. The project investment value should be no less than 10,000 (ten thousand) GEL.

5.4.5. The Program “Plant the Future”

The program implementation started in March 2015 and its main goal is to effectively use the agricultural lands in Georgia through planting perennial cultures, as a result of which the imported products will be replaced by the Georgian ones, the export will grow, it will be easier to provide raw materials to processing enterprises, and the social-economic conditions of rural population

will improve. The program Plant the Future consists of two components and one subcomponent: component for cofinancing of perennial orchards, component for co-financing nurseries, and subcomponents for financing the berries. Orchard component Under the component of perennial orchards, the following costs will be financed: 70% of cost of young trees, and in case of agricultural cooperatives, villages situated along the administrative border line and high-mountainous settlements - 80% of cost (maximum funding per young tree is determined), 50% of cost of drip irrigation system, and 60% of costs for the cooperatives with the agricultural status, villages situated along the administrative border line and high-mountainous settlements (it is determined to allocate no more than 2,500 GEL per 1 ha for arranging the drip irrigation system). A beneficiary can participate in the state program Plant the Future several times; however, the total amount of the received funding should not exceed 250,000 GEL, and the total area or for the planted orchards should not be more than 50 hectares. Within the frameworks of the orchards component of the program, funding will be provided for planting at least 0.5 ha of perennial orchards by one beneficiary. Volume of co-financing should not exceed 10,000 Gel per 1 ha. The maximum limit for blueberries is 15,000 GEL per 1 ha. 28 Under the orchards components, at first, 70% or 80% of the cost of young trees will be financed, and from the remaining difference - the drip irrigation system will be financed.

5.4.6. Agricultural Insurance Program

Goal of the agri-insurance program is to develop insurance markets in the agricultural sector, to support agricultural activities, to maintain revenues for the individuals engaged in agricultural activities and to minimize the risks. The program has been implemented since 2014. Within the framework of the agri-insurance program, the farmers are able to insure their harvest against the hail, flood, hurricane and frost in the fall. Within the framework of the program, it is possible to insure the land area of no more than five hectares, except the grain crops, where the maximum land area is 30 ha. In case of agricultural cooperatives, the maximum amount of insurance premium is 50,000 GEL, and there is no limit for the area of the land to be insured. A farmer who purchases the insurance under the program, well get the funding to cover the following share of costs: 50 % - in case of insuring the vine 70 % - in case of insuring all the other crops.

5.4.7. Program of Co-financing the Agricultural Machinery

The state program for co-financing the agricultural equipment envisages co-financing the following agricultural equipment: Any type of harvesting equipment, both self-moving and attached; Agricultural tractors; Agricultural trailers (implement and rototiller). The amount of agency co-financing per beneficiary is no more than 50% of the cost of agricultural equipment to be purchased, but no more than 150,000 GEL. The agricultural equipment to be purchase should be new (not used), namely, it should meet 2 conditions: The agricultural equipment should be produced no earlier than two calendar years before its purchase; At the moment of purchasing, the agricultural equipment should have an effective warranty. The program beneficiary should be a natural person who is a citizen of Georgia, or a sole trader, or a commercial legal entity registered in accordance with the law (among them, an agricultural cooperative, where the state does not have any share /stake/stocks).

5.4.8. Programs for Supporting the Development of Agricultural Cooperatives

There are many state programs implemented with the purpose of supporting the business-oriented farmers unions and agricultural cooperatives. In 2019, there was a registration announced for the programs focused on supporting the agricultural cooperatives in various sectors, which includes the financial support for the introduction of food safety international system for primary and processing enterprises, and for promoting the produced output. By 2019,

within the framework of the “State program for the rational use of state-owned hayfields and grazing fields in high-mountainous regions”, total of 7,649 ha of hayfield and grazing fields were handed over to 23 agricultural cooperatives out of 38 cooperatives participating in the program, with the 25 year leasing rights. these 23 agricultural cooperatives were received the tractors and trailer equipment with 90% co-financing. For the remaining 15 cooperatives, there are procedures underway as envisaged by the program for the handover of hayfields and grazing fields, and equipment as well. The goal of the state program for supporting the agricultural beekeeping cooperatives is it to improve the material and technical resources of beekeeping holdings of agricultural cooperatives, to improve the quality and to increase the volume of honey and other beekeeping products. Various types of beehives will be handed over to the entities participating in the state program, as a grant covering 30% of the cost. There were seven applications registered as the results of the registration announced within the framework of the program. 37 State program for supporting the dairy producing agricultural cooperatives aims to promote the production of milk and dairy products in Georgia. Within the framework of the program, the agricultural cooperatives registered in high-mountainous settlements will receive 95% co-financing for purchasing the milk processing equipment and appliances, with no more than 150,000 GEL, and 90% co-financing in the remaining territory of Georgia, with no more than 150,000 GEL. There were three applications registered as a result of the registration announced within the framework of the program. State program for supporting the viticulture agricultural cooperatives aims to support processing of grapes produced in the country, among them those produced by agricultural cooperatives; to set up the grapes receiving-processing enterprises equipped with modern technologies within the frameworks of agricultural cooperatives; the agency co-financing includes no more than 90% funding for purchasing the equipment and appliances required for processing no less than 100 tons of grapes, with no more than 500,000 GEL, and 95% of funding in a high-mountainous settlements, with no more than 500,000 GEL. There were 8 applications registered as a result of the registration announced within the framework of the program. State program for branding and introducing the international standards at agricultural cooperatives aims to support the cooperatives to ensure that their production processes are compliant with European standards, and it also aims to promote their output. In case of threats analysis and introduction of system of critical control points, a beneficiary will cover no less than 10% of service fee, and the Agency will cover no more than 90%, where the maximum amount shall not exceed 13,500 GEL. When engaged in the branding component, an agricultural cooperative can request co-financing for the purchase of equipment needed for finalizing/branding the products. No less than 30% of equipment costs will be covered by the beneficiary and no more than 70% - by the Agency, where the maximum amount shall not exceed 10,000 GEL. There were 4 applications registered as the result of the registration announced within the framework of the program.

Projects initiated with the financial support of donor organizations in the field of environmental protection and agriculture:

- Food for Progress Donor - United States Department of Agriculture (USDA) 156 A 5-year project (2018-2023) “Investing in safe and quality cattle breeding”, which aims at enhancing the competitiveness of representatives of cattle breeding, dairy and meat producing industries in Georgia, and enhancing the volume of added value created locally in these sectors. In order to reach this goal, the project will support to improve food safety and quality standards, develop the business models, enhance the product quality, and introduce innovative and marketing instruments.
- Rural and Agriculture Development Project Donor: Austrian Development for a Corporation (ADC) A 4-year project aims to elaborate a rural development policy in Georgia, to improve the value chain, sustainable use of natural resources, and to develop environment friendly agricultural practices. EU for Environment Donor - European Union Goal of the 4-year project is to assist the EU partner states to maintain and better use their natural capital, enhance the

environmental welfare of all population and seize new opportunities emerged in regard to the development.

- Hazardous Waste Management Project of Georgia - Investments Donor: EBRD European Bank for Reconstruction and Development The project will support the establishment of management system for non-hazardous waste, which is not harmful for the environment, and will ensure a clean and safe environment. Within the framework of the project, the hazardous waste will be collected, treated and separated in accordance with the European standards.
- Hazardous Waste Management Project of Georgia - to support the project implementation, corporate development and stakeholder engagement Donor: EBRD - European Bank for Reconstruction and Development The project will support the implementing partner in regard to sales, tender preparation and evaluation, financial control, project management and reporting.
- Capacity Building for the Ministry of Environmental Protection and Agriculture while Nationalizing the Sustainable Development Goals, for Speeding up the SDG Implementation Donor: Food and Agriculture Organization Goal of the project is to raise awareness of the Ministry of Environmental Protection and Agriculture and other stakeholders, into building capacities in regard to sustainable development goals, to ensure that the 157 goals are implemented, and monitoring is carried out in a focused way, with more engagement of agencies, under a clear coordination. As a result, the Ministry will be able to overcome the difficulties identified in the process of nationalization of Sustainable Development Goals, their implementation and monitoring. Within the framework of the project, technical seminars will be held for the representatives of the Ministry and local stakeholders on awareness raising and capacity building. Also, the project will assist the Ministry to implement SDGs related to agriculture, and to carry out the biannual monitoring action plan.
- Conservation of landscape biodiversity at Chachuna protected area, in support to its revival Donor: Society for nature conservation (SABUKO) The project aims at implementing the procedures related to the restoration of rainforests at Chachuna protected area (Chachuna sanctuary); to conduct restoration works at the pilot pasture with the area of 900 hectares, with the purpose of restoring the environmental processes, biodiversity and productivity in this section. With the purpose of long-term sustainability, to manage the grazing process by involving shepherds and other local stakeholders dinner regeneration activities. Youth for Sustainable Development:
- Establishment of Democratic and Peaceful Society Based on Environmental Activities. Donor: EUMM mission of the European Union to Georgia There were eco-clubs created at schools in the occupied/breakaway territories (Gali and Ochamchire), which carried out community-based environmental initiatives and participated in joint activities, among them, in cooperation with Georgian schools.
- The European Neighbourhood Programme for Agriculture and Rural Development – ENPARD II Donor – European Union Assessment was carried out in regard to the indicators planned for the third (last) installment of the second phase of ENPARD (ENPARD, Phase I, Phase II), also for the indicators of the second instalment of the third phase, after which the instalment for the second and the third phases were transferred in September. At this stage there are negotiations underway for initiating the fourth phase of the European Neighourhood Programme for Agriculture and Rural Development (ENPARD, Phase IV). Within the framework of ENPARD II, start with the Ministry of Agriculture were trained, local action groups were formed in 10 municipalities, 95% of food inspectors were trained, food business operators who registered in the registry of economic activities, will be inputted into the database of the National Food Agency. The farmers registry program was elaborated, and currently more than 107,000 farmers / holdings are registered there; law on the seed production was drafted and approved too; and national strategies for rural development in extension were drafted and approved.

- Capacity building for sustainable wildlife management Donor - Food and Agriculture organization (FAO) “Proposals and recommendations for the regulatory policy on sustainable management of the hunting sector“ were drafted and submitted to the Ministry. Based on the recommendations contained in the above-mentioned document, the LEPL National Wildlife Agency was created with the purpose of regulating the field of wild animals and flora management. An instrument was developed for diagnosing the legislative gaps for separating the sustainable hunting in Georgia. The diagnostic instrument for gap analysis represents a conceptual framework, which makes it possible to compare and establish consistency of the Georgian legislation on hunting with the existing international legal instruments (conventions, treaties, directives, etc.).
- Support to the improved management of forest and landscape in Georgia Donor – Global Environment Facility, United Nations Development Programme (UNDP), World Resources Institute (WRI) The Forest and Land Use Information and Decision support system (FLUIDS) was created based on the web technology (Forest and Land Use Atlas https://atlas.mepa.gov.ge/) and a portal (server) of Geographic Information System https://gis.mepa.gov.ge/.
- Applying landscape and sustainable land management for mitigating land degradation and contributing to poverty reduction in rural areas Donor – Global Environment Facility (GEF) 160 Adequate legal, policy and institutional framework on landscape - sustainable management of land resources was developed at the national level, and awareness was raised on the issues of sustainable management of land resources.
- Small Grants Program Donor - Global Environment Facility (GEF) 18 new initiatives of NGOs and community organizations started in various regions of Georgia within the framework of six the working phase of the small grants program in 2019, which will make a significant contribution to the protection of the unique natural environment of Georgia, also to the activities related to climate change.
- Establishment of the national system for pest monitoring and forecasting Donor - United Nations Food and Agriculture Organization (FAO) A list of pests with so called economic significance was made within the framework of the project. Relevant manuals were elaborated in accordance with this lists, with the purpose of monitoring the pest population and forecasting their development. Specialists of the regional division of the National Food Agency were trained for ensuring the effective usage of manuals. The project’s important components were also the promotion of contemporary plant protection methods in Georgia, namely, Integrated Protection Methods (IPM) were used in two pilot plots (for vegetables and fruits), and then based on these plots, a so-called the farmers schools practice was introduced in the country for the first time.
- Adaptation of remote sensing methods in water resources management and assessment of extreme hydrometeorological situation in Georgia Donor - Slovak Agency for International Development Cooperation (SlovakAid).
- Improving Trade Opportunities in Horticulture Donor - EU-EBRD-FAO European Union - European Bank for Reconstruction and Development – United Nations Food and Agriculture Organization (UN FAO) The project significantly supported the development of horticultural sector in Georgia through various activities, information sharing about technologies, and markets or other activities.
- Support to Sustainable Value Chains through the Development of Geographic Indications in Georgia Donor - European Bank for Reconstruction and Development / United Nations Food and Agriculture Organization Institutional capacities in geographical indications was strengthened;
- Agricultural Education Donor – United States Department of agriculture (USDA) 162 Training courses were held for the specialists engaged in the agricultural sector. Cochran Fellowship Program (CFP) Donor - United States Department of agriculture (USDA).

- Identification of typical Georgian foodstuffs “terroirs” Donor – Czech Republic Within the framework of the project, the typical Georgian foodstuffs/terroir-based products were studied/inventorized in Tusheti and Mtskheta-Mtianeti regions. The study will create a basis for the promotion of identified terroir products and for advancing the business initiatives of local communities.
- Agricultural statistics Donor - US Department of agriculture (USDA) The project has supported the National Statistics Office of Georgia to elaborate, publish and conduct quarterly surveys.

There are three main priority directions presented in the 2017-2020 Rural Development Strategy of Georgia, namely: economy and competitiveness, social conditions and quality of life, environment protection and sustainable use of natural resources.

The 2017-2020 Rural Development Strategy of Georgia and the 2018-2020 Action Plan includes 67 activities for 2019. The 2018-2020 Action Plan of the 2017-2020 Rural Development Strategy of Georgia envisaged 24 activities that fell under the responsibility of the Ministry of Environmental Protection and Agriculture of Georgia, with a total budget of 153,867,100.0 GEL. As of 2019, actual budget expenditure amounted at 162,687,757.6 GEL.

