GLOBAL INTEGRATION OF **TURKISH AGRICULTURE** AND **AGRICULTURE 4.0**

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EGE ÜNİVERSİTESİ İKTİSADİ VE İDARİ BİLİMLER FAKÜLTESİ

Global Integration of Turkish Agriculture and Agriculture 4.0

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ABBREVIATIONS

EU: European Union
USA: United States of America
R&D: Research and Development
ARIP: Agricultural Reform Implementation Project
nec: Not Elsewhere Classified
ICT: Information and Communication Technologies
CEMA: European Agricultural Machinery Association
CSE: Consumer Support Estimate
ÇATAK: Agricultural Land Protection Programme for Environmental Purposes
ÇKS: Farmer Registration System
DEFRA: UK Department of Environment, Food and Rural Affairs
FAO: UN Food and Agriculture Organisation
GPS: Global Positioning System
GAV: Gross Added Value
GSSE: General Services Support Estimate
GNP: Gross Domestic Product
GTHB: Ministry of Food, Agriculture and Animal Husbandry
IIBS: Statistical Regional Units Classification
ILO: International Labour Organisation
IOT: Internet of Things
IPARD: Instrument for Pre-Accession Assistance for Rural Development
ISIC: International Standard Industrial Classification of All Economic Activities
İBBS: Statistical Regional Units Classification
KOSGEB: Small- and Medium-Sized Enterprises Development Organisation
NFIA: Netherland's Foreign Investment Agency
OECD: Organisation for Economic Cooperation and Development
PSE: Producer Support Estimate
RFID: Radio Frequency Identification
NGO: Non-Governmental Organisations
TAGEM: General Directorate for Agricultural Research and Policies
TARMAKBİR: Asscociation of Turkish Agricultural Equipment and Machinery Manufacturers
TARSİM: Agricultural Insurance Pool
TOBB: Union of Chambers and Exchanges of Turkey
TSE: Total Support Estimate
TÜBİTAK: Scientific and Technological Research Council of Turkey
TÜİK: Turkish Statistics Institute
UK: United Kingdom
UN: United Nations
UNCTAD: United Nations Conference on Trade and Deveopment
USDA: United States Department of Agriculture
VRA: Variable Rate practices

FOREWORD

Industry has evolved since its rise in the 18th century in line with the accumulation of knowledge owned by humankind and always offered us more effective production levels and models. And the key to the present-day production system in which Industry 4.0 is experienced is the information technologies enabling machinery to be in communication with one another during the whole production process.

We can say that the agricultural sector, due to its structure, is slower than the other sectors in catching up with the digital transformation which has made its mark on our age as compared to the other sectors. Considering that the agricultural sector has so important responsibility as feeding the ever-increasing population of the world, placing such issues as efficiency and sustainability to forefront, it appears before us as an undeniable reality that we have to change this course of things.

According to the report of the World Government Summit, we have to produce 70% more food in 2050 as compared to the present day due to the increased demand. Therefore, the whole world must draw a road map in consideration of problems of demographic change, correct use of natural resources, climatic changes and food wastage.

This Exchange that has been closely following all changes in the world, including those in the agricultural sector, for 127 years and the Aegean University Faculty of Economic and Administrative Sciences have undersigned an exciting project which will contribute to the development of policy suggestions for the integration of Turkey to the Agriculture 4.0 process and the implementation and dissemination thereof.

Existing problems have been identified by the “Project Final Report” issued under our project “Global Integration of Turkish Agriculture and Agriculture 4.0”, which you are now holding in your hands, and suggestions have been tried to develop for a successful integration to this process.

I would thank estimable tutors of the Aegean University Faculty of Economic and Administrative Sciences Prof. Dr. Fatih Saygılı, Prof. Dr. Ayten Ayşen Kaya, Lecturer Elif Tunalı Çalışkan, PhD, Researcher Özge Erdölek Kozal and the employees of this Exchange and wish to meet in a great many studies which will bring together agriculture and technology.

Işınsu KESTELLİ
İzmir Commodity Exchange
Chairperson

GLOBAL INTEGRATION OF TURKISH AGRICULTURE AND AGRICULTURE 4.0

EXECUTIVE SUMMARY

Great change and technological developments that started with the Industry 4.0 process also showed up in the agricultural sector, and reflections of this process on agricultural production have started to shape as efficiency, effectiveness, speed, sustainability, food safety and competitive power. Ability of the agricultural sector to satisfy the food demand of the ever increasing global population within this great transformation depends on the use of advanced technology in agricultural production process.

With this transformation referred to as Agriculture 4.0, it has become necessary to identify a new ecosystem in the agricultural sector and, in this context, installation and dissemination of computer-aided control systems, various software and hardware tools, agricultural machines and areas equipped with digital sensors and intercommunication thereof and such smart systems as image processing technologies have gained importance. By such systems, all factors that are important for the sustainability of agricultural production have been rapidly and simultaneously offered to the information of producers, thus ensuring the effective use of resources.

In order to increase the production potential, effectiveness and efficiency of Turkey, which is a country of agriculture, its integration to the Agriculture 4.0 practices and to this process is quite important in terms of the future of the Turkish Agricultural sector and sector's ability to gain international competitive power. From this viewpoint, "Global Integration of Turkish Agriculture and Agriculture 4.0" has been determined as the project

subject under the cooperation protocol entered into by and between the İzmir Commodity Exchange and the Aegean University Faculty of Economic and Administrative Sciences Department of Economics.

Purpose of the project “Global Integration of Turkish Agriculture and Agriculture 4.0” is to develop policy suggestions for the identification, implementation and dissemination of ecosystem elements required for the integration of Turkey to the Agriculture 4.0 process.

In this context, the phases of our project are the following:

First, the Agriculture 4.0 process has been defined and information provided on the elements of this transformation occurring in agricultural production in the world and on smart systems and some successful examples of the practices thereof in the world briefly related. This section has been determinative in the creation of the road map in the integration of agriculture to the Agriculture 4.0 process in Turkey.

In the following section, present status of agriculture in the world, EU and Turkey has been compared on basic indicators, development of the Turkish agricultural sector studied in detail from the 1990s to the present day and the analysis of the sector revealed by making it in terms of investment incentives and foreign trading in this transformation process. Within the framework of this analysis, developments and changes in the agricultural policies in Turkey have also been studied, thus trying to identify any ecosystem elements and policy suggestions necessary in the global integration of the agricultural sector. Then, this analysis has been detailed for the İzmir region in particular and an intermediate workshop and a questionnaire survey carried out in order to identify the technological innovation potential in agricultural production in the region.

Intermediate workshop of our project was held under the theme "Technological Transformation, Present Status, Determination of Problems and Solution Suggestions in Agriculture" on November 29, 2017. In this workshop, stakeholders of the agricultural sector (growers, chambers and unions, technology companies, public bodies and university representatives) were brought together. Present status and development potential of agriculture in Turkey and developments enjoyed in the Agriculture 4.0 practices in the world and Turkey were shared and views, contributions, problems and solution suggestions were discussed.

Questionnaire study was carried out with 500 farmers and 10 technology companies in the townships identified in the İzmir Region and the results obtained for the identification of agricultural innovation potential were analysed in detail in our project.

Consequently, results obtained at all phases of our project were evaluated and policy suggestions and tools for successful accomplishment of Turkey's integration to the Agriculture 4.0 process were identified.

Analyses we have carried out on the basis of the İzmir Region are important in terms of providing a basis for the studies to be carried out to identify the region-specific agricultural products with development potential and, in this context, achieve the implementation of bio-technology and information technologies on the basis of a specific product and enterprise (cotton, raisin, organic agriculture, medical aromatic herbs, greenhousing, etc.). In consideration of these results, it will be possible to implement the ecosystem elements identified for the Turkish Agriculture on regional basis and evaluate the outputs if case the project continues.

INTRODUCTION

With the increasing global population, global demand for food is also increasing. It is anticipated that the world population which was approximately 7,5 billion in 2016 will increase to 8,5 billion as of 2030 and 9,7 billion in 2050. Agricultural production should increase by 70% by 2050 so that the foof need of this increasing population may be satisfied (FAO, 2017). This projection has ensured the agricultural sector to come to the fore as a strategic sector on one hand and made it necessary to re-consider the present status and development trends of the agricultural sector on the other.

In 2011 and afterwards, it was first announced in Germany that an industrial process called Industry 4.0 would be entered in which information technologies and industry would come together and product would work at maximum efficiency by means of integrated computer systems and artificial intelligence would come to the fore. Integration of the agricultural sector to this process presents great importance. Such integration represents that all other value chain steps of the agricultural sector are interlinked in a manner in which they are in communication with one another on real-time and continuous basis. Agriculture 4.0 defined as the enhancement of efficiency and effectiveness in agricultural production thanks to the use of the information communication technologies in the agricultural sector first creates opportunities for access to reliable and healthy food and speeds up the information sharing and decision-making processes.

Agriculture 4.0 practices are achieved by the fact that agricultural machinery and areas are equipped with sensors and are in communication with one another, and it is aimed to increase efficiency and quality by the use of modern technologies. By smart systems, such factors as climatic conditions, condition of soil, minerals of plants, irrigation and harvest times which are so important for agricultural production are rapidly and simultaneously offered to the information of producers, thus ensuring the effective use of resources. With these technology-based practices, production costs may be substantially reduced and quality products with high nutritional value are produced, thus increasing the international competitive of countries. Further, Agriculture 4.0 refers to an environment-friendly and sustainable agricultural production as well.

In this context, transformation process which the agricultural sector has gone under by the use of new technologies will be studied and then examples of the countries that have been successful in the agriculture 4.0 practices in the world will be contained in the first chapter of the study. In the second chapter, the present status of the agricultural sector in the world and Turkey will be determined. First, comparisons will be made on the basis of the data related to the agricultural sector in the world, European Union countries and Turkey. In this chapter, reference shall be further made to the developments experienced in the Turkish Agricultural Policy particularly after the 1990s, to the supports and investment incentives in Turkey and Turkey’s agricultural product foreign trade. In the third chapter, a general framework will be drawn for agricultural production at the level of regions in Turkey and then the present status of agriculture in the İzmir region will be discussed. Fourth chapter of the study is allocated to the analysis of the Turkish agricultural sector within the technological transformation process.

First of all, results of the intermediate workshop in which due diligence has been made in technological transformation in agriculture will be presented. Then, light will be cast on 40 years of agriculture in Turkey by the use of all input-output tables issued by TÜİK between 1973 and 2012 and detailed analyses will be made using the 2012 Input-Output Table which is the last one issued. Finally, findings from the questiıonnaire study applied by holding face-to-face interviews with 500 farmers and the results of the questionnaire study made with 10 companies producing agricultural technology in order to study the compatibility process with new technologies in agriculture will be shared. Last chapter of the study is allocated to the conclusions and suggestions.

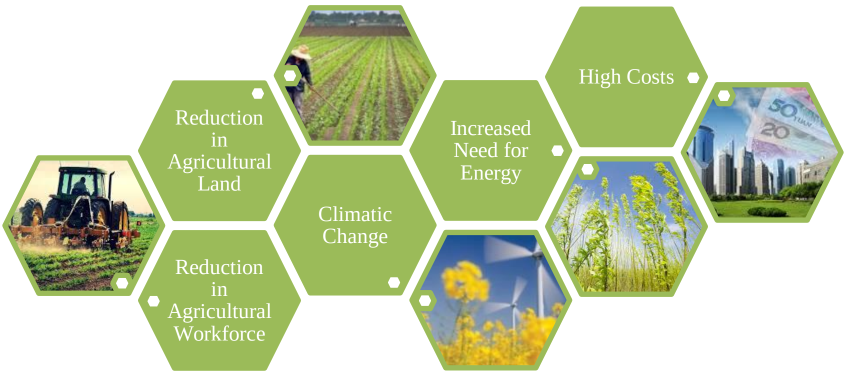
CHAPTER 1

NEW TECHNOLOGIES IN AGRICULTURE AND AGRICULTURE 4.0

1.1. Technological Transformation of Agriculture

Rapid increase of the world population has brought to agenda a sustainable solution seeking to the nutrition problem of the humankind. It is anticipated that agricultural production should be increased by 70% in order to satisfy the need for nutrition of the world population which is estimated to reach 9.7 billion by 2050. However, how to provide such increase in production in the changing climatic conditions and how to make it sustainable appears before us as an important issue in the present day. In consideration of the fact that 11% to 15% of the greenhous gas emission in the world occurs as a result of the industrial agricultural practices, it is a fact that an uncontrolled increase in production will have an adverse impact on the climatic change. Yet another consequence of the population increase is a rapid increase in urbanisation in the world and, accordingly, reduction in both agricultural land and agricultural workforce. Adding to all these the high costs of both technology and input in te agricultural sector and also the increase in need for energy from day to day, it is clear that a road map is needed in order to increase agricultural production by 70% by 2050.

Figure 1 Basic Problems in Agricultural Sector



However, the agricultural sector is in a great transformation under the effect of the developing technology in the present day and the future of the agricultural sector is now shaped by technological practices. In order to be able to reveal the practices being used in the present day in a clearer manner, it is quite important to study the technological transformation process of agriculture. In fact, agriculture's transformation in technological terms goes back to the early 20th century. The most basic feature of the period in which the initial transformation referred to as ***Agriculture 1.0*** was experienced is that it possessed a labour-intensive production mode with lower efficiency. In this period, society's need for food was satisfied at an adequate level as one third of the society actually worked in a great number of farms and participated in the production process of agricultural products.

By the late 1950s, synthetic pesticides, fertilisers and more effective machines had reduced the production costs and thus the ***Agriculture 2.0*** period referred to as ***Green Revolution*** started. An increase in efficiency was experienced thanks to inexpensive inputs and new tools.

Figure 2 Technological Transformation of Agriculture

Agriculture 1.0	Agriculture 2.0	Agriculture 3.0	Agriculture 4.0
Early 20th C	*1950*	*1990*	*2010*

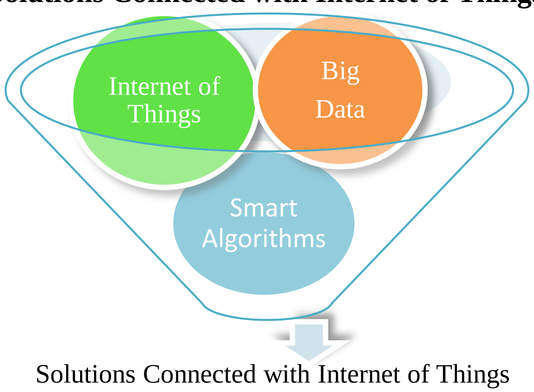
Agriculture 3.0 period which started in the 1990s once GPS signals were brought into service for everybody is usually referred to as ***Precision Agriculture*** in the present day. Manual orientation thanks to the GPS technology and tracking of the fertilisation process in particular via the VRA (Variable Rate Application) systems applied to harvesting machines appear before us as the fundamental technologies applied in this period. By the precision agriculture methods, tracking and solutions specific to each plot of the land or specific to each animal in the herd are offered and the process is more effectively managed by reducing production costs.