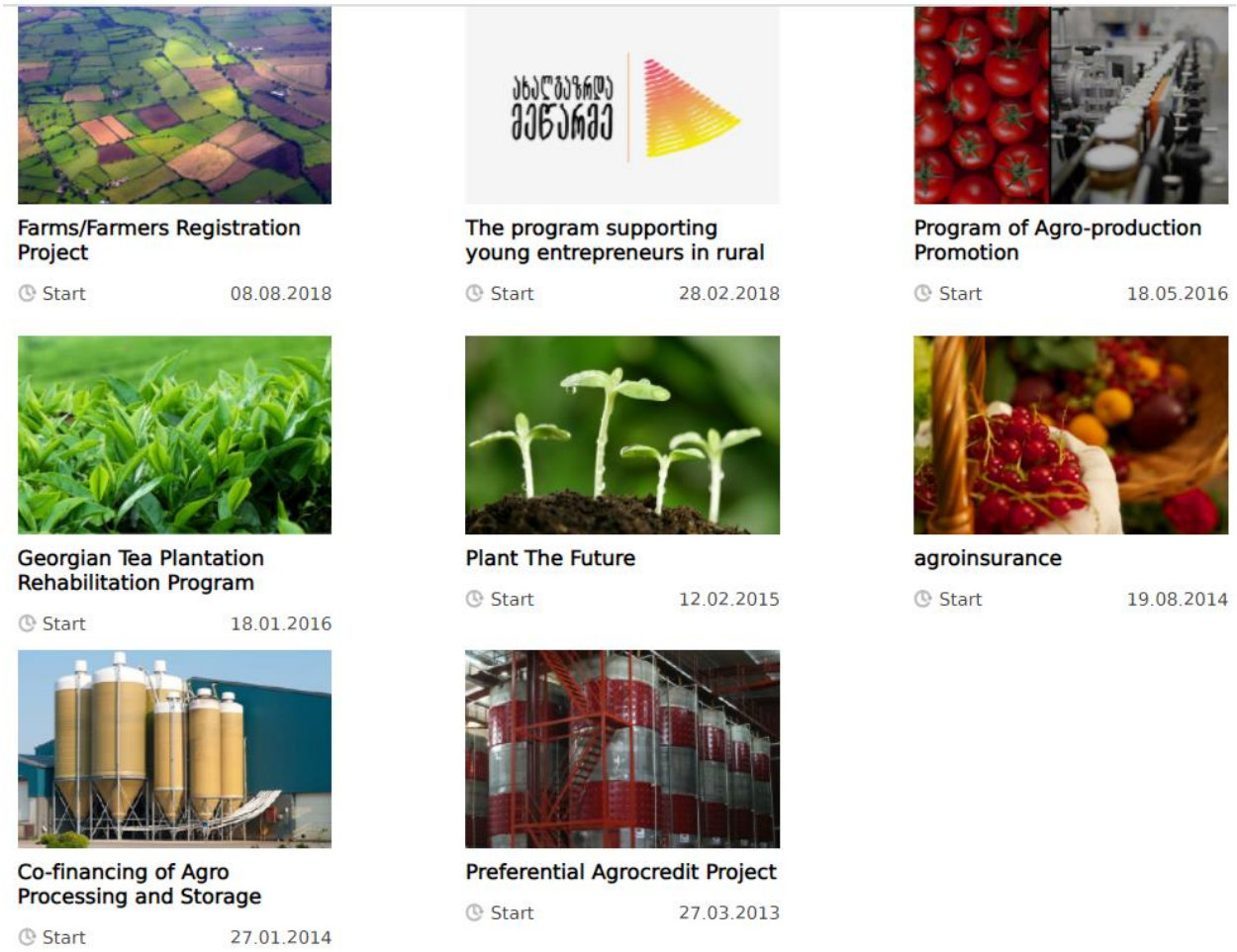


Fig. 66. Projects implemented in the agricultural field

Technical Assistance to Support the Establishment of

Start 19.12.2018
Finish 19.12.2018

Japan's Non-Project Grant Aid for Provision of Japanese

Start 12.11.2018
Finish 12.11.2018

Environmental Protection of International River Basins

Start 12.11.2018
Finish 12.11.2018

Preschool infrastructure assessment and support to

Start 01.04.2018
Finish 01.10.2018

Capacity Building for Sound Management of Chemicals

Start 01.01.2018
Finish 31.12.2020

Sustainable Development of Mountain Regions and their

Start 01.01.2018
Finish 31.12.2020

Technical assistance for the improvement of waste

Start 01.12.2017
Finish 31.12.2019

"Strengthening the administrative capacities of

Start 08.08.2017
Finish 08.04.2019

Strengthening Sustainable Management of Forests in

Start 01.02.2017
Finish 31.12.2018

Start 30.10.2018
Finish 13.11.2018

Diseased Chestnut Forest Restoration/Renewal Program

Start 01.01.2016
Finish 31.12.2019

Industrial Tangerine Realization Support Program

Start 01.11.2014
Finish 31.01.2017

Fig. 67. Projects implemented in the agricultural field

5.4. SWOT Analysis

Strength

- Economic growth and political stability
- A unique and rich natural environment recognised internationally
- Attractive environment for investments (including investments in agriculture)
- Growing sub-sectors of agriculture
- State investments in transport and energy infrastructure development
- Information and consultancy centers at the municipal as well as regional levels
- State programmes facilitating business and farm development
- State programmes aiming to improve the accessibility of public services
- Simplified land usage (land registration) procedures for the rural population
- Accumulated knowledge and experience from existing pilot projects (local action groups)
- Rich cultural and historic heritage
- High accessibility of school education
- Significant decrease in pocket spending on healthcare

Weaknesses

- Poor development of the value chain in every sector of agriculture (i.e. primary production, processing and storage infrastructure, marketing and
- sales)
- High level of land fragmentation
- Poor access to irrigation and drainage systems
- Insufficient use of modern technologies and knowledge
- Limited employment opportunities in economic activities other than agriculture
- Unequally and mostly poorly developed rural infrastructure (internal roads, drinking water and natural gas supply)
- Poorly develop cultural infrastructure
- Shortcomings in efficient use of land ownership rights (e.g. shortcomings in cadastral drawings due to non-existent or relevant standards for cadaster in previous years)
- Mostly poor access to public services due to distant locations of service provider institutions
- Shortcomings in sustainable use of water, land and forest resources
- Poor waste management infrastructure
- Week mechanisms for inclusion of rural population in the process of revealing and solving the local needs and lack of skills for participating in existing mechanisms
- Poor access to vocational education for urban population
- Poor access to modern knowledge and technologies for rural population and lack of skills to use them

- Limited access to pre-school education

Opportunities

- Stable growth of tourism sector, including growing tourism in rural areas
- growth of competitiveness of local production on local as well as on international markets
- Growth of export of agricultural products on important markets, including EU market
- Improvement of social situation of local population through the development of cultural tourism
- Variety of products with protected geographic indications and names of origin
- Diversity of landscapes and efficient utilization of protected areas for local economic development
- Growth of awareness of Georgian agricultural products internationally and increase of export geography
- Efficient and maximum use of economic potential of sustainable use of water and forest resources
- Potential of development of profitable sectors of economy

Threats

- Decrease of population in villages
- High level of poverty in rural areas and low income of the rural population; Large share of families receiving social allowances in the total number
- of social allowance receivers
- Aging of rural population, especially in mountainous regions
- Negative impact of disastrous hydro meteorological phenomena (Hail, drought, floods, high winds, etc.) on agriculture activities in the view of if
- climate change
- In case of further unsystematic use of pastures, their degradation is unavoidable
- Continued and irreversible biodiversity loss
- Spontaneous household waste landfills
- On-going degradation of forest resources
- Contamination of surface waters by fertilizers and chemicals used in the agriculture among the others
- Relatively high level of leaving school in urban areas (especially by girls)

5.5. Conclusions and Recommendation

Georgian agricultural sector has a great potential as Government of Georgia is committed to supporting the sector and is actively investing in agricultural infrastructure (irrigation/drainage systems). Moreover, the Deep & Comprehensive Free Trade Agreement (DCFTA) with the EU, which was signed in June 2014, gives us the opportunity to significantly increase exports to the European Union. The growing number of tourists adds attractiveness to the sector as local consumption increases.

Georgia has strategic location, which makes it perfect for forming regional hub for exporting agricultural products to region (Caucasus, Central Asia, other CIS countries).

Georgia's natural resources and various micro-climatic zones are perfect for producing a wide range of grains, vegetables and hard and soft fruits, etc. There are over 21 micro-climates in the country. Soils are of volcanic origin located in the river valleys. They tend to be quite fertile and reasonably easy to cultivate.

IMPORT SUBSTITUTION OPPORTUNITIES

- Dairy production
- Pork & beef production

EXPORT OPPORTUNITIES

- Wine and mineral water

- Fruits and vegetables

SETTING UP PROJECTS IN AGRICULTURE VALUE CHAIN

- Storage and distribution infrastructure
- Processing plants
- Greenhouses

TRANSIT HUB

- Grain storage elevators
- Animal feed production

Chapter 6. Republic of Moldova's regional analysis

6.1. Republic of Moldova's background / situation

6.1.1. Description of country's background

The Republic of Moldova is a tiny landlocked nation with a total area of 32,870 square kilometers, located between 460 and 480 N latitude and 270 to 300 E longitude. In Eastern Europe, bordered to the west by Romania and to the north, east, and south by Ukraine. Due to the breakup of the Soviet Union, it proclaimed independence in 1991. Moldova's current Constitution was adopted in 1994. The nation is divided into 32 districts (raioane), 5 municipalities (muniten, which are special-status cities), and two autonomous regions - Găgăuzia and Transnistria - the latter of which is embroiled in political strife and claims unrecognized independence. Since 1990, the breakaway government of Transnistria has had de facto control of a strip of Moldovan territory on the east bank of the Dniester River. Chisinau, the country's capital, has a population of about 786,000 people.

Moldova's topography is primarily an undulating hilly plain sloping northwest to southeast with an average elevation of about 147 meters above sea level. Hill Balanesti (429.5 m) in Nisporeni district is the highest point in the district, which has a very fractured landscape with hilly terrain and deep valleys. Sedimentary minerals, such as limestone, chalk, gypsum, sand, sandstone, bentonite, tripoli, and diatomite, are commonly found in parent rocks and can be used in construction, cement and glass manufacturing, food processing, chemical and metallurgical industries, and so on.

Black dirt, also known as chernozem, covers about 75% of Moldova. More clay-textured soils can be found in the northern hills. Red-earth soil dominates in the south. Although the soil becomes less fertile as you travel south, you can still grow grapes and sunflowers. The soils in the hills are forested. The Prut and Dniester rivers' lower reaches, as well as the southern river valleys, are saline marshes.

Approximately 60% of the country's waters flow into the Nistru river (1,352 km, including 657 km within the country's borders), approximately 34% into the Prut river (a tributary of the Danube that flows for 695 km along the Romanian border), and the remainder into a series of small rivers that directly flow into the Black Sea. There are approximately 60 natural lakes and 3,000 reservoirs in Moldova. Costesti-Stinca (678 million m3) on the Prut River, run jointly by Romania and Moldova, and Dubasari (235 million m3) on the Nistru River are the two largest reservoirs. In the north and central parts of the country, reservoirs are used to regulate water levels over the course of the year, while in the south, they are mostly used for inter-annual storage.

Deep enclosed aquifers hold the majority of groundwater supplies. Boreholes for groundwater withdrawal number about 7,000. The restricted aquifers' natural recharge ability is minimal, and there is a risk of overexploitation. The country's total available water supplies are 5.6 km3, with 4.3 km3 of surface water and 1.3 km3 of groundwater (including 0.7 km3 that comply with the national standards for drinking water).

Around 15% of the land is covered by natural vegetation, mostly trees, steppes, lakes, and rivers. Forests and other wooded land (OWL) occupy 13.7 percent of Moldova's land area

(approximately 462,700 ha), in extremely scattered stands ranging from 5 to 1,500 ha. The steppes cover 1.92 percent of the land (roughly 65,000 ha) in 0.5-300 ha fragments. The flora of the steppe is diverse, with over 600 plant species, the majority of which belong to the Asteraceae, Fabaceae, Poaceae, and Lamiaceae families. Just 3% of the land is covered by natural meadows, which are found along the Prut and Nistru river basins (about 101,400 ha).

Due to intensive and unorganized grazing and the reduction of lands with steppe vegetation, the state of flora in steppe habitats is unsatisfactory in the republic. Human activities have had a significant effect on the steppe areas in the southern and south-eastern regions (lower Nistru river terraces and Bugeac plains), but they are still rich in traditional plant communities characterized by grasses and oak forest groves. 2,8% of the nation is covered by rivers, lakes, and other wetlands (95,000 ha). There are 34 dominant aquatic plant groups and 83 partnerships, with 37 of them being endangered.

Moldova can be divided into 3 major agro-climatic zones: (i) the Northern zone including the northern plateau along the Nistru river, the Transnistria highlands and the Balti rolling plain, with annual mean temperatures ranging from 6.3-9.7 ºC, and annual precipitation between 550-600 mm; (ii) the central zone covering the Condrii highlands, where hilly terrain and deep valleys 3 alternate, with annual mean temperature between 7.5-10 ºC and annual precipitation from 500-550 mm, up to 60% falling during the crop vegetative period; and (iii) the southern zone including the hilly terrain interspersed with plains and large valleys of the Bugeac plain and the Tigech highlands, with annual mean temperature between 8.3-11.5 ºC and annual precipitation of 450-550 mm. In all cases around half of precipitation falls during the crop vegetative period.

Republic of Moldova isn't a big country, it has a total population of 3.555 million people, with 1.266 million who are considered economically active. Of these workers, 822,000 are employed in the non-agricultural sector ; i.e. 444,000 are employed in agriculture; however, according to statistical evidence, up to 1 million people are living and working abroad – in the EU as well as in Russia.[14] Even though it is an agricultural country, the sector's overall contribution to GDP is small in comparison to the number of people employed.

Moldova has adopted a market economy, liberalized prices and interest rates, stopped issuing preferential credits to state enterprises, backed steady land privatization, and abolished export controls since becoming an independent country. However, this resulted in rapid inflation, and Moldova experienced a severe economic crisis from 1992 to 2001, with energy shortages contributing to sharp output declines. Following this, the economy started to change, and the nation has seen consistent annual growth of between 5% and 10% since then.The overall unemployment rate declined to 6.6% in 2011 (from 7.4% in 2010). As a result of decreases in industrial and agricultural production the relative weight of the service sector in the economy of Moldova started to grow and began to dominate GDP.

6.1.2. Brief description of COUNTRY or BSB region agriculture and history

The Republic of Moldova is regarded as an agricultural region, with agriculture serving as the backbone of the Moldovan economy. The contribution of GDP and the impact on the job rate may also support this assertion. The agricultural sector employs a large number of people, particularly when it comes to subsistence agriculture.

Agriculture is a vital part of Moldova's economy and the primary source of income in rural areas. It accounts for nearly 14% of the country's GDP (down from 20% in 2004), with the food

[14] JICA. „Data Collection Survey on Agriculture Sector in Moldova", september 2017, p.5

processing industry accounting for an additional 7%. Winter and spring grains, such as wheat, barley, and maize, as well as potatoes and other vegetables, as well as horticultural crops and berries, are important crops. Approximately 75% of the population lives in rural areas and makes a living from agriculture and related activities.

Despite the fact that agriculture, particularly the agri-food industry, is critical to Moldova's economy, its performance has been uneven, with slow and highly variable growth.[15] Moldova is Europe's most vulnerable country to climate change8. Over the last century, the temperature and rainfall in Moldova have risen, and extreme floods and droughts have become more common. During the years 1984 to 2006, Moldova suffered an estimated annual economic loss of USD 61 million as a result of natural disasters. This pattern had recently shifted, with the 2007 and 2012 droughts causing losses of approximately USD 1 billion9 and USD 290 million, respectively. Floods have also had a major effect on Moldova, costing the country about USD 120 million in 2008 and USD 42 million in 2010.

Most of Moldova's agricultural land was shifted from state to private ownership during the 1990s, and today 73.8 percent (1.84 million ha) is in private ownership, while 26.2 percent is owned by the state (660,000 ha). Around 40% of agricultural land is owned by limited liability companies (LLCs), 37% by family farms, 10% by other types of business associations, 10% by production cooperatives, and 3% by individual businesses. Moldova's agricultural production is 70 percent vegetal and 30 percent animal in general.[16]

Agricultural production amounted for roughly €1.4 billion in 2011 and increased by 4.6% compared to the previous year. Agricultural output has accounted for over 15% of GDP24 in the last five years and 36% when combined with the food processing industry.

Agri-food products account for approximately 41% of total exports and particularly wine and spirits, as well as fruit and vegetables, both fresh and processed. 70% of exports go to CIS countries and 30% to the European Union, mostly in the form of semi-finished products.[17]

Republic of Moldova it is well known for the soil we have, highly fertile black chernozem. In this context, let's take a short look how the land it is used in our country.

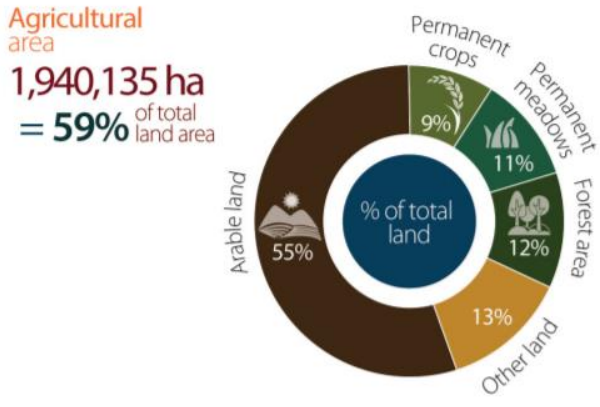


Fig. 68. Source: Climate-Smart Agriculture in Moldova

Agricultural land makes up about 59 percent (2 million hectares) of Moldova's total land area, with 55 percent of that being arable land for annual crop production (maize, wheat, sunflower, barley, oilseed, soybean, sugar beet). The highly fertile black chernozem soils, which are mostly found in the north and along the Dniester River Valley, provide ideal conditions for farming, especially the production of cereal grains, maize, fruits, and vegetables. Soil degradation and erosion have been exacerbated in recent decades by land fragmentation and low land management capability, inadequate soil health practices

[15] JICA. „Data Collection Survey on Agriculture Sector in Moldova", september 2017, p.5
[16] John Millns. „Agriculture Rural Cooperation Examples from Armenia, Georgia and Moldova", 2013, p.
[17] *ibidem*

(especially tillage), overgrazing, illegal logging of protected forest belts, including wetlands, and general inefficiencies in land-use planning, including crop rotation. Inadequate nutrient management practices, such as insufficient storage and application of agrochemicals and manure, have resulted in contamination of surface and groundwater sources, as well as increased contributions of the agricultural sector to national GHG emissions (primarily due to inadequate nutrient management and soil tillage).[18]

So, we basically have 3 types of farmers[19], according to the scale of their territory. We should talk about small-scale farmers, who account for 97.7% of all farms and have land sizes ranging from 0.85 to 10 hectares, and medium-scale farmers, who have land sizes ranging from 10 to 50 hectares. Small-scale farmers usually grow sunflower, wheat, maize, vegetables, and orchards, all of which have low yields and high production costs. To cover production costs, the crop is primarily used for animal feed and sold unprocessed/raw on the local market. Just a few of them cultivate high-value crops like potatoes, strawberries, and raspberries. When we look at medium-scale farmers, we can see that they usually grow wheat, maize, sunflower, and soybeans, as well as perennial crops, fruits, and table and wine grapes. On land greater than 50 hectares, large-scale farmers grow field crops such as sugar beet, orchards, and vineyards (table and wine grapes). In Moldova can be found three main agro-ecological zones[20] :

1. Northern Zone – along the Dnister River, also known as the forest-steppe, with high productivity rates for forages, pastures, and livestock, but also suitable for crops, such as maize, wheat, sunflower, soybean, barley, sugar beet, and pea, among others ;
2. Central Zone – a hilly and forested area best suited for perennial crops (vineyards, orchards) ;
3. Southern Zone – a mix of hills and plains which, due to higher temperatures and low rainfall, is less suitable for agricultural production

Moldova is capitalizing on its agricultural export potential, especially in cereals, sunflowers, fruits, vegetables, and sugar. Exports of animal origin goods to EU Member States are currently not possible due to underdeveloped food safety institutions.
Agriculture is becoming a polarizing practice in the Republic of Moldova. A small number of large-scale farmers are increasingly able to take advantage of the expanded opportunities provided by the country's main agricultural export destination, the EU. Smallholders, on the other hand, find it difficult to meet the stringent EU business conditions and instead focus on the more open markets.

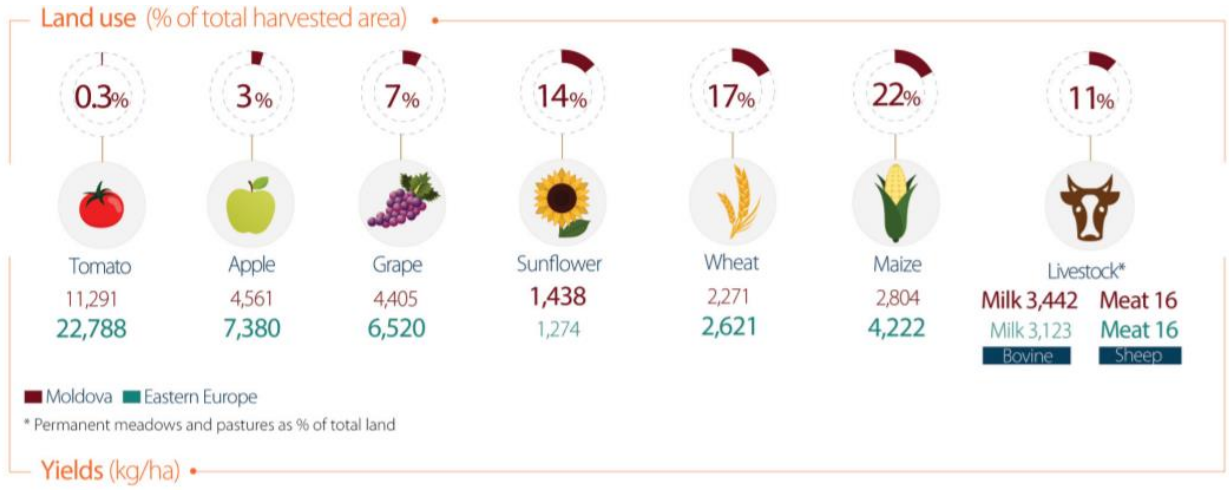


Fig. 69. Land use in Moldova. Source: Climate-Smart Agriculture in Moldova

[18] Climate-Smart Agriculture in Moldova
[19] *ibidem*
[20] Climate-Smart Agriculture in Moldova

Young people from rural areas are migrating to towns. Small-scale farmers are especially vulnerable to rising costs. They are the least prepared to respond to the consequences of climate change.

Table 11. Basic agriculture indicators in Moldova (World Bank WDI database)

	2008	2018	Difference	Diff %
Population	4 112 891	4 051 944	-60 947	-1.48
Agriculture, value added (% of GDP)	8.81	10.16	1.35	15.32
Agricultural land (% of land area)	75.43	74.22 (2016)	-1.21	-1.6
Rural population (% of total population)	57.32	57.37	0.05	0.09
Employment in agriculture (% of total employment)	31.06	32.18	1.12	3.61
Employment in agriculture, female (% of female employment)	28.34	27.78	-0.56	-1.98

Moldova's mobile broadband penetration is comparable to the CIS average. 3G/LTE coverage is widespread in the territory and population (Fig. 70). The first 3G networks were launched in 2008 (with coverage reaching 100% in 2018), and LTE services were introduced in 2012, with 97 percent of the population covered. The number of mobile broadband subscribers is growing; in 2018, there were 73 subscriptions per 100 people (up 25 points in two years). The Internet is used by 76% of the population, and slightly more than half of households have Internet access at home.

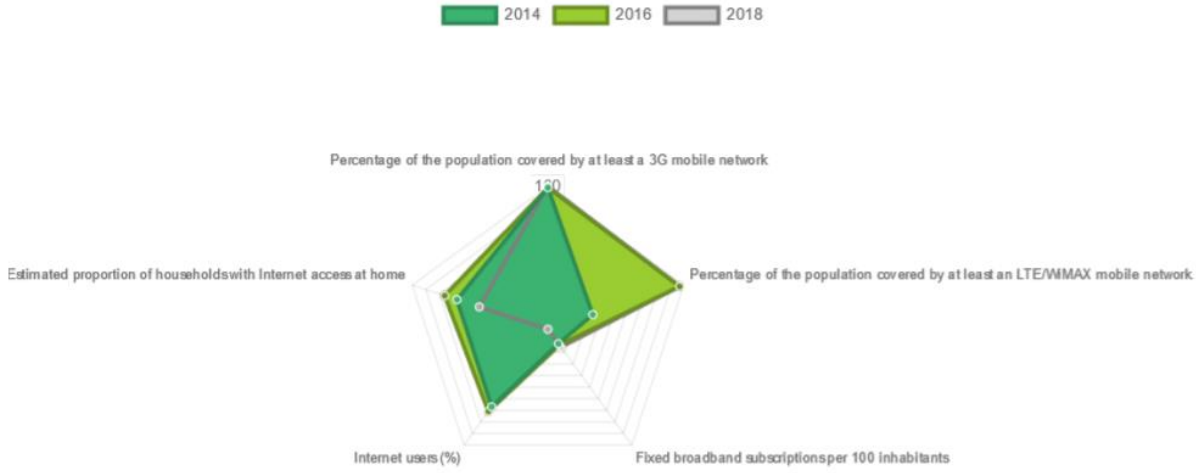


Fig. 70. The basic indicators of ICT access and usage in Moldova (ITU WTI Database)

6.1.3. Agriculture field in comparison with other sectors

Even though agriculture's contribution to the development of gross domestic product (GDP) is decreasing at the moment, agriculture remains a significant sector in the Republic of Moldova's economy. During the period 2010-2019, the contribution to GDP of this sector remained stable,

fluctuating only slightly from 11.2 percent in 2010 to 9.9 percent in 2019. Looking at the situation from the inside, we may conclude that these fluctuations in the agricultural sector are actually caused by rural infrastructure, such as highways, electricity, and water for household needs, as well as irrigation, which are all in poor condition and have the greatest negative effect on agricultural income.

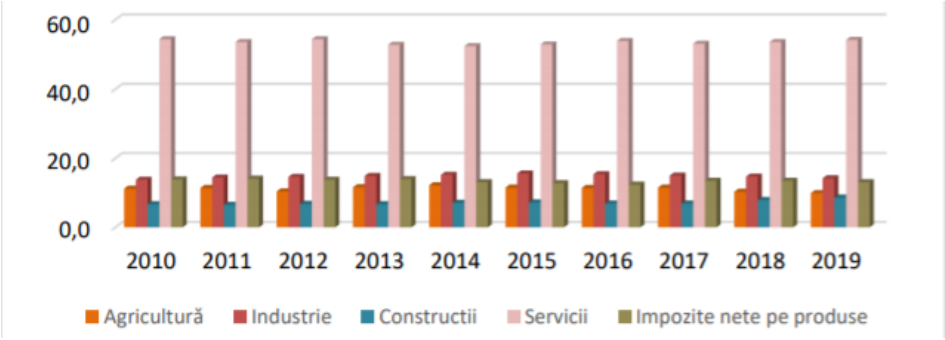


Fig. 71. Contribution of economic activities to GDP formation in the Republic of Moldova, 2010 – 2019. Source : National Bureau of Statistics

As Fig. 71 shows, in 2019, the country's largest economic sector is the service sector, which accounts for 54.2% of GDP, followed by the industry sector, which accounts for 14.2% of GDP. As can be seen, the agricultural sector has decreased, which is due to climatic conditions, especially the drought in recent years.

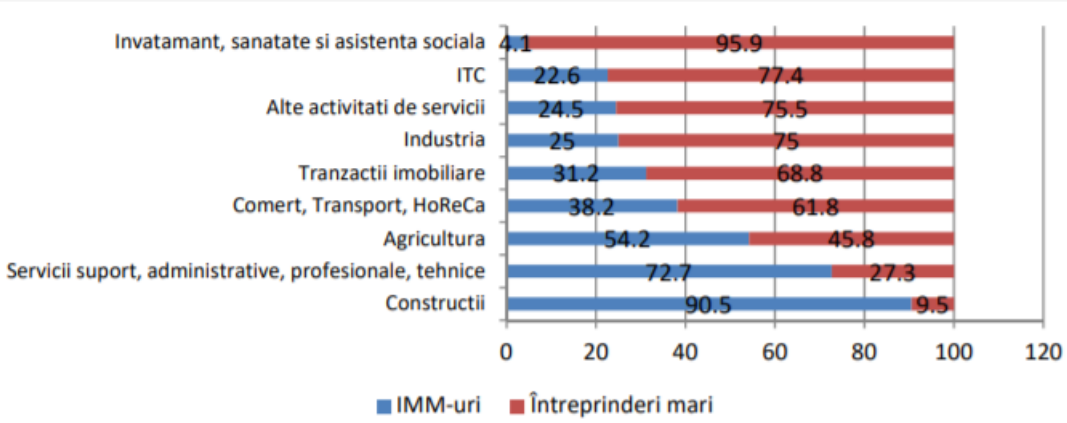


Fig. 72. Distribution of value added produced by SMEs by economic activitie in 2020. Source : National Bureau of Statistics

The agricultural sector in the Republic of Moldova is slow-growing and inefficient. Low levels of investment, a lack of access to finance, slow institutional transformation, and limited market prospects have all contributed to Moldova's agriculture operating at a fraction of its potential. When it comes to the distribution of gross value added between small and medium-sized enterprises (SMEs) and large enterprises, we can see that SMEs dominate in the construction sector, with an average of 54.2 percent in support, administrative, educational, technological, and agricultural services.

6.2. Agriculture policies in Republic of Moldova

Through recent development, Moldova is still a developing nation. Moldova remains one of Europe's poorest nations. Moldova's economy is heavily reliant on its agriculture sector, which includes fruits, vegetables, wine, wheat, and tobacco, thanks to its temperate climate and fertile farmland. Moldova also relies on annual remittances of around $1.2 billion, or nearly 15% of GDP,

from Moldovans employed in Europe, Israel, Russia, and other parts of the world. Moldova imports almost all of its energy from Russia and Ukraine due to a lack of natural resources. Moldova's reliance on Russian energy is highlighted by a $6 billion debt to Russian natural gas supplier Gazprom, which stems primarily from unreimbursed natural gas consumption in the breakaway region of Transnistria. In August 2014, Moldova and Romania completed the Ungheni-Iasi natural gas interconnector project. The 43-kilometer pipeline connecting Moldova and Romania allows for natural gas import and export. Gas was not allowed to flow into Moldova until March 2015 due to a number of technical and regulatory issues. Gas exports from Romania to Moldova are largely symbolic. Moldova granted Romanian Transgaz a contract in 2018 to construct a pipeline linking Ungheni and Chisinau, carrying gas to Moldovan population centers. By 2022, Moldova wants to be connected to the European power grid.