By the 2010s, a parallel process similar to the revolution experienced in industry with Industry 4.0 started to be experienced in the agricultural sector. This process is called by t-such names as "*Agriculture 4.0, Smart*

Agriculture, Digital Agriculture" and reference is usually made to the application of smart technologies containing sensors, detectors, microprocessors, autonomous decision systems, cloud-based information and communication technologies in the agricultural sector. Thanks to internet-based portals and various algorithms, it is ensured to store and analyse big data and track and guide the whole process from the field to the table and make future projections. Agriculture 4.0 further reveals the cooperation of different actors in the agricultural and food value chain and thereby the importance of ecosystem.

Agriculture 4.0 practices create significant and effective tools so that the agricultural sector may be made more efficient, more competitive and sustainable. Technologies used in Agriculture 4.0 cover the activities of suppliers, producers, growers, brokers and technology providers, i.e. those of different actors working in the agricultural sector. Activities of all these actors may be gathered together by the internet of things, big data and smart algorithms.

Figure 3 Solutions Connected with Internet of Things

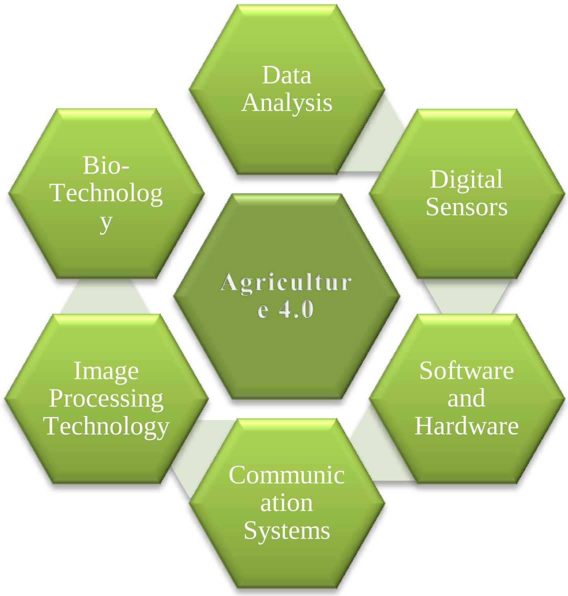


By the application of technology to the agricultural sector, agricultural tools and agricultural areas are equipped with sensors and detectors, thus ensuring that the agricultural tools are intercommunicated. Thanks to sensors, humidity, vegetation, temperature, vapour and weather conditions may be measured and plant species distinguished by remote detection, stress conditions, drought, soil and plant conditions monitored and data collected and analysed. Images received from satellites may be processed and combined with the data received from the sensors. All agricultural fields may be observed by cloud-connected unmanned aerial vehicles and any information so obtained may be followed by smart devices.

By the start of the use of the GPS system which is a navigation system that enables the users to record their position information in a correct manner in the agricultural system, farmers may find the precise position of such area features as soil type, detrimental formations, weed invasion, water holes, boundaries and obstacles. And by the correct determination of such positions, seeds, fertilisers, agricultural pesticides and water required for irrigation may be used in accordance with the area features and in a more effective manner. It is possible to form geographical information system by using digital information in different areas by this technology, to map the field in terms of yield, soil and quality and determine the delivery rates of agricultural inputs depending on the soil type by this technology.

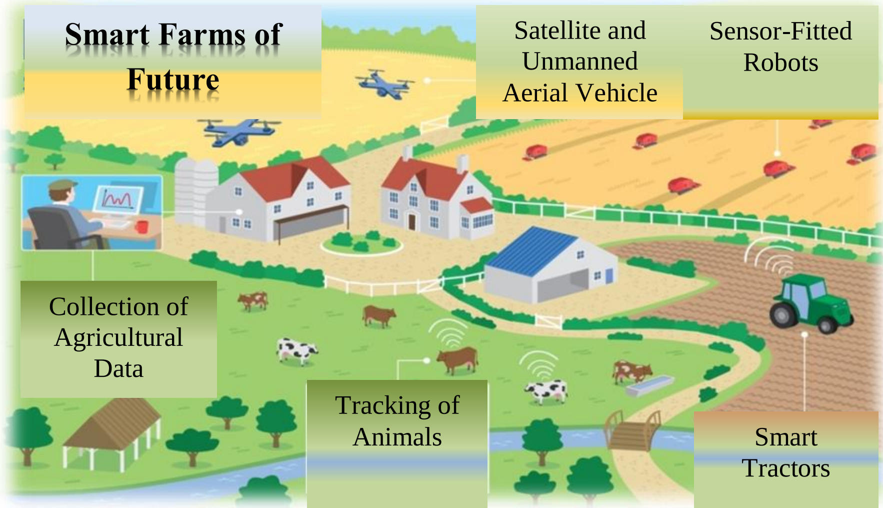
Moreover, robots and artificial intelligence are also used in the agricultural sector and thus more crops may be grown in a faster and healthier manner. For instance, robots employed in spraying and weed disinfestation reduce the chemical used in agricultural production by 90 percent. Robots also reduce loss in picking of crops and increase speed, thus reducing costs.

Figure 4 Smart Systems in Agriculture



Besides these technologies constituting the basis of smart systems, all phases of agricultural production may be tracked from the arrival of resources at the farm to the departure of the product (from field to table) by information-based farm management systems. Further, there is a tracking and sensor system (RFID sensor and tracking) by which consumers may follow the process which continues from the field to the place where he buys a product. Thanks to this system, producers' responsibility for producing safe food increases.

Figure 5 Smart Farms of Future



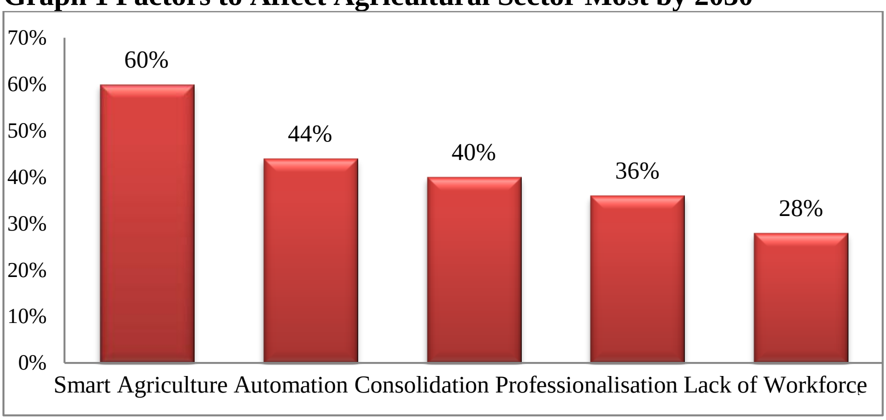
Source: Translated into Turkish from https://www.nesta.org.uk/blog/precision-agriculture-almost-20-increase-in-income-possible-from-smart-farming/ by the authors.