As a result of the government's stated objective of EU integration, some market-oriented progress has been made. In 2017, Moldova's economy grew faster than predicted, thanks to increased demand, increased revenue from agricultural exports, and improved tax collection. Moldova signed an Association Agreement and a Deep and Comprehensive Free Trade Agreement (AA/DCFTA) with the EU in the fall of 2014, allowing Moldovan goods to enter the world's largest market. Moldova's exports to the EU have increased significantly as a result of the EU AA/DCFTA. In 2017, the EU bought over 65 percent of Moldova's exports, a significant shift from 20 years ago, when the Commonwealth of Independent States (CIS) bought over 69 percent. A $1 billion asset-stripping heist of Moldovan banks in late 2014 hit the economy hard in 2015, and the resulting bank bailout exacerbated inflationary pressures and led to the leu's depreciation and a mild recession. Moldova's development has also been hampered by widespread corruption, which restricts business growth and discourages foreign investment, as well as Russian restrictions on Moldovan agricultural imports. The government's efforts to restore stability and enact substantive reform resulted in the approval of a $179 million three-year IMF program aimed at improving the banking and fiscal environments in 2016, as well as additional assistance from the EU, World Bank, and Romania. In 2017, Moldova earned two IMF tranches totaling $42.5 million. Moldova's economy is still vulnerable to corruption, political instability, poor administrative capability, entrenched bureaucratic interests, energy import dependency, Russian political and economic strain, heavy reliance on agricultural exports, and unresolved separatism in Moldova's Transnistria region over the long term.

6.2.1. Local/regional/national policies in agriculture and connected sectors

The transformations that occurred in the 1990s in Moldova, as in other countries in transition to market economies, resulted in a variety of issues relating to changes in ownership relations, the transition from a planned economy to a market economy, the alignment of the agro-industrial complex components to new market requirements, the development of market infrastructure, the investment process, and so on. Agricultural policies promoted over the last decade pursued several shared goals for transition economies and included a variety of actions aimed at preventing the agri-food sector from deteriorating further. The financial resources allocated from the government budget is aimed at partially financing some programs aimed at assisting agricultural farmers, subsidizing agricultural production risks, and assisting the grape and winemaking industries, among other things.

For Moldova, the agricultural sector's growth is critical. The agricultural sector and other associated activities provide income to 58 percent of the total population in rural areas. In this context, the government must take policy measures to assist rural residents in sustaining their income. The agricultural sector accounts for approximately 12% of GDP, and together with the food processing industry, it accounts for approximately 35%. However, agri-food products, which are the country's main export goods, account for 40% of total exports.

Changes in the agricultural sector resulted from the transition to a market economy, as well as a slew of reforms implemented in the early 1990s. Around the same time, agriculture accounts for just around 5% of total government spending. Farmers do not have enough resources to ensure their activities, many of them being not profitable. In addition, the amount of money invested in this sector is very small. As a result, Moldova's agricultural sector needs government assistance in order to become more attractive to investors, thereby contributing to the sector's growth, as well as a reduction in production costs and prices.

State funding for the agricultural sector is one of the most important aspects of government policy. The main goal of subsidy allocation is to maximize the benefits of government assistance while minimizing the negative consequences as much as possible, particularly in countries with low agricultural production competitiveness and limited accumulated capital that could be used to rebuild the sector. In several countries, the agricultural sector is heavily subsidized by the government. Support for farmers has occupied a central role in Moldova's promoted government policy in recent years. As a result, a number of documents reflect Moldova's agri-food sector's long-term development, such as the "National Strategy for the Agri-Food Sector's Long-Term Development for 2008-2015," which has objectives centered on competitiveness, rural population living standards, and rural area preservation, and the "Concept for the Agricultural Producers' Subsidizing System for the Years 2008-2015." The National Strategy for Agricultural and Rural Development of Moldova for 2014-2020 was adopted in 2014, with the key goals of increasing agricultural competitiveness, ensuring the sustainable use of natural resources in agriculture, and improving rural life quality.
The subsidizing program was given a lot of weight as a key measure to help farmers and improve the agricultural sector's competitiveness. This was expressed in the “Concept of the Agricultural Producers' Subsidizing Scheme for the Years 2008-2015,” which had two key goals:

- • agricultural sector modernization – subsidizing investment activities such as the establishment of agricultural storage and processing units, the procurement of suitable equipment, the provision of agricultural raw materials, the establishment of vineyards and orchards, and the development of agricultural services;
- • the implementation of efficient agricultural activities in the vegetable and livestock sectors – direct payments will be made for increased agricultural productivity and competitiveness, market stabilization, food security assurance, and equal incomes for agricultural producers, taking into account agricultural crops, animal species, and their individual average yield when compared with other agricultural crops and animal species.[21].

The ***Agency for Interventions and Payments in Agriculture (AIPA)*** was established as a legal entity under the Ministry of Agriculture and Food Industry in 2010, and it is responsible for administering financial resources aimed at supporting agricultural producers, monitoring their distribution, and evaluating the qualitative and quantitative impact of government support measures.

The subsidizing fund was previously administered by four separate agencies, the majority of which were under the Ministry of Agriculture and Food Industry (about 70 percent).

According to preliminary estimates from the National Bureau of Statistics, global agricultural output in households of all types (agricultural enterprises, farms (households), and households) increased by 72.9 percent in 2020 compared to 2019. The decline in global agricultural output (by 27.1 percent) was exacerbated by a 35.9% decrease in vegetable production (which resulted in a 26.1 percent reduction in the general index of global agricultural production) and a 3.8 percent decrease in animal production (-1 .0 percent).

[21] Data from the official website of the Governemnt of Republic of Moldova

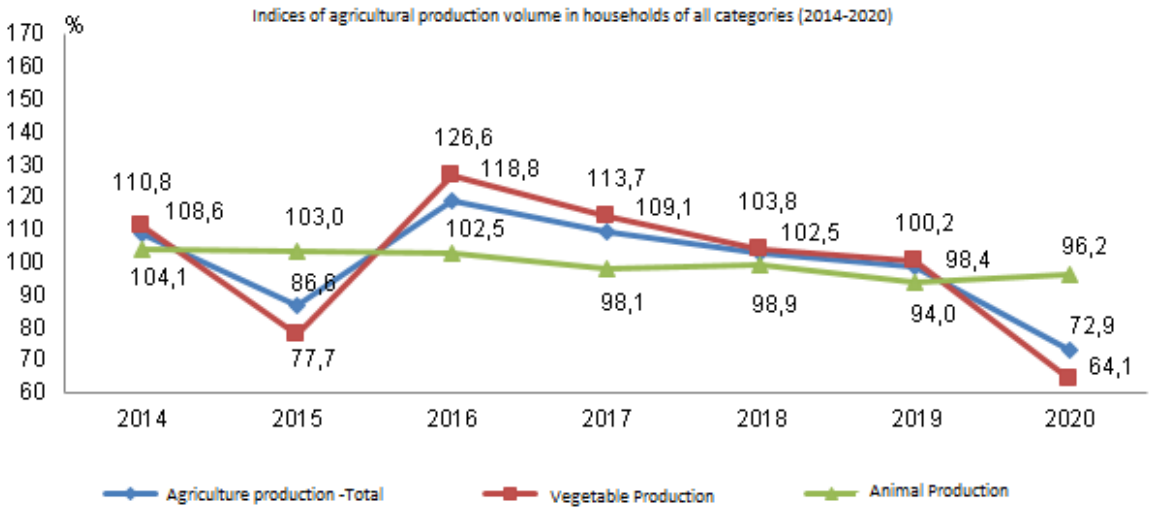


Fig. 73. Indices of agricultural production volume in households of all categorie (2014-2020) Source : National Bureau of Statistics

Moldova considers itself to be one of those countries committed to boosting the IT industry's growth and prospects. This is emphasized in strategic documents such as the national strategy for the growth of the information society, "Digital Moldova 2020," and the Strategy for the development of the information technology industry and the digital innovation ecosystem for the years 2018–2023, which continue the government's efforts to grow the field. The Strategy includes a number of initiatives aimed at boosting the entrepreneurial and IT educational ecosystems, as well as their start-ups and funding mechanisms, as well as promoting IT goods in niche markets.

The Broadband Development Programme for the years 2018–2020 was approved, and an action plan for its implementation was adopted in the field of electronic communications. The main goal of the program is to build broadband electronic communication networks with increased data processing ability. The Radio Spectrum Management Programme for the years 2013–2020 was created to facilitate effective management of radio spectrum resources and thus ensure the continuous growth of public broadband electronic communication networks and services.

The Strategic Program for technical modernization of development policies in the agro-industrial sector (e-agriculture) was approved by the Ministry of Agriculture, Regional Development, and Environment in 2013. The program's goals were to digitize the Ministry's subdivisions' public services, establish integrated information systems for planning and executing the sector's growth strategies, and develop surveillance information systems to ensure food safety and security. E-agriculture was conceived in the light of state food safety and protection, the National Strategy for Agricultural and Rural Development (2014–2020), and the government's strategic program for technical modernization (e-Transformation).

6.3. Funding initiatives in Smart Farming from Republic of Moldova

All national strategies around agriculture are developed in close collaboration with farmers associations (FAs). They participate in decision-making around the regulation of subsidies and water use, lobby for farmers' interests to state structures, and initiate legislation change. FAs also have a seat in the Supervising Committees in the implementation units for international financing projects, and many technical assistance projects are implemented directly by FAs. However, FA

structures in Moldova are relatively new, and the membership fees are low, which gives them limited financial capacity to act and academic institutions work on sustainable agriculture and soil protection issues.

6.3.1. Projects implemented in the agricultural field and IoT technologies in agriculture

In Republic of Moldova there have been throught the years implemented many projects in the agricultural sector, and in the last few years there has been a very hard focuse on the projects implemented in agriculture where the smart and IoT technologies could be applied.

One of this types of project is the project "*Supporting Moldova's National Climate Change Adaptation Planning Process*", that had the goal to respond to the needs of farmers, and to ensure that Moldova has a system in place for medium- to long-term adaptation planning and budgeting, with the aim to reduce the vulnerability in key sectors (particularly agriculture), to the impacts of climate change. With funding provided by the Austrian Ministry of Environment via the Austrian Development Agency (ADA), and supported by UNDP Moldova, the project is being implemented by the Ministry of Environment's Climate Change Office. Working in three key sectors: agriculture, energy, and water resources, pilot projects are being implemented in six districts vulnerable to climate, in order to promote adaptation measures and catalyze their replication in other regions of the country. Through the project's dedicated grant scheme to showcase innovative adaptation measures at the local level, three agricultural grants have been used to improve agricultural conservation practices, while helping to restore soil fertility. By promoting new agricultural technologies, like automated GPS navigation to increase the efficiency of pesticide and fertilizer application, or by using improved soil conservation methods and precision machinery, the overall objective is to develop farmers' climate-resilience.

In the North of the country, in the Fălești district, one of the grants from the same mentioned project, provided funding to the group, Abilitate Agro LTD, to purchase a ripper and a precision no-till seeder. The ripper uses strong tines to loosen hard layers of soil - allowing the roots to grow deeper to access subsoil moisture and the precision no-till seeder deposits seeds in the ground more effectively - significantly reducing labor and related fuel costs.

The adjacent community farming pilot project, LLC Sadac-Agro, was the 3rd recipient of the agriculture grants. The farm covers 8,000ha and is comprised of the individual plots of 1,100 villagers. Growing rapeseed, mustard, barley, wheat, corn, and sunflower, the farm also includes a vineyard and an orchard. With their grant they were able to purchase a ripper and a GPS guidance system. Mr. Nicolae Prohniţchi, director of Sadac-Agro LTD said: "We were able to use the GPS auto navigation kit... for a uniform particle distribution without overlap. We are pleased with the purchased... primarily on account of savings resulting from their use and increasing quality work. For all farmers facing climate change issues, I recommend them to purchase this equipment, because they already are a necessity for farms in the country." By promoting new agricultural technologies, like automated GPS navigation to increase the efficiency of pesticide and fertiliser application, or by using improved soil conservation methods and precision machinery, the overall objective is to develop farmers' climate-resilience.

Conservation methods like continuous no-till or minimum-till, crop rotation, and cover crops are keys to building healthy soils. Changing cultivation technology has required building technical skills and raising conservation awareness. In order to implement the right technologies, the Austrian Development Agency and UNDP experts have trained farmers on adaptation practices. Following the successful implementation of pilot projects, local producers are motivated to make plans for the future, applying technologies that contribute to adaptation, simultaneously enhancing food security and improving the welfare of rural populations. As part of the NAP Global Support

Programme, assisting Least Developed Countries (LDCs) to advance National Adaptation Plans (NAPs), the project is aligned with the NAP-GSP's aims to strengthen medium and long-term climate change adaptation planning as well as budgeting, with an emphasis on gender-sensitive approaches[22].

For exemplification we present in table Nr.1 below a list of the most important projects implemented in Republic of Moldova during 2009- 2020 (and some of the project are on-going) in the agricultural sector, also some of the projects present the specific objectives of implementing (or the need to implementation) of IoT tools in the agro-food sector of our country.

Table. Nr.1 List of Project implemented in Republic of Moldova during 2009-2020 in agriculture (also connected to IoT sector)

Project Title	Total Budget (E)	Period
Improving The Export Capacities of The Ministry of Agriculture and Food Industry	2 000 000	01/10/2008 - 29/11/2010
Cross- Border Networking For Organic Agriculture	83 118	05/04/2011- 02/10/2012
Facilitate the trade of Agro-Food Products in The Black Sea Basin (FTAP)	188 059	01/11/2011- 31/10/2013
EC/FAO Programme on information systems to improve food security decision-making in the ENP-East Area	3 000 000	23/11/2009- 31/12/2013
Preparing the conditions for penetration of the Black Sea Wines in the International market : Black Sea WinExports	220 273	24/05/2013- 23/05/2015
Cross Border Support Center For The Assisteed Development of Zootechny	121 471	16/09/2013- 16/07/2015
"Promoting sustainable production and implementation of good practices in the bovine farms from Romania, the Republic of Moldova and Ukraina cross-border region"	416 000	01/12/2014 - 31/07/2015
Creation of a trilateral cross border network for development and marketing of the agro-alimentary local and traditional products in the Lower Danube cross border area	394 095,28	08/11/2013- 08/08/2015
Development of the agriculture sector through creation af an agricultural cross-border network	552 597,20	01/11/2013- 31/08/2015
Protection of borders against threats posed by homeless animals	13 675	18/12/2013- 17/10/2015
Transparent Convergence to EU Policies in Sanitary Issues: the case of Georgia and Moldova	152 216,54	01/11/2013- 29/02/2016
Technical assistance Project to support the project Implementation Unit (PIU) for the “Filiere du vin” operation, and the beneficiary Small and Medium-sized Enterprises (SMEs)	1 706 500	01/07/2014- 01/07/2016
Technical Assistance for the Implementation of the Sector Reform Contract: European Neighbourhood Programme to Agriculture and Rural Development (ENPARD)	2 387 160	11/11/2016- 10/05/2019
Twinning project „Support to the National Food Safety Agency of the Republic of Moldova“	2 000 000	17/12/2016- 16/12/2018
Development of the Ukrainian-Moldavian cross-border production-scientific-educational cluster for processing of winemaking by-products	90 350	12/12/2017- 11/02/2019
Strengthening Regional Capacities for Applying Environmentally Friendly Technologies in Integrated Pest Management Systems	300 000	12/12/2017 - 11/01/2019

[22] www.adapt.clima.md

Support to Agriculture and Rural Development through promotion of confidence building measures	4 755 776	01/01/2016 - 31/12/2018
Technical assistance to support the implementation of the "Fruit Garden of Moldova" operation, and the beneficiary Small and Medium-sized Enterprises (SMEs) Republic of Moldova	2 184 000	16/04/2018 - 30/06/2021
Cross border network for Innovative Agriculture	99 890	30/11/2017-29/11/2018
"Increase trading and modernization of the beekeeping and connected sectors in the black sea basin" - ITM BEE-BSB 136	758 303	27/03/2019 - 26/03/2021
ENPARD Moldova Program - Support to Agriculture and Rural Development	64 075 000	01/07/2015-01/07/2022
Supply of laboratory diagnostic kits to the National Reference Laboratory of the National Food Safety Agency (ANSA)	196 496,13	24/02/2020-12/03/2022
"Trade and innovation in the wine industry-WINET"	385 099	04/04/2019-04/04/2021
Further support to agriculture, rural development and food safety in the Republic of Moldova.	2 000 000	01/09/2020-31/08/2022
Horizon2020- PRO Business Innovation Moldova	24 138,99	01/01/2020 - 31/12/2021
Microbiological tools for assessment and prediction of the impact of soil management on soil organic carbon in high-organic black soils of Moldova	20 000,00	25/05/2020 - 25/12/2020
Establishing Capacities for Isotope Hydrology Techniques for Water Resources and Climate Change Impact Evaluation	286 633	17/05/2020 - 29/12/2023
Sterile Insect Technique Based Blood Irradiator Equipment	349 680	01/11/2020 - 30/04/2023
The Project "Fruit garden of Moldova"	120 000 000	03/11/2014 - 31/12/2021
Bringing Organisations & Network Development to higher levels in the Farming sector in Europe (BOND)	99 312,50	01/11/2017 - 31/10/2020
FP7-KBBE-2013-7, AGRICISTRADE, nr.612755, Exploring the potential for agricultural and biomass trade in the Commonwealth of Independent States	47 880	01/01/2014 - 31/12/2016
Capacity building of the Moldovan Agency for Intervention and Payment in Agriculture (AIPA) for the application of EU norms and standards for the administration of ARD support schemes	1 185 485,68	07/12/2016 - 01/07/2020
Facilitating active engagement of the civil society actors in the agro-rural policy dialog	266 726,21	01/03/2017 - 30/06/2020
Sustainable Agricultural Trade Network in Black Sea Basin - AgriTradeNet	73 435,16	01/09/2018 - 01/12/2020
Total	**136 453 920,26**	

Financial support was allocated to agricultural producers from state budget through a number of programs or single actions, as well as from external sources (e.g. Project of Investments and Rural Services, Project of Agriculture Revitalizing, Program of Rural Financial Services and Marketing etc.). Nevertheless, a unifying tool of all the programs and projects is the subsidizing fund for agricultural producers.

6.3.2. Investments in agriculture

As to make a small summary of the investments made in the agricultural sector in the last year in Republic of Moldova, we presented here data related to this analysis report. Means of the National Fund for the Development of Agriculture and the Rural Environment (in continued - FNDAMR) is approved each year under the State Budget Law. At the same time, it is counted that in 2020 FNDAMR amounted to 1200 million lei, increasing by 26.3% compared to the financial means

allocated in 2019 (950 million lei). FNDAMR is capitalized 100% every year. Benefit of subsidies economic entities, natural persons engaged in the activity of enterprising under national law as well as local public authorities first level.

According to the data presented by the Intervention and Payments Agency in Agriculture (hereinafter - AIPA), the sources of FNDAMR in 2020 were targeted as follows:

- the state contribution in the National Vine and Wine Fund - 17.9 million lei, in in accordance with art. 2 lit. g. of the Law on the state budget for 2020 no. 172/2019;
- payment of arrears to agricultural producers in 2019 - about 503.8 million lei, in accordance with art. 33 para. (5) of Law no. 276/2016;
- advance grants for young and women farmers for development start-up projects - 16.2 million lei, according to art. 23 para. (3) of Law no. 276/2016, as well as the Government Decision no. 507/2018;
- grants in advance to improve living and working in rural environment - 25.7 million lei, under the conditions of art. 23 para. (11) of Law no. 276/2016 and Government Decision no. 476/2019;
- financial aid granted to agricultural producers whose agricultural production was affected by natural disasters in 2020 - 310.8 million lei, pursuant to art. 37 para. (2) of Law no. 276/2016, as well as the Government Decision no. 582/2020;
- post-investment subsidy - 325.7 million lei, according to the Decision Government no. 455/2017. Additionally, AIPA administered 59.73 million lei - sources granted from Government of the Russian Federation, intended to partially compensate for the damage caused by the 2020 drought on maize cultivation and soil preparation for harvest of 2021[23].

6.3.3. BSB opportunities

The extended Black Sea region has been and remains an area of contact for cultures and civilizations throughout the history. There are three civilizations that now meet in the Black Sea region: Western, Orthodox and Islamic. The region is characterized by some unresolved conflicts: in Transnistrian Zone, in Eastern Ukraine, in Abkhazia and South Ossetia, in Nagorno-Karabakh. This shows that there is a real need for a sincere dialogue between all the countries (nations, cultures) bordering the Black Sea, in order to seek and find a profound and comprehensive solution to all conflicts – a security architecture. In the regional context, Moldova is a unique case. Historically, it was at the intersection of the interests of the Austrian, Russian and Turkish civilizations and empires. Moldova is a civic nation that includes several ethno-linguistic communities (a majority with a neo-Romanic Moldovan language, some Slavic minorities – Ukrainian, Russian and Bulgarian, and a Turkish-Gagauz minority), which nevertheless have political, civilizational (religious), cultural and others common values. This makes Moldova an appropriate platform for intercultural, inter-civilizational and political dialogue between the Black Sea region countries.

BSB projects in Moldova aim to improve the living standards of people in the riparian regions of the Black Sea Basin through sustainable economic growth and joint environmental protection. Actions are mainly focused on the promotion of business and entrepreneurship, the promotion of a coordinated environmental policy and the reduction of marine litter in the Black Sea Basin through joint actions, thus each project where Republic of Moldova is part of helps improve the cooperation between the entrepreneurs ,farmers, local businesses as well as make exchange of good practices study cases and learn from the experience of other countries.

[23] Source SIA ESBS AIPA

6.4. Qudruple helix approach in agriculture field

6.4.1. Theoretichal Approach (theory)

The approach used for this regional analisys study was based on the Quadruple Helix. The Quadruple Helix is a development of Triple Helix approach by integrating civil society, innovation and knowledge. Quadruple Helix innovation theory is a collaboration of four stakeholders, namely: academician, businissman, civil society, and goverment, that play roles to encourage innovation. It is useful in an innovation process where the citizens needs are central, especially in agriculture sector. Using the Quadruple Helix and involving the citizens in the development of an innovation can led to more successful, user-oriented innovations. The end users will be more likely to accept and use the innovation.

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.

- **Academia.** A generous number of research and academic institutions work on sustainable agriculture and soil protection issues. The education and research system has been restructured in the past years to give a stronger emphasis on applied science and to improve the quality of research output by optimizing the number of scientific institutions. However, knowledge and know-how sharing between scientists and farmers has remained limited, and the research conducted is still insufficient to answer questions about the impact of the various practices and technologies on adaptation/resilience, productivity, and mitigation goals and on how such efforts could be scaled out to reach a higher number of farmers.
- **Industry.** Rural population involved in agriculture practices in Moldova can be divided in three categories: (i) Smallholder poor farmers with small land properties, who crop their land and own livestock, with limited access to loans; (ii) Small and medium rural entrepreneurs “leaders” that consolidated the land into large plots by renting part of the land to rural residents, sometimes financially backed by investors; they are the major economic driving force in rural areas accounting for a significant portion of employment (permanent and seasonal) and investments; (iii) Rural residents that rent the whole or most of their land to “leaders” account for about 70% of the rural residents, and are not engaged in farming (apart from home garden and poultry); leasing agreements with farming “leaders” are often verbal and fees are in-kind through the provision of agreed quantities of crop production (about 15-20% of average harvest yields).
- **Public Authorities.** The public sector can play a key role in creating an enabling policy and legal environment for climate-smart agriculture, which can permit private sector and civil society stakeholders to make timely, well-informed and efficient decisions related to securing food production, adapting to climate change and reducing and removing greenhouse gases. Many stakeholders, especially smallholder agricultural producers with limited assets will only be inclined and able to take necessary actions if their work is enabled by a coherent climate-smart agriculture policy framework. The transition to climate-smart agriculture requires transcending sectoral and other boundaries and calls for the full integration of climate change issues into the policy-making process at all levels. This means that new institutional structures and alliances among private and public stakeholders in a range of different areas, including policy making, research, extension and financing may be needed.

Moldova's government views information and communication technologies (ICTs) as a high-priority field with significant benefits, and has taken proactive measures in a number of areas. The law on information technology parks, which paved the way for the creation of the Moldova IT

Park, is one of its flagship initiatives for IT industry growth. For companies registered in the Moldova IT Park (for a wide range of qualifying IT and related operations, such as software development, IT services, digital graphics and design, research and development, and educational projects), the park offers a special tax regime and streamlined tax administration.

- **Society.** Despite its long history, smart agriculture (SA) is still a relatively new concept in Moldova, and farmers and policymakers, like elsewhere, have been wary of introducing novel and unfamiliar agricultural practices. One of the preliminary lessons learned from this study was the identification of bottlenecks in accepting SA and developing national strategies and policies to encourage SA, not only at the smallholder farmer level but also at the ministerial, academic, and civil society levels more broadly.

6.4.2. List of stakeholders from the investigation

Fifty percent of the stakeholders involved in gathering the data for the mapping were representatives of the business and industries (mainly those that are working in the agriculture sector and those that are provider of the technologies for this sector).

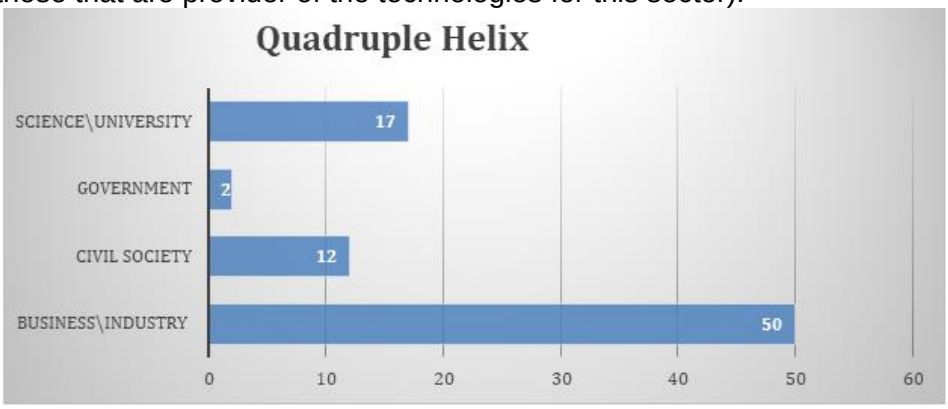


Fig. 74. Quadruple Helix Representation from the list of 100 stakeholders

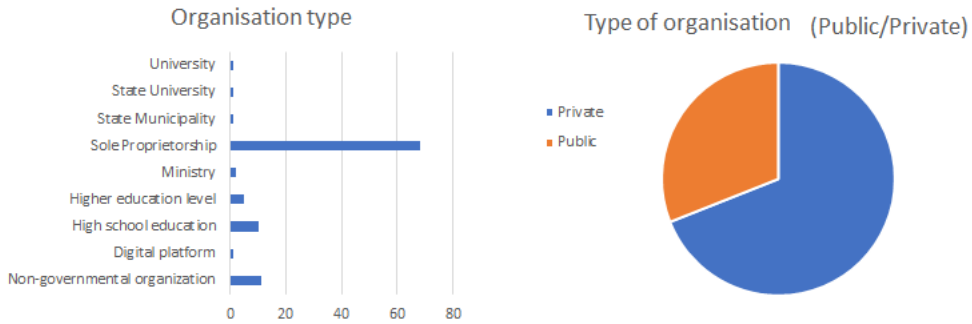


Fig. 75. Results from the questionairs regarding the respondents

Despite its long history, smart agriculture (SA) is still a relatively new concept in Moldova, and farmers and policymakers, like elsewhere, have been wary of introducing novel and unfamiliar agricultural practices. One of the preliminary lessons learned from this study was the identification of bottlenecks in accepting SA and developing national strategies and policies to encourage SA, not only at the smallholder farmer level but also at the ministerial, academic, and civil society levels more broadly.

6.4.3. The key stakeholders involved in the questionnaire (50)

For the regional analysis investigation were interview 50 respondents as follows :

- 35 respondents are from the private sector and 15 from the public sector. From which 6 are governmental organisations and 44 are non-governmental.
- Eleven (11) entities are non-profit organisations and 39 entities are profit based entities.