As a consequence, by the system called the internet of things (IOT) in which machines intercommunicate, information and communication technologies (ICT) underlie the technological practices in the agricultural system and, depending on them, efficiency and quality enhancement may be achieved by big data analysis and smart algorithms. Besides, real-time production performance assessment may be made, access to reliable and healthy food facilitated, detailed analysis of the products and production processes achieved, effective and sustainable resource utilisation ensured, costs reduced and environment-friendly agricultural production made. Therefore, correct use of this powerful tool may create a great number of opportunities and competitive advantage.

1.2. Agriculture 4.0 practices in the World: Examples of Successful Countries

According to the "Smart Agriculture Market Survey", which the company Huwawei caused to be carried out in 2017, the value of the world smart agricultural market which was 13.7 billion US dollars in 2015 is expected to rise up to 26.8 US dollars in 2020. And this means that the market will increase two-fold in value within 5 years. It is stated in CEMA's (European Agricultural Machinery Association) "Agriculture 4.0: Future of Agriculture" report that there are 4500 producers with an annual turnover of 26 billion euros manufacturing 450 different agricultural machines in Europe and that 135000 individuals are employed in this sector. According to the same report, 70-80% of the new agricultural equipment sold throughout Europe is equipped with precision agriculture technology component. It is another point which is emphasised in the report that smart agricultural practices will be the factor which will affect the agricultural sector by 2030 and will play a driving role in the provision of the sustainability of the European agriculture.

Graph 1 Factors to Affect Agricultural Sector Most by 2030



Source: CEMA (2017), "Farming 4.0: Future of Agriculture"

Those countries that noticed the advantages of Agriculture 4.0 prioritised the Agriculture 4.0 practices both in their national and in their joint policies and sped up the supports, incentives and R&D studies in this area. In this chapter of the study, examples of the successful countries that started to invest in agricultural research and technologies, i.e., passed on to smart agricultural practices .

United Kingdom:

United Kingdom is one of the countries that have most successfully achieved smart agricultural practices with the cooperation of university, industry and government. It has started this process by bringing up young scientists and establishing research centres on the matter. Most important resource of the success the United Kingdom has achieved is identified as the support it has provided for agricultural research and training in this area. In fact, the government spent 450 million euros on the research and development activities in the agricultural and food sector between 2011 and 2012.

There is a myriad of organisations and institutions working in agriculture in the United Kingdom. Among the substantial ones of such organisations is DEFRA (Department of Environment, Food and Rural Affairs) working under the government. In 2016, DEFRA published the "Agriculture in the UK" report in which they related the agricultural data and the condition of agriculture in the United Kingdom together with the Northern Ireland Department of Economy, Environment and Rural Affairs, Wales Assembly Government's Department of Rural Affairs and Scotch Government. Quite striking data are contained in this report. According to the report, 250 million pounds were spent on agricultural technologies in

2015. Thus, they increased wheat production from 7 tons to 8 tons per hectare. In 2015, income from the agricultural market was 96 billion pounds and is equal to 0,7% of the GDP. 3.8 million people are employed in the Agricultural and Food sector. This constitutes 1.2% of the total workforce.

Another of the most prominent institutions working in the agricultural area in the United Kingdom is Rothamsted Institute. Celebrating its 175th anniversary this year, the Institute's basic working area is environmentally sensitive agricultural technologies. The Institute undersigns successful projects with its budget of 38 million pounds and 450 researchers. Cumulative contribution of the works they perform to the UK economy is 300 million pounds per annum. Researchers of the Institute publish approximately 300 papers every year and make 70% of such papers available free, thus contributing dissemination of knowledge worldwide. They are currently carrying out genetic studies and projects on future agricultural and food technologies to improve food safety and efficiency. They erected the very first field crops analysis facility of the world in 2015. The facility working on 24H basis is equipped with a scanner which is capable of scan an area of 15m x 120m with sensors and cameras. By this means, the field surface can be scanned and growth and health of the plant analysed.

One of the most important cooperations in the area of agricultural and food technologies in the United Kingdom is the N8 Agrifood platform consisted of the country's eight leading universities (Newcastle, Lancaster, Manchester, Durham, Liverpool, York, Leeds and Sheffield Universities). In this platform, more than 450 researchers and more than 150 PhD students are working with a fund of 269 million pounds. Further, they provide more than 40 business concerns with support thanks to their works. Their basic areas of work are sustainable food production, safe food supply chain and plant and food health. In this context, they focus on sensitive agriculture and Agriculture 4.0 technologies and gene studies.

United Kingdom has been one of the leading and successful countries in Agriculture 4.0, bringing both national cooperation and international cooperation to the forefront and placing great importance on research and training on agricultural technologies.

Netherlands:

Another example of successful countries in the area of agricultural technologies is the Netherlands. As half of its territories is at least 1 meter below the sea level, nearly 60% of the country has been obtained by filling the territories remaining under the sea level. Despite this fact, Netherlands occupies the second place in the exports of agricultural products in the world. It holds 77% of the agricultural exports volume of the European Union, 6% of the world fruit trade and 16% of the world vegetable trade. It is in the first place of the world in tulip exports with 8.1 billion euros. Its total agricultural exports set a record and reached 85 billion euros in 2016. Further, the Netherlands imports agricultural products amounting to 4.6 billion euros from 107 countries and then processes and packs them and exports them to over 150 countries, thus earning a profit of 7.9 billion euros. The fact that three of the 25 big food and beverage companies of the world are based in the Netherlands and that it possesses a total of 1150 companies in the food sector is also one of the factors affecting this process.

One of the most advanced countries in the area of Agriculture 4.0 technologies, the Netherlands' success stems from its pursuing long-term and technology-based agricultural policies. The Dutch government has carried out a study of 1.4 million euros in order to purchase satellite data to enhance the sustainability and efficiency of agriculture and provides farmers with online information about soil, atmosphere and crop growth with such data. Data so collected enable farmers to closely monitor plants and get more efficiency and sustainability.

Netherland's provision of efficiency in its limited arable land is underlay by its agricultural policies as well as its ability to have reflected its success in information technologies on agricultural technologies. According to the data from the Netherlands Foreign Investment Agency (NFIA), 70% of the innovations in the Netherlands, which is the 4^{th} biggest exporter in the information technologies sector, is achieved with respect to information technologies. By this means, the Netherlands can both produce agricultural technologies and export such technologies. Value of its exports of agricultural technologies reached 9 billion euros in 2015. Dutch producers have achieved to increase their production and efficiency via highly efficient irrigation systems, advanced seed technologies, renewable energy systems, cobots and automation system, big data analyses and smart farm software. Yet another advantage of the country is the studies carried out in 2014 by the Wageningen University, which is the first university of Europe and second in the world in the list of QS world universities in the area of agriculture and forestry. Economic research carried out by the Wageningen University focuses on monitoring of food safety, agricultural and food policies, agricultural and food value chain via software developed for this purpose and on the production of agricultural technologies. Among the projects which the agricultural technologies work team started and got involved are to develop drones for automatically identifying and mapping weeds; to develop garden and harvest robots; to produce durable and precise sensors and detectors.

It has a significant share experienced in the private sector in the Netherlands. By the eco-village project it has prepared, the company Regen aims at establishing villages that can produce their own food and generate their own energy in the Netherlands. First steps of the project intended for producing more organic food by the use of the technological infrastructure, consume cleaner air and water and generate self-sufficient energy have been taken in Amsterdam. In this context, an area with 25 houses is now being established 25 km away from the city. First houses are scheduled to complete in the second quarter of 2019. The company has stated that the project will be applied in different European countries including, but not limited to, Sweden, Denmark and Norway in case this project proves successful.

Dutch agricultural sector has so strong an international reputation and the government supports this leading position by investing in innovations. Further, significant contribution is made for the agricultural and food sectors of the country in the studies carried out in the area of agricultural technology by universities, research institutions, companies producing agricultural food and companies producing technology.

United States of America:

The largest agricultural exporter of the world, the secret of United States of America’s success is the investments in has made in both technology and teaching of the use of technology. There are a great many institutes and subsidiaries working under the US Department of Agriculture

(USDA). One of them, the National Agriculture and Food Institute aims at increasing efficiency in agricultural production, reducing food prices by reducing the use of water, fertiliser and agricultural pesticides, mitigating the damages caused in the environment by agriculture and ensuring the production of safe food. In this context, the Institute supports research in physics, engineering and computer sciences, in the production of agricultural machinery, sensors and software and in training of farmers on how to use the technology.

At the summit entitled "Select USA" which was held in 2016 by the Department of Commerce, importance of agricultural production and agricultural technologies was emphasises. Farmers who were not content with land reclamation and greenhouse cultivation for increase in production got support from the government and started to use integrated systems controlling temperature, humidity and hazardous substance online in their fields.

United States meets 80% of the world's almond production. However, almond's need for water is too high, and therefore its production cost is also high. Moisture sensors were installed in almond trees and soil analyses made in order to find some solution to this issue. Data collected in the Cloud were transferred to the irrigation systems of farms and irrigation was properly achieved. Thanks to this technology, 20% saving was made only in irrigation.

Furthermore, NASA sent an observation satellite to the space in order to measure the amount of moisture in the soil. Satellite transmits detailed information on drought, flood and climatic change every third day.

Private companies producing both agricultural machinery and equipment and software under the agriculture 4.0 have quite a big role in USA's advancement in agricultural technologies. In 2001, the US company John Deere, which is the largest agricultural equipment manufacturer of the world, added GPS sensors to its tractors and other mobile machines and thus fuel costs spent in fertilisation and agricultural disinfestation was reduced by approximately 40 percent. Great number of farmers started to use GPS for the improvement of crops and mapping of yield. Also, by the mobile application called Scoutpro which was developed in the United States, growers can watch their fields live and possess detailed information about the field conditions. In addition, the Green Sense Farm located in Chicago is the most comprehensive indoor vertical farm of the USA. Various plants of high quality are grown on the vertical shelves by providing heat, moisture, adequate amount of light and water by computerised systems. As these plants are supported by creating a suitable environment by computer-controlled LEDs, products may be obtained twice a week.

US Department of Agriculture both provides incentives for integrated technologies for production and offers various opportunities of supports to farmers so that they may use agricultural technology. Through such incentives and supports, agricultural food products of approximately 300 billion US dollars are produced in the United States today.

Israel:

Despite the fact that only 20% of the Israeli territories is arable due to high salt rate, that its natural water resources are blow the limit of water poverty as et by the United Nations and that its agricultural workforce is rather low, it is capable of satisfying 95% of its own food need in the present day thanks to its success in agricultural technologies. In this context, Israel is perhaps the most attention-drawing one among the examples of successful countries. It has achieved to turn all those disadvantages to advantages thanks to the technologies it developed and applied. Besides vegetable and fruit exports of approximately 2 billion US dollars per year, it also exports a great many fertiliser and agricultural technologies it produces to several countries.

In Israel, which has achieved to rise from a disadvantageous position to a self-sufficiency level in agricultural production and even displayed a successful export performance, importance has been first placed on the reclamation of arable fields. Thus, it accomplishes 66% of its vegetable and fruit exports from seven farms it has established in the desert located 150 m below the sea level. Despite cultivation is only possible in the top 30 cm part of the soil due to the fact that the land is desert, it obtains a high yield from its production and exports 90% of the crops it grows. However, Israel has solved its irrigation problem by purifying the salt water and the waste water from industry. Eighty-six percent of the water used in irrigation in the country is supplied from the recovered water. It may purify 3.000 litres of salt water by the electric power generated on daily basis in each solar panel installed. Temperature may be kept under control for 12 months by the pipes laid under the ground. Several companies producing fertilisers using various have been established, including but not limited to Israeli Chemical Company, which is one of the largest fertiliser companies of the world.

One of the leading seed companies of Israel, Evogene tries to enhance crop efficiency through its research and development studies on plant genetics and bio-technology. The company Afimilk provides growers with information on both medical conditions of animals and the quality of milk on real-time basis by the technology it has developed. The company Eshet Eilon provides information on the nutritional value of a fruit, maturity, quality data and even when it will ripe by using X rays by the spectral imaging machine which it has manufactured. The company identifies in advance a fungus of mould type which sets the biggest obstacle in its date exports to the Arabic countries and which is found in date and responds and assists in the prevention of the impediment of exports thanks to this machine.

Israeli government supports agricultural technologies, especially those for irrigation systems, bio-technology and re-use of waste water. Such that, research and development expenses incurred in agricultural technologies constitute 17% of Israel’s budget. New technological enterprising companies have a great effect on the transformation of compelling conditions of the agricultural sector of Israel.

Japan:

Agricultural sector constitutes 1,5% of GDP in Japan. Japan, where arable land covers only 11% of its territories, where population working in agriculture is gradually reducing, where the average of age of hose working in the agricultural sector is rather high, where there are high taxes and where products produced in the rural areas are only commercialised in large cities and sometimes even in international markets, has just started to revive its agricultural sector thanks to the investments it has made in agricultural technologies. While agricultural technologies increase production, efficiency and quality on one side, it has started to make agriculture attractive and guide the interest of citizens towards agriculture again.

Responsibility for any decisions related to agriculture lies on the part of the Ministry of Agriculture, Forestry and Fishery in the country. According to the Annual Report on Food, Agriculture and Rural Areas (2016) issued by the Ministry, reduction of input costs, application of structural reforms in the distribution and processing process and formation of strategic exports system occupies an important place in the agricultural policies. Agricultural technologies are considered to be the most important factor in the reduction of input costs.

Universities, technology centres and private sector come to the fore in agricultural technologies. A vegetable factory has been erected over an area of 2000 m^2 at the Osaka Prefecture University. Both two-fold faster crop growth is achieved without using any sunlight but using only artificial lights and harvest can be achieved 20 times at this factory. These vegetables grown in a sterile manner may be consumed without washing them. Tokyo University of Agriculture and Technology usually performs studies on robotics. Wearable mechanical skeleton designed by the scientists at the university make the farmers' life easier in the course of the harvest of manually picked crops, thus ensuring a faster harvest. Thus, leg fatigue and pain of farmers were reduced by 50% and their arm and shoulder fatigue and pain by 85 percent. Beside technology production, the Fukushima Agricultural Technology Centre provides local farmers with technological support implements awareness studies on the importance of agriculture and offers free laboratory facilities to farmers so that they may produce and use technology.

The company Spread produces 10 million lettuces per year by robots. In this process, 98% of the water used at the farm is sent for recycling. Level of heat, moisture, light and carbon dioxide is adjusted by computers. The company Mebiol achieves high efficiency in vegetative production with so small amount of water thanks to the hydrogel film which it has designed with a thickness of 0,06 mm. Thanks to this film, the plant is provided with water, necessary vitamins and minerals and hazardous substances filtrated. The company Pattruss has achieved to extend the shelf life of its products by means of plastic packs of a pyramidal form.