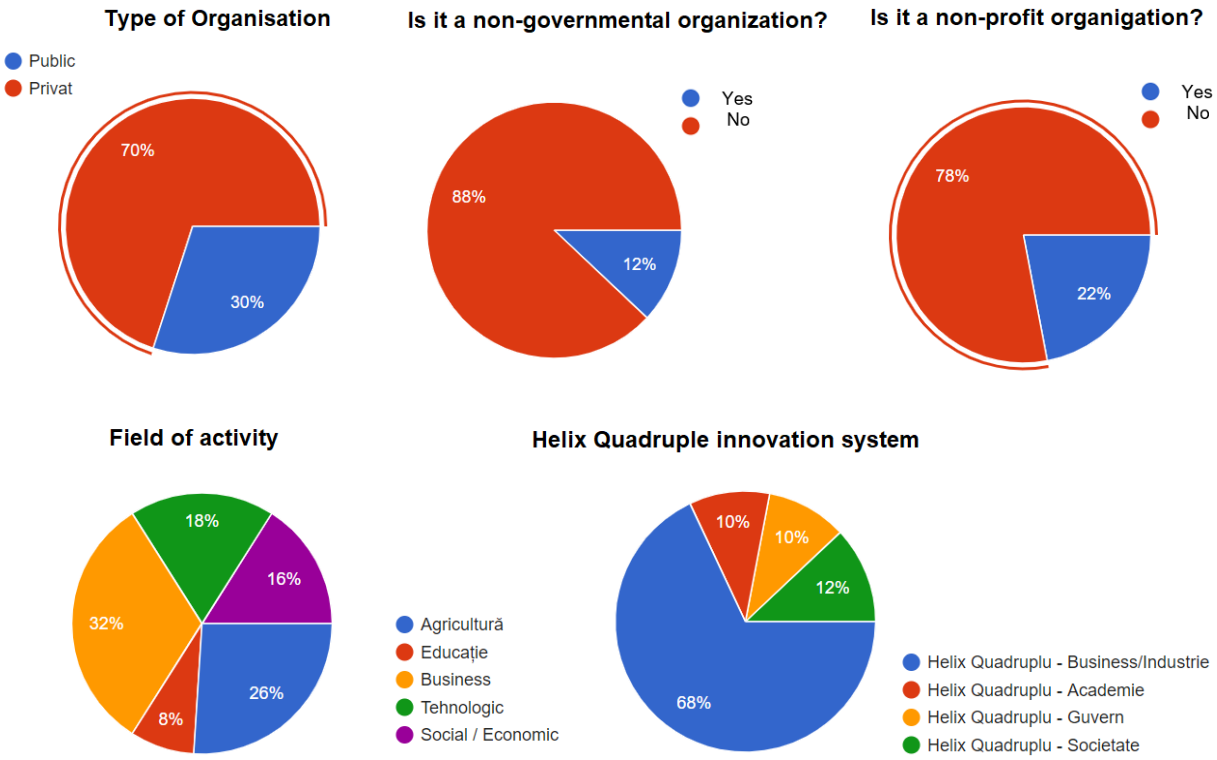


Fig. 76. Field of activity and the 4-helix representation of respondents

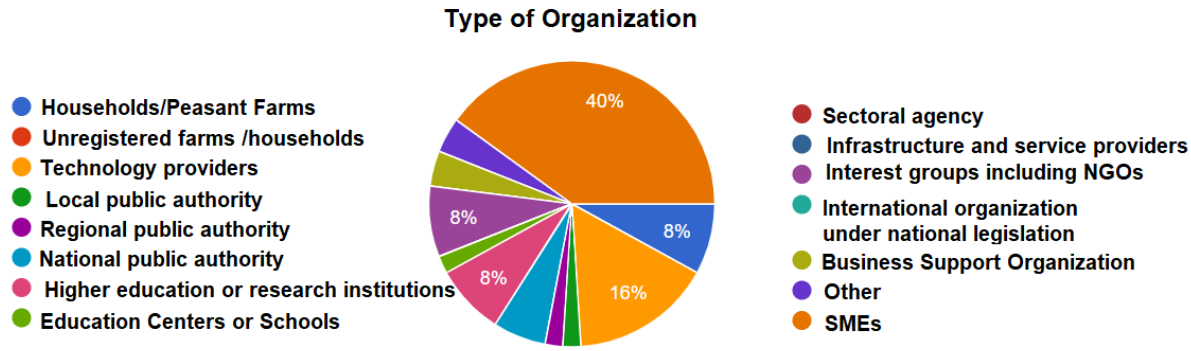


Fig. 77.Type of organization

From the interviewed respondents 16 are business entities, 13 are in agriculture, 9 entities are offering tools and tehnologies for the agriculture, 8 repondents are from social/economic field, and 4 are from education and academia environment. As asked by the methodology 68% of the interviewers are from Business/Industry, 12% Society, 10% Government and 10% Academia.

The most of the interviewed entities are Small and Medium Enterprieses (SMEs) both from the urban and the rural area, within the agriculture field of activity, 16% are also SMEs but providers of technology in the agricultural sector, 8% are households with agriculture as main activity, 8% are NGOs , 8% Higher Education and Research Institutions, 4% Business Support Organizations, 2% Education and Training center, 6% National Public Authority, 2% Regional public authority, 2%Local Public Authority.

The most of the interviewed respondents are SMEs working in the agriculture sector , in rural areal, using conventional methods of agriculture, and half of them(54,2%) own (or have in usage/rent) more then 10 hectares of land which means that their production is also considerable. On the other hand 16,7% of respondents are very small farms that have been on the agriculture market recently and are still trying to manage to fit and keep their quota. Around 12,5% cultivate between 4-10 hectares , 8,3% between 2-4 hectares and 8,3% between 1-2 hectares.

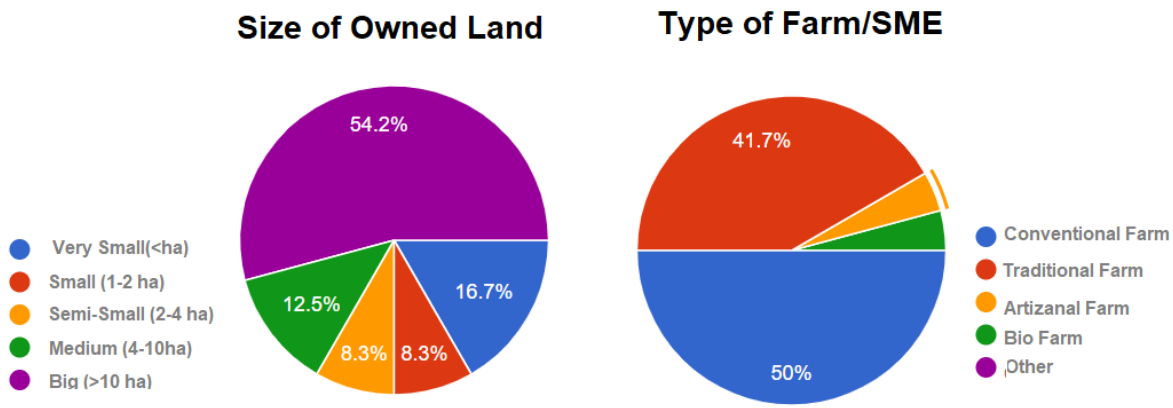


Fig. 78.Type of farm and size of owned land

6.5. Smart and IoT technologies existent in Republic of Moldova

Agriculture is a mainstay of Moldova's economy. Despite the highly fertile soils, agricultural productivity and yields are constantly threatened by natural hazards such as drought, hails, frosts, severe storms, which multiply already existing processes of land degradation and erosion and volatile market conditions. Water resources for agriculture are scarce, and irrigation infrastructure is almost inexistent among small-scale farmers.

Projections on climate change, manifested through increased rainfall variability and overall drop in rainfall, show an increased demand for irrigation water and a decline in available surface water resources. To sustain livelihoods and overall productivity, CSA investments would, therefore, need to target the development and accessibility of both irrigation and water treatment infrastructure, while improving water-use efficiency through adequate production technologies and knowledge capacity. Climate change is also expected to reduce crop yields across the three agro-ecozones by 10–30% by 2050 (relative to 2013 yields), considering no adaptation measure and given the current water challenges. However, higher temperatures could shift grape cultivation towards the country's northern border and may improve grape quality, by increasing sugar content, which could significantly boost wine quality.

Conservation agriculture techniques, micro-irrigation systems, anti-hail and anti-frost systems, and investments in improved pastures are some of the key practices that farmers in Moldova are implementing in response to these climate and environmental threats.

With ongoing EU-integration negotiations, Moldova is bridging the gap between EU markets and the rising markets of the CIS countries. Agriculture plays a significant role in the country; its value added accounts for 15% of GDP, agriculture employs 26% of the labor force, and Moldova has the highest land use for agriculture among the countries that participated in the workshop.

Several information systems have been built to help solve problems in agriculture's priority sectoral needs and contribute to the implementation of agro-industrial sector growth policies:

- the Digital Agricultural Register, to ensure access to operational data on the economic activity of economic agents in the agro-industrial sector and facilitate the provision of public services, including online, according to the single window principle;
- the State Animal Register;
- the System of Identification and Traceability of Animals, a basic subsystem and an integral part of the process of traceability of animal products;
- Management of Strategic Sanitary-Veterinary Measures, to support the preparation, registration and monitoring of the annual strategic plan drawn up by the National Agency for Food Safety;
- Laboratory Management, to generate the information needed for the complete management of sanitary-veterinary and food safety laboratories;
- the Administration of State Agricultural Heritage;
- AGROMAIA, used to monitor and collect operational information on agricultural and harvesting works;
- the Agricultural Equipment Register, used to provide IT solutions for identifying, recording and managing information about the technical potential of economic agents in the agro-industrial sector;
- agricultural subsidy file management, to automate workflows for managing subsidies while offering the possibility of generating different reports and controlling document circulation;
- Wine Register (includes a series of subsystems and modules that automate and ensure the processes of identification, registration, validation, archiving, deletion or modification of the data, according to the activity of the economic agent, to register wine parcels/wineries);
- Management of the Release of Phytosanitary Certificates (includes management of the export and re-export of products of plant origin, the preparation of reports, producer and exporter records, export directives).

EU4Digital, a new EU initiative, will help to improve the digital economy and society in the region. Among other things, the program aims to extend the advantages of the EU Digital Single Market to Eastern Partner States by assisting them in expanding e-services and harmonizing digital frameworks.

From 2020, a new FAO project will greatly boost data collection and management in Moldovan agricultural and rural statistics, bringing them up to international standards and allowing the collection of data on key SDG indicators such as labor productivity and smallholder incomes.

The country's ICT metrics are average or slightly below average: The internet is used by half of the population, and half of the households have internet subscriptions. The cost of telecommunication services is slightly higher than the WS-country average. According to the WEF NRI index, Moldova is making rapid progress in terms of government efforts, especially in terms of online government services and e-participation indicators, and is making good progress in

terms of ICT promotion. Other indicators indicate that the country's output is about average, but the effect of ICTs on new services and goods is still a field that needs to be improved significantly[24]. The performance of a series of strategies, beginning with the National Strategy for Building an Information Society ("Electronic Moldova" or E-Moldova), adopted in 2005, has been linked to Moldova's progress in ICT growth. The construction of an effective information system at different levels was a top priority of the early strategies. Among the online services introduced were an online fiscal declarations system, a biometric passport and automated biometric border crossing system, the Moldova digital map, mobile digital signature, and other online services (e-record, e-license). The government approved the Technological Transformation Strategic Program or "e-Transformation" program (supported by the World Bank) in 2011 as the key framework for state ICT progress.

The new "Digital Moldova 2020" plan seeks to create a modern information society. The strategy is accompanied by an Action Plan that outlines the steps that must be taken to achieve the strategy's key objectives. The following are the key pillars of the strategy:

- Access and infrastructure - connectivity and network access improvement;
- Digital content and electronic services promoting digital content and generating services;
- Capacities and utilization - strengthening literacy and digital skills to enable innovation and usage stimulation.

In Republic of Moldova there are a few programmes especially facilitating the process of development, management and implementation of development policies of the agricultural IoT sector , to be mention in this regards, such us « e-Agricutlure Strategic Program » , « Export Moldova- Market Assistance website » , « Agravista ».A small description of the mis presented below.

"Export Moldova" - Market Assistance website

- Country: Moldova
- Organization: National Agency for Rural Development
- Access: Public, USAID/CNFA
- ICT technology: Web portall

"Export Moldova" has been incorporated into the larger national extension service website. Export Moldova provides a portfolio of important information to traders and producers to facilitate their access to export markets. The information covers 13 products and drills down to detailed market information on export markets, varieties, packaging, and postharvest handling and processes, as well as EU quality standards, the standards endorsed by Global G.A.P., and similar information.

www.acsa.md/category.php?l=ro&idc=178

Agravista

- Country: Moldova
- Organization: National Federation of Agricultural Producers
- Access: Public
- Operational: since 2004
- ICT technology: Web portal

The National AGROinform Federation was established by a network of 30 regional NGOs that were working for the economic development of rural communities. The online service (see www.agravista.md) not only makes a wide variety of market information available to farmers, but producer groups can actually do online trading with domestic and international buyers. In the first year alone, products valued at over USD 90 million were offered for sale online, with more than USD 10 million in contracts being signed. According to the federation's annual report, AGROinform upgraded the Marketing Informational System in 2014. For the MIS, a new software was launched. Farmers placed almost 3 000 commercial offers in the new system, and MIS had 78 000 registered users last year.

www.agravista.md/

[24] FAO. 2018. Status of Implementation of e-Agriculture in Central and Eastern Europe and Central Asia - Insights from selected countries in Europe and Central Asia. Budapest, 52 pp.

e-Agriculture Strategic Program

- Country: Moldova
- Organization: Agricultural Information Centre
- Access: Public
- Operational: since 2012
- ICT technology: Various

The e-agriculture programme, coordinated by the Agricultural Information Centre (AIC), was created in 2012. AIC is an independent economic agency, under the Ministry of Agriculture and Food Industry, responsible for the development and implementation of the e-Agriculture Strategic Program. AIC became the Unique National Operator of all information systems in agri-food sector in Moldova in 2013.The e-agriculture program has three main objectives:

- Modernization of public services through digitization and reengineering the operational processes.
- Streamlining the activities of the entities from agribusiness sector through modern technologies.
- Streamlining the elaboration and implementation of development and monitoring policies from the agri-business sector.

There are many expected results of the programme, especially facilitating the process of development, management and implementation of development policies of the agribusiness sector and providing the business environment with accurate, coherent information, which will enhance business development in the agricultural sector. It also can contribute to the re-engineering of public services and operational processes in agriculture, forecasting business development in agriculture and the professional development of personnel from the agricultural sector. *www.cia.md/eng/about/about_cia*

The results of this research show that Moldova has potential for growth in regards to technical equipment used in the agriculture sector. The main supllliers of machinaries and tools on the internal market are presented below. Althought the tehnologies in their inventory is vary and of good quality the IoT in agriculture are still lacking form their portofolios. Below are presented the top providers of technologies for the agriculture sector in Republic of Moldova.

Fig. 79. Providers of technologies for the agriculture sector in Republic of Moldova

These entities provide such smart technologies as : automatic agricultural weather station, combine harvesters and tractors, deep plows, sowing equipment, trailers and semi-trailers, drills, feeders, loaders, compact cultivators, fertilizer harvesters minerals, vegetable seeders, spare parts, grain cleaning and drying equipment, milling cutters, tractors, soil preparation equipment, sprinklers, headers , driving systems, telescopic loaders, precision navigation and agriculture systems, vineyard shredder. As the research showed on the market there are present few companies that provide with drones, integrated systems, farming OS control systems. Thus there can be stated a lack of smart tools that could easy the work of entrepreneurs on their farming and agriculture activities.