Being very successful in soilless agriculture, Japan has achieved to speed up production and harvest and to pick a fruit per 8 seconds thanks to robots. Producers can carry out production by controlling the temperature, moisture and light by computers at the bio-farms established. Further, they can track the temperature, length of daylight water-retaining capacity of the soil by cameras and sensors, thus being able to fight pests and diseases and determine the harvest time. Japan can produce 10.000 tomatoes from a single tomato plant by filtrating harmful sun rays and giving only the useful ones by means of a rotating lens system. 16.897 tomatoes were obtained from a single tomato plant by the same method at the Tsukuba Science Expo.

Thanks to all these technological developments, Japan's agricultural exports increased by 24% and an income of 35 billion US dollars in 2016. Japanese government maintains its price support policy in order to support farmers and make agriculture attractive. Further, studies are in progress for the facilitation of the commercialisation of rural production. Thanks to agricultural technologies, it maintains its studies to increase both the employment in the sector and the competitiveness of the country. A comparison of Turkey and the examples of successful countries each of which has different characteristics is given in Table 1.

Table 1 A Comparison of Turkey and Examples of Successful Countries (2016)

	UK	Netherlands	USA	Israel	Japan	Turkey
Surface area (km^2)	243.610	41.540	9.834.000	20.770	377.970	785.350
Population (million)	65.354	16.980	325.952	8.192	127.749	79.622
Agricultural Land (km^2)	171.320	18.370	4.058.625	5.339	44.960	385.460
Arable Land (km2)	60.110	10.330	1.522.625	2.972	42.010	206.450
Pct of agricultural employment in total employment	% 1,1	%2,3	%1,7	%1,1	%3,5	%19,5
Pct of agricultural added value in GDP	% 0,5	%1,6	%1,0	%1,2	%1.2	%6,2
Agricultural Exports (Million $)	30.981	100.188	161.397	2.155	10.496	16.641
Agricultural Imports (Million $)	66.901	69.415	159.548	6.168	73.888	15.638
Pct of ICT products in total exports	% 4,10	% 10,92	%9,66	%11,73	%8,31	% 1,47
Pct of ICT products in total imports	% 8,29	% 13,46	%14,06	%10,88	%13,01	% 5,67

Source: FAO, World Bank, World Trade Organisation, UNCTAD, UN

Turkey occupies the second place behind the USA in terms of surface area, population, agricultural land and arable land. It is in the first place in terms of the pct of agricultural employment in total employment and in terms of the pct of agricultural added value in GDP among these countries. Despite this fact, considering the export performance of the countries, it is seen that Turkey is now not able to utilise its resources effectively. It is clear that the basis of the success of these countries including the Netherlands and Israel is technology. Considering the pct of the Information and Communication Technology products in their total exports and imports, those countries that have adapted to the Agriculture 4.0

process have high values in both exports and imports of these products. These countries have been able to enhance their efficiency via technology.

Upon the developments experienced in Agriculture 4.0 in the world, Turkey has also sped up its studies in this area. Research and development activities in the area of agricultural technology have been recently being supported and developed by both governmental policies and universities, research centres and the private sector in Turkey, which has a high agricultural production capacity. Studies in this area have started to increase through national and international cooperations at the Aegean University, Bosphorus University, Ankara University and Konya Food and Agriculture University. The project "Global Integration of Turkish Agriculture and Agriculture 4.0" being implemented by the Aegean University Faculty of Economic and Administrative Sciences and the İzmir Commodity Exchange is one of the studies carried out in this area. Further, the number of companies producing agricultural equipment, R&D and software, including but not limited to GSM companies, and their application for patents are increasing from day to day. Examples of cooperation have started to be seen among private sector companies in this area. Vodafone Smart Village established as a partnership of Vodafone Turkey and TABİT in the province of Aydın to support agricultural development is rapidly progressing to be the very first smart village equipped with digital technologies from end to end of the world and Turkey. Basic purposes of the Vodafone Smart Village where traditional agricultural methods are combined with advanced technology include increasing efficiency in agricultural production with information and technologies, increasing the youth employment in agriculture and ensuring technology to spread over the other villages as well. Minimum savings are expected to 20% in vegetative production costs, 22% in animal production costs and 20% in irrigation. In the following chapter of this study, the present status of agriculture in Turkey is revealed and detailed information is presented particularly on the developments experienced in the Turkish agricultural policy after the 1990s and on investment incentives.

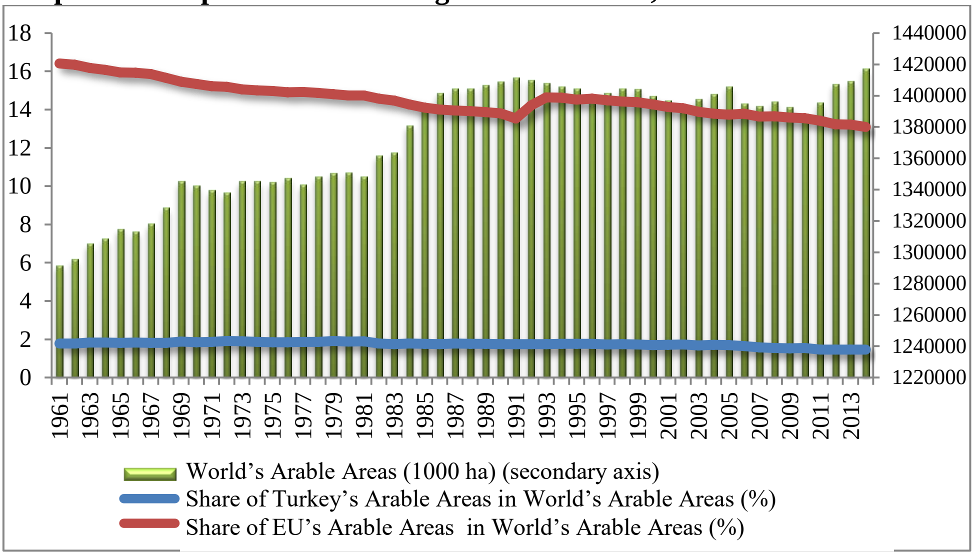
CHAPTER 2

AGRICULTURAL SECTOR IN THE WORLD AND TURKEY

2.1. Present Status of Agriculture in the World, European Union and Turkey

Agricultural and food industry has a great importance as they both provide nutrition of the country’s population and provide various industrial branches with basic inputs. Therefore, the fact that the agricultural sector in which dynamic developments have been experienced in technological terms especially for the past 20 years has become a current issue as a strategic sector again is quite important for all countries. In this chapter of the study, a framework will be psented as to the overall appearance of the agricultural sector in the world, European Union (EU) countries and Turkey. Graph 2 shows the change in arable agricultural land in the world, EU countries and Turkey in the post-1960 period. Even though world’s agricultural areas have had an increasing trend after 1990, this increasing trend could not be maintained and started to reduce after 2003. And in 2010, arable areas passed on to an increasing trend all over the world. However, the essential important point here is whether or not the increase in arable areas is at a rate which will satisfy the food demand caused by demographic changes.