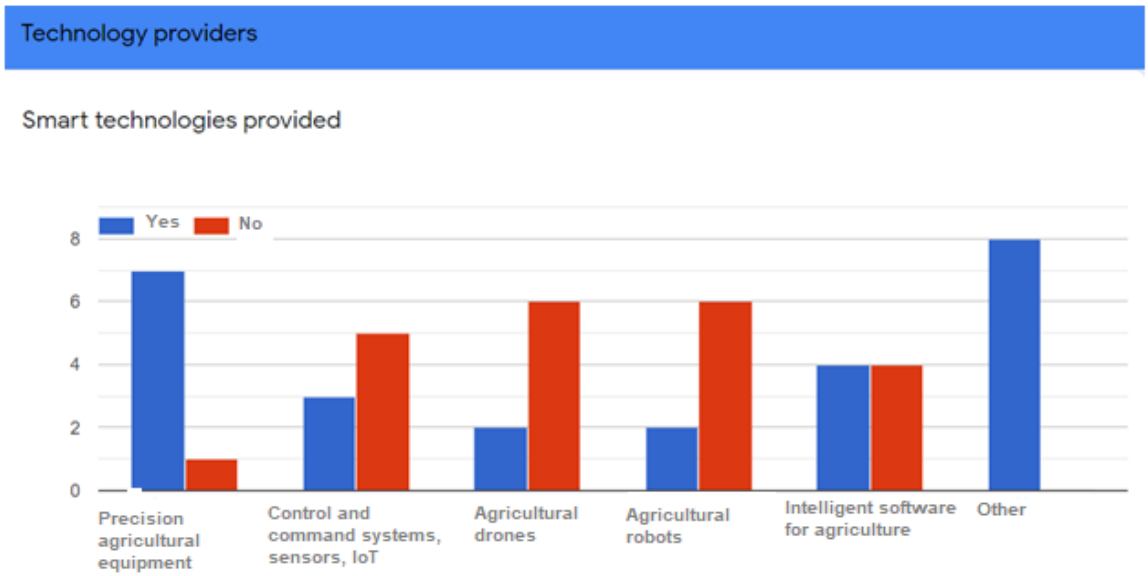


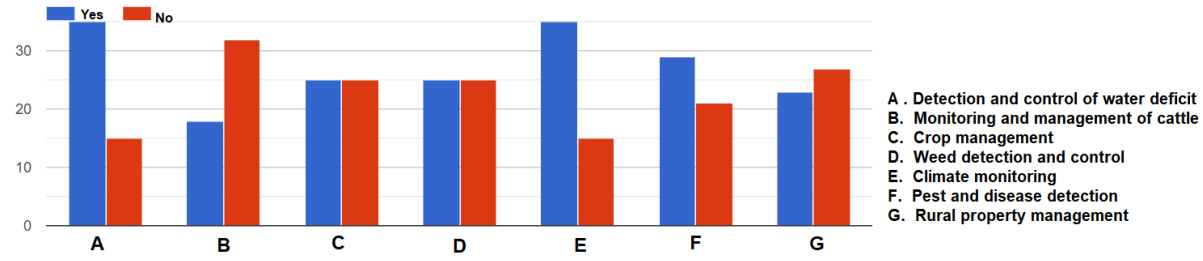
Fig. 80. Smart technologies provided by the local distributors.

6.6. Agricultural needs of the rural communities in Republic of Moldova

Digital technologies can help Moldovian farmers deliver safe, environmentally friendly and quality food. These technologies not only help farmers to produce more with more few resources , but they can also contribute to combating climate change. Existing and new technologies, such as the Internet of Things (IoT), artificial intelligence, robotics and large volumes of data can all contribute to streamlining processes and can lead to the creation of new products and services.

Investigations into the level of preparedness for smart agriculture

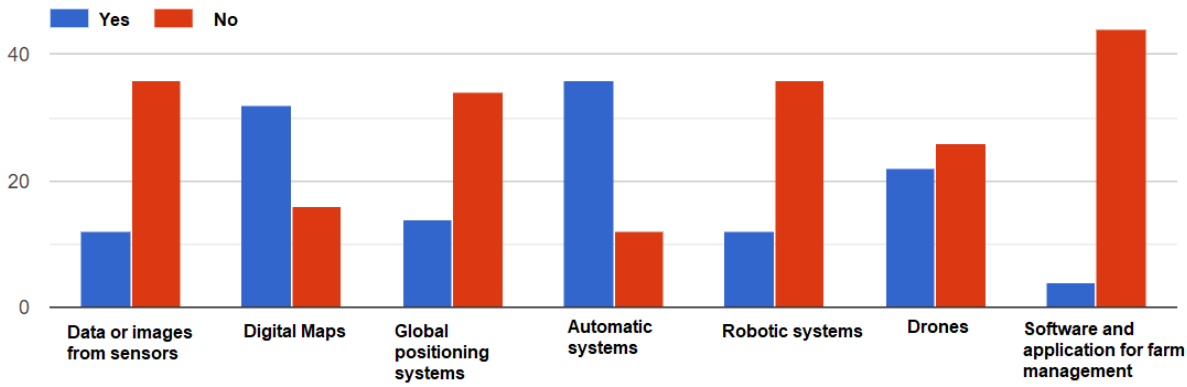
1. What smart agricultural application do you know?



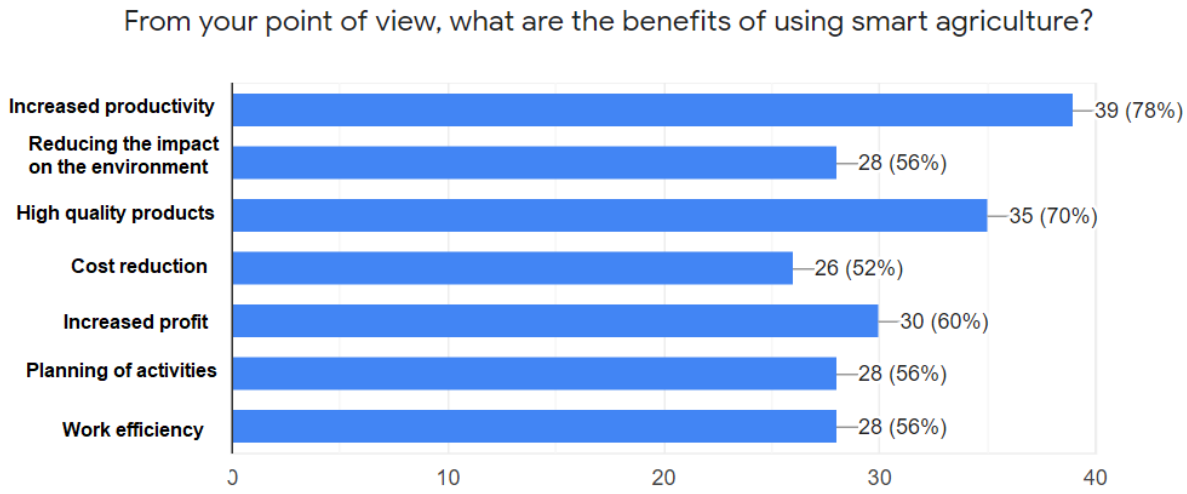
Digitization can also play a role in creating a better life in rural area of Republic of Moldova. The use in the future of digital technologies will be increasing most important for farmers and other rural enterprises, to enable them to provide sustainable solutions to current and future challenges. As an aim to be set for the National Public Authorities of Republic of Moldova is the digitalization of the agricultural sector and rural areas in Moldova and empower them through data.

Although the digitization of the agricultural sector brings many benefits, and a number of actions and tools have already been implemented, there are still barriers to unlocking its full potential in our country.
Analysing the data from the questionnaire based on the knowledge of the repondents it can be stated that the most common know and used intelligent technologies are digital maps, automatic systems and drones. Still as the answers are subjective we can only state that the info provided by the respondents is not enough to state the reality of the level of the technologization of the rural areas and the use of such technics in the agriculture sector of Republic of Moldova.

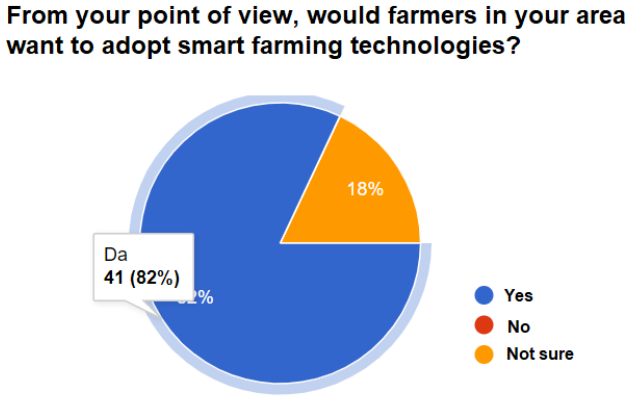
2. In your territory, what kind of intelligent agricultural technologies are used?



Globally, agriculture has advanced significantly. By using technology, agriculture can achieve an efficiency that our parents or grandparents never saw as possible. Technology is advancing at a dizzying pace, and now we are not just talking about software and hardware solutions, but especially about technology capable of interpreting all collected data (eg data entered into the management system, data transmitted by weather stations, various sensors or drone). In addition, there is also the knowledge transmitted by previous generations, information that can be unique to each farm and related to the geology and microclimate of the area. All this, put together and interpreted properly, can be the basis of a "recipe" to farm efficiently, to use resources optimally for maximum results.
The benefits of using smart agriculture from the point of view of our repondents are increased productivity (78%), high quality products(70%), incresead profit (60%) , planning of activities (56%), work efficiency (56%), reducind the impact on the environment (56%), and cost reduction (52%).



Due to consumers who want quality food at the lowest possible prices, but also to factors that cannot be controlled, such as unfavorable weather conditions, in general, farmers' incomes are quite low. The supply chain is also becoming wider as the distribution network moves further into the globe, with growing demand for farmers to produce more for less. Farmers will need to find the means to finance such cutting-edge technologies and minimize operating costs, while maintaining effective margins to be competitive.

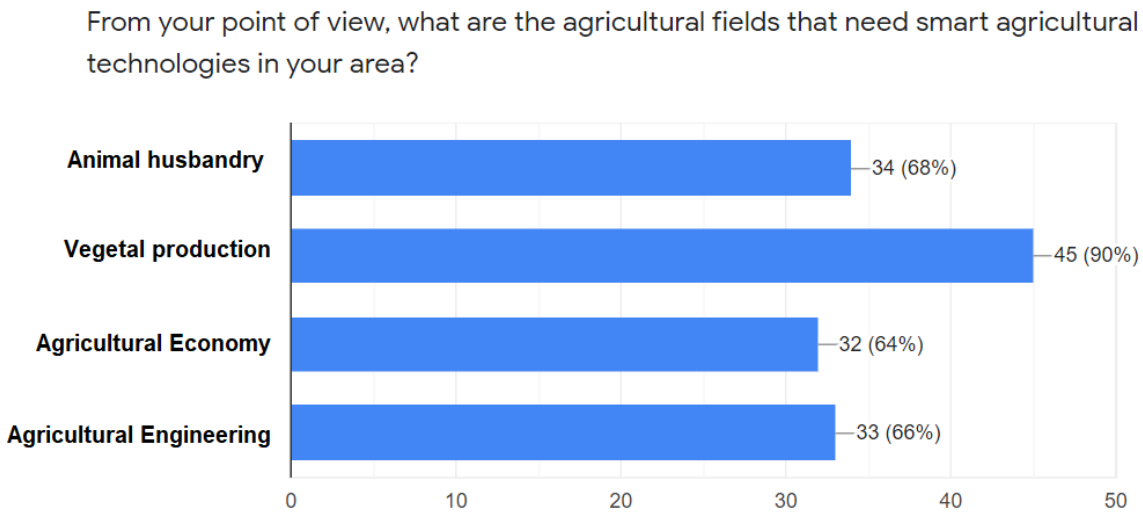


Only 18% of repondents were not sure of the need of smar farming technologies in their activities and in our country in general, but the majority (82%) consider this a must.

The agricultural sector in the Republic of Moldova has been strongly influenced by climate change in recent years. Torrential rains followed by extensive droughts remove nutrients from the soil and affect

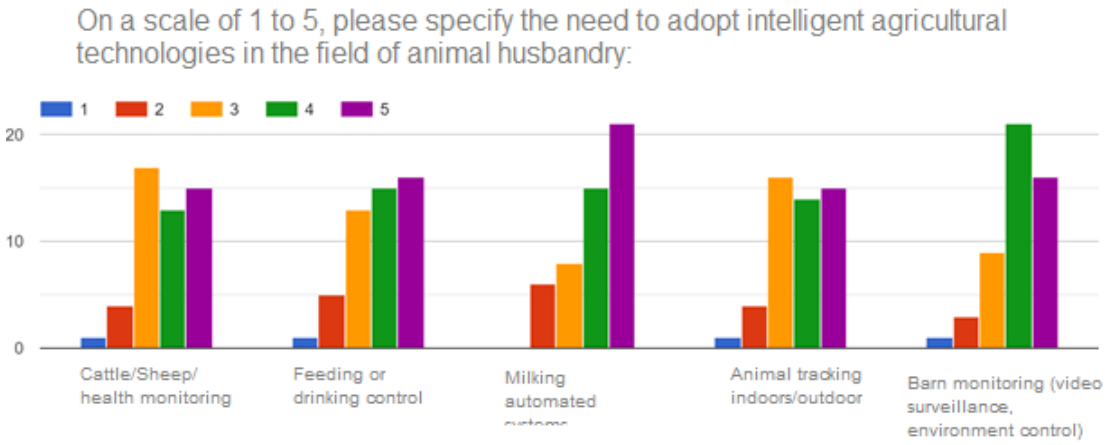
the fertility and ability of the soil to grow crops. Under these conditions, domestic producers are thinking of different strategies to cope with and innovate agricultural products, the technology used and the ways of promotion.

Those repondents that stated the need of smart agricultural technologies in Republic of Moldova, mentioned the most need in the vegetal production, grop growing and soil cultivation (90%) , thus being mostly determined by the fact that the most repondents have their main activity in this field area. Animal husbandary (68%) is another field that could benefit from the IoT, and also agricultural engineering (66%) and agricultural economy (64%).



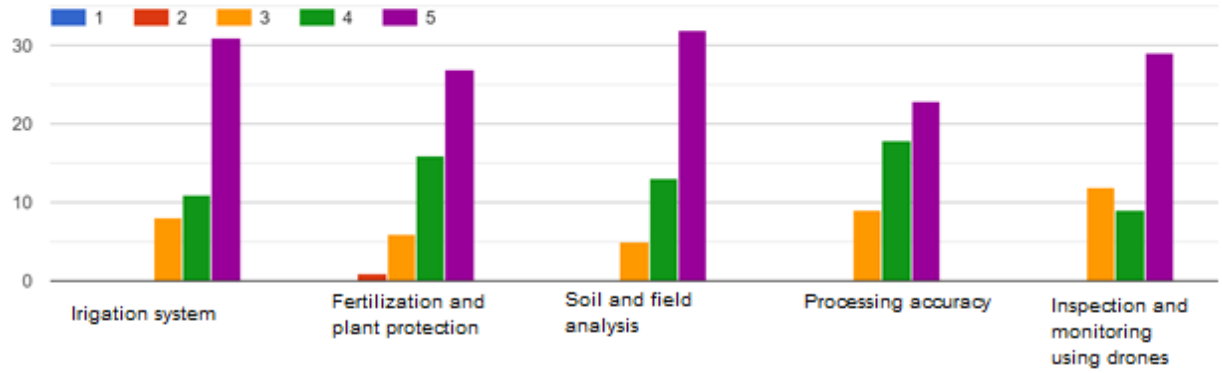
The Republic of Moldova has an enormous potential to achieve performance in agriculture, if farmers would adopt more innovations and implement modern technologies in production. Many of them have already been convinced of the efficiency of digitizing agricultural businesses, but for some, however, digitization is about the future.