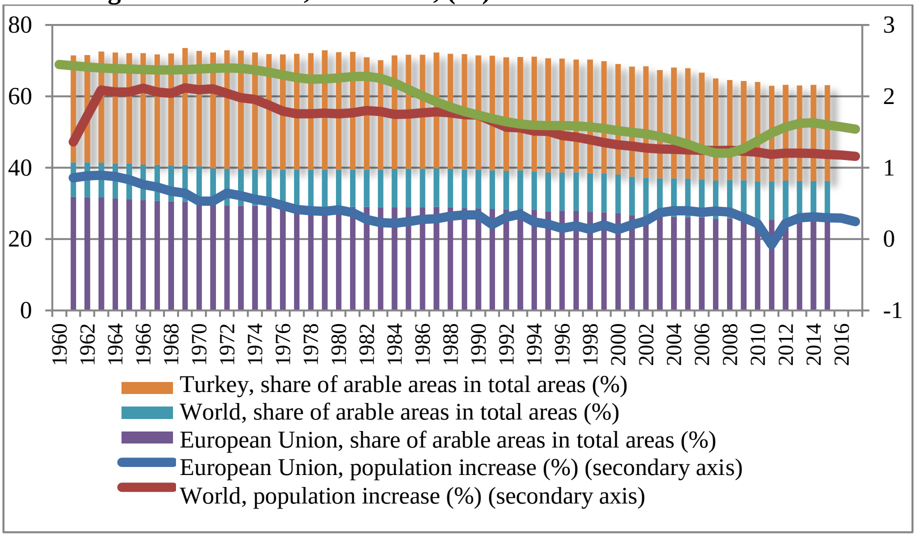
Graph 2 Development of Arable Agricultural Areas, 1961-2014



Source: FAO

Graph 2 shows that the pct of EU's arable areas in the world's arable areas is higher than those of Turkey. Graph 3 aims at more clearly show the relation between population growth rate and the pct of arable areas in total areas in the world and Turkey. Even though the pct of the EU countries' arable areas in the world's arable areas had reduced by the early 1990s, it started to increase again after 1993. According to the published 2014 data, member states of the European Union have approximately 13.5% of the world' arable areas. There was not any remarkable change in Turkey's pct in the world's agricultural areas in the studied years. This rate is below 2% in the period of 1961-2014.

Graph 3 Progress of Arable Agricultural Areas and Population in Increase in Arable Agricultural Areas, 1960-2017, (%)



Source: World Development Indicators

Considering the historical course of arable areas with population increase, a more meaningful picture may be revealed. When one examines the annual population increase rate in Graph 3, it is seen that the world's population increase rate fluctuated in the range of 2% and 1,5% in the period of 1960-1994.

And in Turkey, the population increase rate went at a rate above the world's population increase rate by 2006. Unlike the reducing trend in the population increase rate in the world, an increasing trend is involved in Turkey especially after 2008. This graph is important as to the fact that both it shows that food production intended to feed the total population must increase by a minimum of 1,5 folds every year and that the increase in the world's arable areas is slower than the world's population increase rate. While the increase rate of population is important, rural and urban distribution of the population is also important. Relocation dynamics of the population between rural and urban areas are the subject of comprehensive research in their own right. However, it is clear that there is some connection between the acceleration of industrialisation trends in the world and population's rapid transition from rural to urban areas. When one examines the percentage of rural and urban populations in the total population in Graph 4, it is seen that rural population increasingly reduce in the world, EU countries and Turkey. Percentage of the rural population in the total population is 66% in the world in the 1960s. Percentage of the urban population in the total population exceeded that of the rural population in the total population for the first time in the world in 2008, and as from that year, the difference between the rural population and the urban population started to get wider against the rural population.

And in Turkey, while the percentage of those living in rural areas by the 1980s is over 50 percent, this rate was 40.7% in 1990. In this period, even if the percentage of the rural population in the total population reduced, it should be underlined that this rate is relatively high as compared to the European Union countries. This rate is 29% in the European Union countries in the same year. However, it is also seen that the difference between the rural population and the urban population is gradually increasing in the post-1980 period. It is understood that this is a worldwide trend and this relocation movement of the population brings together two important questions:

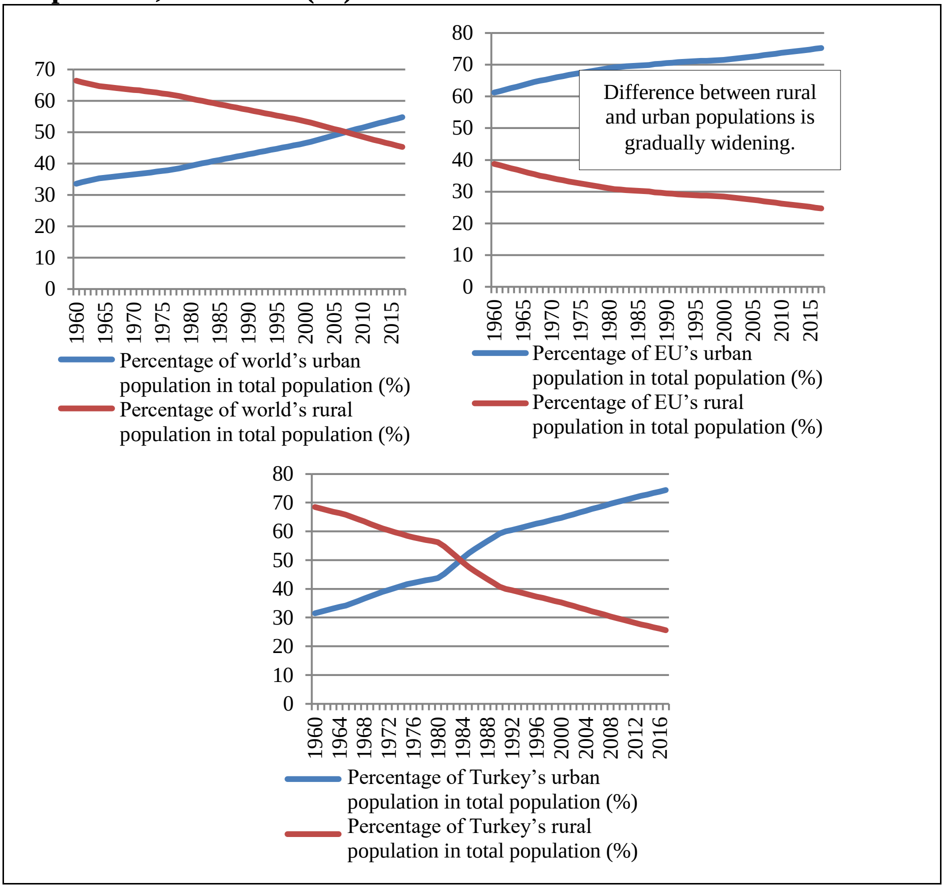
- How will the reducing rural population and thereby agricultural employment which will reduce feed an increasing urban population?

- How will the consumption habits of the urban population change when considered with the increased urbanisation and to what extent may agricultural production respond to such change?

Traces of the relocation movement of the population may also be read from the historical development of the percentage of agricultural added value in GDP. Contribution of the agricultural added value to the national product tends to reduce in the world and Turkey. While the percentage of the agricultural added value in GDP in the world in the early 1990s was 8 percent, the World Bank data published in 2016 and addressing agricultural production together with forestry and fishery show that this rate is approximately 3.5 percent. Contribution of agriculture to domestic product is rather low in the European Union member states. 2017 data assert that tis rate is 1.4 percent.

In Turkey, change of the percentage of agriculture in GDP is more striking. While the contribution of agriculture to national product was 56% in 1960, this rate fell to 26% in 1980. This contribution which was 15.8% in 1990 reduced to 7% in 2016 according to the latest data disclosed. Turkey seems to have been abandoned to a great extent especially in the post-1980 period. One of the important points here is that manufacturing industry has failed to replace agriculture which has fallen from favour. Such factors as the fact that import-substituting policies yielded to outward-oriented policies after 1980, that agricultural supports were reduced in this context, that there was pressure on agricultural product prices and that foreign trade limits turned against agriculture have accelerated gradual dissolution of agriculture to a great extent in Turkey. Turkey has been following a growth path basing on service sector to a great extent from the 1990s to the present day.