In the field of animal husbandary the need to adopt intelligent agricultural technologies was stated mostly in the area of automated milking and cattle health monitoring, but nevertheless the respondents considered that they could benefit if this types of technologies would be implemented also in tracking animals indoors/outdoors and in barn monitoring, due to the level of thefts in the rural area.



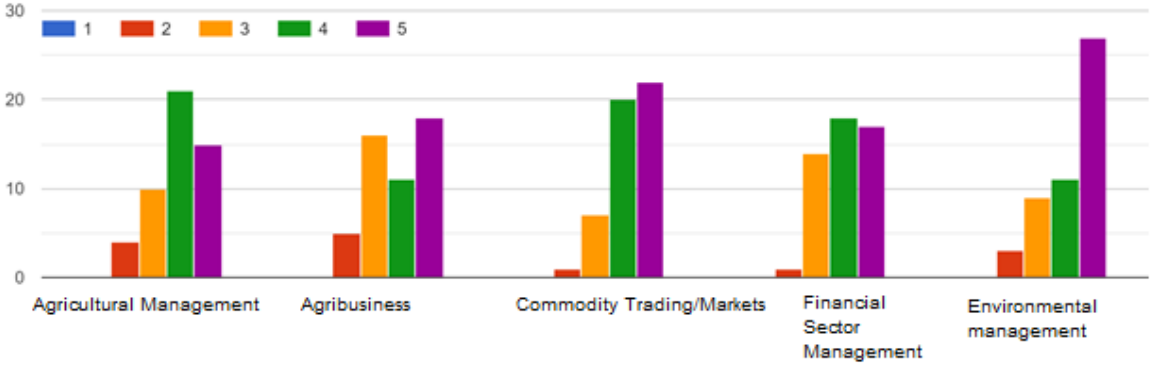
In the field of plant production the need to adopt intelligent agricultural techonologies is felt needed in all the areas, but the most in irigation and soil and field analysis, follow closly by the need of IoTs in the fertilization and plant protection, processing accuracy and inspection and monitoring using drones.

On a scale of 1 to 5, please specify the need to adopt intelligent agricultural technologies in the field specific to plant production:



The need to adopt smart agricultural technologies were appraised as beeing very high especially in the environmental management field and also for the trading sector and using it in markets, for selling the agri products. The IoT is not used enough in the field of agricultural management, as the management itself is beeing neglected at some point, thus the respondents stated the hight need of smart technologies in this secotr, and also in the financial sector.

On a scale of 1 to 5, please specify the need to adopt smart agricultural technologies in the specific agricultural economic field:

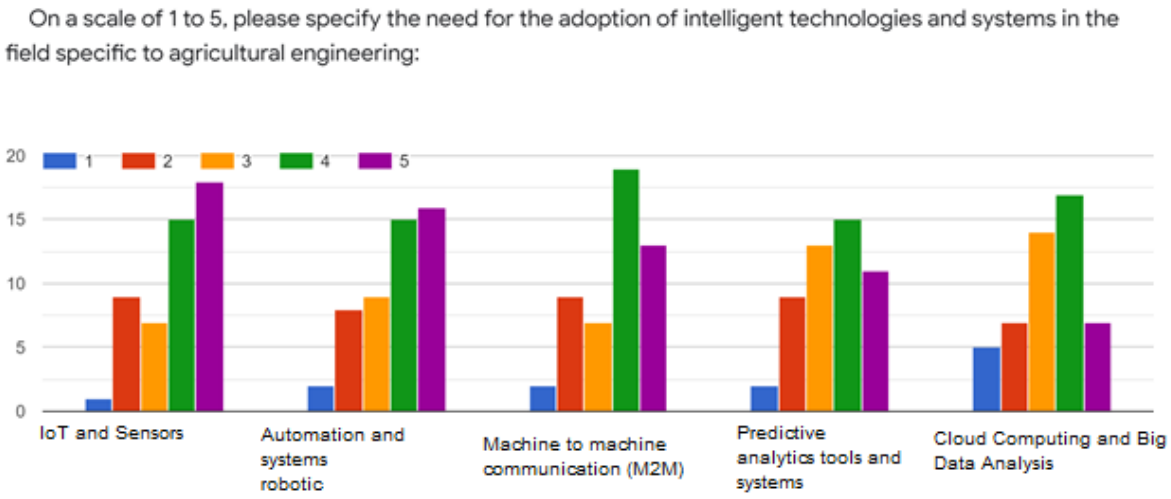


Stating the need of intelligent technologies and systems in the field specific to agriculture engineering the most demanding is the IoT and sensors and the automation and robotic systems. Technologies that would ease the machine to machine communcation (M2M) are also needed as this can contribute to a more efficient time management and help the agriculture sector is by providing insights that could make farmers and other members of the agriculture supply chain more aware of risks.

There are situations at risk, where illnesses can spread quickly in a herd of hundreds or thousands of cows. In many instances, the sicknesses contracted by a few cows spread to dozens of others before farmers realize the problem. Thus the need for several IoT gadgets is felt in order to

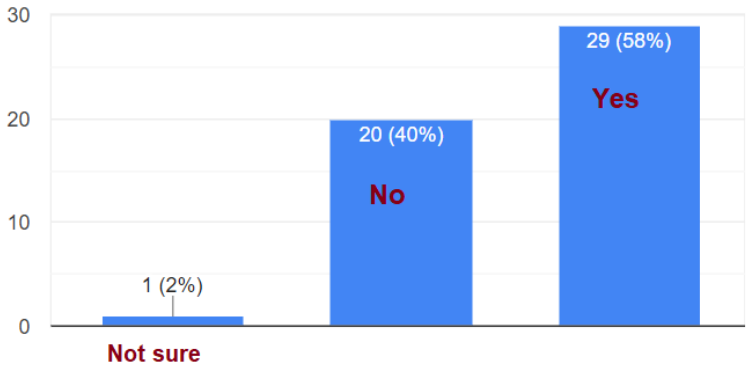
prevent that issue and others. Some of them could monitor fertility, which could be specifically advantageous on properties where farmers depend heavily on successful breeding. Others could notify farmers when cows are in periods of high milk production. Based on what the data says, farmworkers can do things like adding a type of grain that promotes lactation to an animal's feeding regimen. Sensors if implemented could collect data about behavioral abnormalities, too. Since those variations could be the first sign of a severe illness, the information could helps farmers be proactive in curbing possible health issues by isolating cows that may be ill. Since these sensors typically receive data continually and could be used on farms with thousands of cows, it's easy to understand why data centers are instrumental in helping agriculture professionals collect and retrieve information.

Predictive analystic tools and systems are less demanding but not to be ignored as such tool are already used in the agriculture sector in regarding to meteo forcast etc. Agricultural supply chains present a number of challenges for farmers and distributors. Unlike most goods, food products are perishable and can pose a health risk if they're not handled properly during transport. Data analytics can greatly improve the way these products make their way from the farmers' fields to markets around the world. Distributors will be able to identify inefficiencies in their supply chains to help agricultural products get to their destination faster and more cost-effectively. Retailers can use sales and inventory data, as well as information they've gathered about customer behavior, to minimize waste and excess inventory while staying a step ahead of market demands.



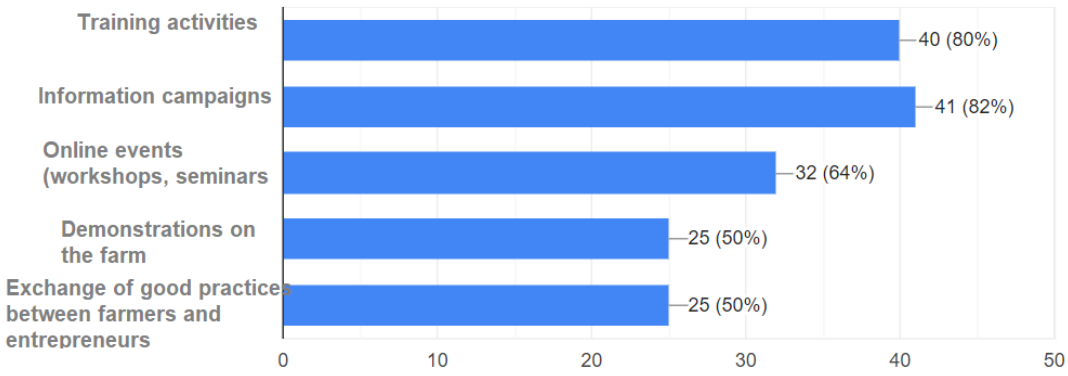
The challenges foreseen in agriculture as far as the need to double food supply is concerned are now putting agricultural sustainability at par with ensuring food security. There is a need for a resource efficient global food system that takes into consideration the aspect of sustainability. For example, if you are struggling to ensure efficiency in how you use water in your farm, ways of reducing soil erosion and ensuring minimum degradation, or even minimizing energy input, you are not alone. Every farmer all over the work hopes to achieve all these and other goals at the minimum possible cost. However, such goals post some of the highest requirements in agriculture which cannot be achieved successfully through traditional approaches of farming. With the increase in the demands and the need for sustainable agriculture, it is becoming really necessary for farmers and the associated stakeholders to invest a lot in knowledge and more sophisticated machines and devices. Unlike in the past, nowadays farmers can use smart farming approaches to collect data and make informed decision from it. There are are diverse data analysis techniques that farmers can use. For example, though smart technology, farmers can establish the fertility of their farmland through the analysis and the comparison of satellite images and in the end use the data to derive the yield potential of a given land.Thus most of the respondents stated that smart technologies can help fix major socio-economic challenges.

In your opinion, can smart technologies and IoT lead to proper management of agriculture and address other major socio-economic challenges in your field, such as brain drain, youth unemployment and wasted intelligence?



For the initiatives to promote smart farming in Republic of Moldova the most common requested are training activities and information campaigns, followed by online events (due to the COVID-19 outbreak) that could help local farmers get acquainted to new possibilities in the smart farming area.

In your opinion, what kind of initiatives are appropriate to promote smart farming in the farming community in your territory?



6.7. Conclusions and recommendations

Smart farming is the use of modern agricultural technology to increase output while also preserving and improving the land resources on which production is based. SA supports the idea of increasing yields and income while still ensuring the provision of local and global environmental benefits and services. The principles of SA are to restore the land, optimize crop production inputs, including labor, and maximize income. In contrast to other approaches, conservation agriculture advocates a set of values rather than a specific technology to achieve conservation goals. Through reducing the use of fossil fuels, pesticides, and other toxins, and conserving environmental integrity and facilities, agricultural communities become providers of more sustainable living conditions for the wider community.

Adoption of new and unfamiliar agricultural practices is traditionally a difficult process because non-leader smallholder farmers, particularly the poorest and most vulnerable, are hesitant to take risks and depart from generations of conventional approaches.

Agriculture has no future without digitalization. The widespread use of technological tools will also support innovation in agriculture and increase its productivity. Unfortunately, universities do not provide enough knowledge to students about digitization / software, nor there is enough information provided by the public authorities in regards to digitalization of agriculture and the important of it in the nearest future. The development of the Smart Agriculture (Agricultural Smart Technologies) sector would require new knowledge and skills, which should be implemented in educational institutions. The Agrarian University should add to their curriculum such a course - technologies already implemented in agriculture. Large companies in the agricultural field, do not have knowledge of using digital tools and do not know how to capitalize on solutions. Therefore, a training phase is needed for their employees in this regard. For the digitization of the agricultural sector, the necessary financial resources are very large and there is an acute lack of funds. For example, a platform develops and becomes functional in about 7 years. The existence and granting of subsidies to intensify the digitization process in agriculture is needed today more than ever.

SA encourages minimal soil disturbance (zero tillage and direct sowing), balanced chemical application, and good management of residues and wastes. This decreases land and water contamination, as well as soil degradation, as well as long-term reliance on external inputs, environmental management, water quality, and water use efficiency, and GHG emissions. SA produces excellent results in both small and large-scale cultivation, and it is adaptable to climate change-related issues such as decreased rainfall. In comparison to conventional methods, SA allows for increased soil production while consuming less labour. Even if market access conditions or crop prices stay stable, higher yields result in higher profits.

Private businesses are also involved in providing farmers with digital solutions, including agrometeorological data. Orange Moldova has begun to roll out digital solutions for farmers, including GPS fuel control and vehicle tracking – to reduce prices, conserve fuel, avoid theft, and facilitate auto-guidance – as well as digital tools for capturing, storing, and analysing weather data to protect crops. The services will be available via high-speed Internet throughout the country.

Despite the significant benefits of Smart Agricultural practices to productivity, resilience, and mitigation objectives, many small-scale farmers are still reluctant to such investments. Limited access to relevant technical assistance and to adequate financial resources, insufficient water resources and technologies for irrigation are some of the main barriers to adoption of CSA practices. Moreover, long-term benefits from investing in CSA are generally unknown to farmers, which makes them sceptical about new agricultural paradigms. Developing policy and institutional mechanisms to deliver relevant extension and financial services to farmers in a timely and effective manner is key for developing a climate smart agricultural sector in the country. A first step toward this is strengthening the early warning, weather, and hydrological information systems, accompanied by public-private mechanisms of compulsory insurance against natural hazards, accessible to small-scale farmers. Rural infrastructure development could help re-emphasize the importance of agriculture as an economic activity, especially since rural areas are the main providers of food for urban populations, and could bring a new agricultural development paradigm, where farmers and investors would have more incentives to invest into long-term solutions to climate-related threats.

It has already been determined that in order for SA to be more widely accepted and enforced, a concerted effort must be made to raise awareness about climate change, the effect of climate

change on Moldova's agricultural sector, and SA as a form of climate change agriculture that benefits both farmers and the environment.

It was recommended that value chain players, researchers, individual farmers, agriculture companies, forest managers, extension service providers, governmental workers, educators, and NGOs support the development of platforms to help create awareness about Smart Agriculture. Governments must be able to express their visions, set strategic goals, determine outcomes, identify trade-offs, develop action plans, and negotiate and compromise on individual contributions to the plans' implementation. Although individual smallholders may adopt SA practices, a coordinated response led by a strategic vision incorporating efficiency, connectivity, and conservation is needed to spread SA across the landscape.

In rural areas, the private sector has a dual structure, with a booming modern competitive sector and a static subsistence sector that is being increasingly marginalized. The main challenge is to bridge the gap between the two segments, as well as to re-establish a middle class of farmers and agribusinesses that can provide appealing non-emigration opportunities, especially to young people. Mentoring, extension, and business consulting services are all services that NGOs and service providers can offer.

The country analysis of Moldova's ICT-centric innovation environment reveals that existing policies are focused on international interests and should be refocused on national strengths. Many stakeholders believe that a holistic plan should prioritize particular ICT regions, other economic sectors, or specialized niches. Nanotechnology, e-agriculture, and the aerospace industry were among the suggested fields. ICTs, agriculture and food processing, biomedicine, and energy are the smart specialization areas defined in Moldova (where agriculture also plays a role).