Graph 4 Percentage of Rural and Urban Populations in Total Population, 1960-2017 (%)

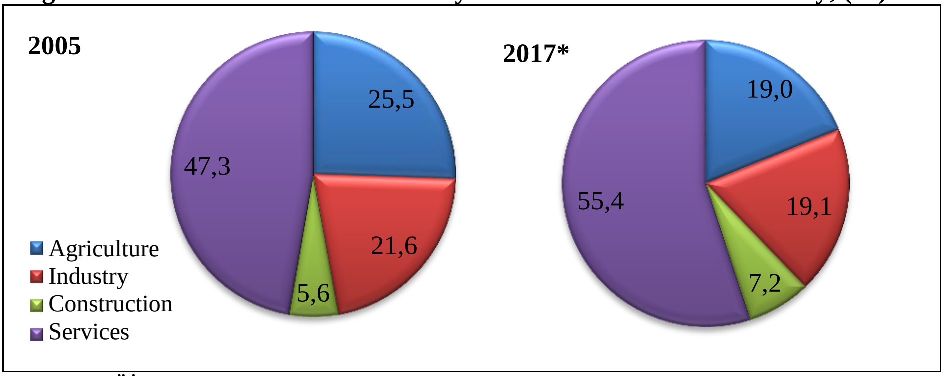


Source: FAO, World Development Indicators

Percentage of agricultural employment in total employment is also apt to reduce in line with the population and added value. Data from the International Labour Organisation (ILO) reveal that percentage of population working in agriculture in the working population in the world was 43.3% in 1991, but this rate reduced to 26.5% in 2017. And in the European Union, it is 9.8% in 1991 and 4.2% in 2017 (ILO, 2018). Employment profile in Turkey is different from that in the world and the European Union countries.

In 1991, 48% of the total employment works in agriculture. This rate is even above the world average for the same year. However, 25.5% and 19% of the total employment are in the agricultural sector in 2005 and 2017 respectively (TÜİK, 2017).

Figure 6 Distribution of Work Force by Main Business Lines in Turkey, (%)

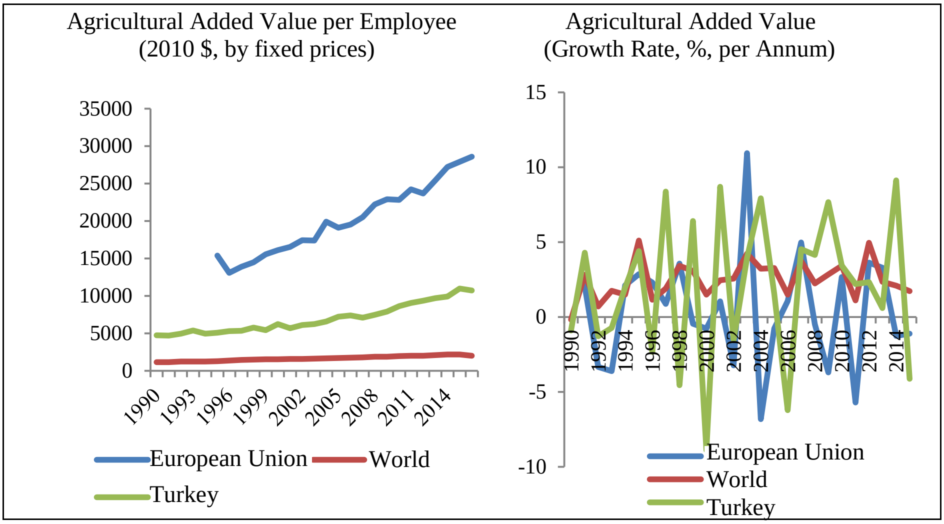


Source: TÜİK, Workforce Statistics *Data for 2017 are temporary semi-annual ones.

In this context, course of agricultural added value per employee and fluctuations in the growth rate of the agricultural added value in the world, European Union and Turkey has been studied. It can be observed in Graph 5 that the growth rate of agricultural added value displays a high volatility in the 1990-2014 period. At this point, it should be remembered that the agricultural sector's high vulnerability to external shocks directly affects the production potential.

On the other hand, when on studies the agricultural added value per employee, attention should be drawn to the increase observed particularly in the European Union countries in and after 1996. Turkey is above the world average in the generation of added value per employee. While the added value per employee is 1.154 US dollars in the world in 1990, it is 4.755 US dollars in Turkey. And in 2016, while Turkey's agricultural added value per employee increased to 10.723 US dollars, this value rose to 2.024 US dollars in the world.

Graph 5 Agricultural Added Value, 1990-2014/2016

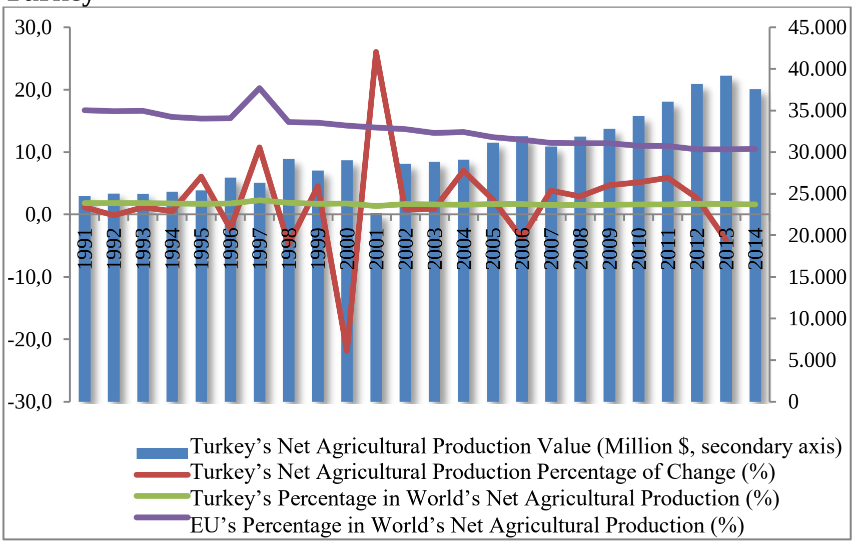


Source: World Development Indicators

At this point, attention should be drawn to the high efficiency in the European Union countries. Even if agriculture has a limited contribution to domestic product in the European Union countries, the agricultural added value per employee is much above both the world average and that of Turkey. Particularly in the early 2000s, efficiency of the workforce working in agriculture started to rise and is still apt to increase. It is possible to address this within the context of the reflections of the new process of transition to Industry 4.0 on agriculture in Europe.

In the data presented by the World Bank, the agricultural sector also covers data related to the forestry and fishery industries. And in the statistics issued by the United Nations Food and Agriculture Organisation (FAO), agricultural production values provides opportunity to exclude forestry and fishery. Therefore, the percentage of vegetative and animal production of Turkey in the world has also been studied by using the statistics presented by FAO. Graph 6 provides an opportunity to compare the net production values obtained by subtraction of animal feed and seed production values from the gross production values in the world and Turkey. Despite the increase in added value per employee in Turkey, Turkey's percentage in the world's net agricultural production has been almost the same since 2000 and is below 2 percent.

Graph 6 Course of Net Agricultural Production* in World, EU and Turkey



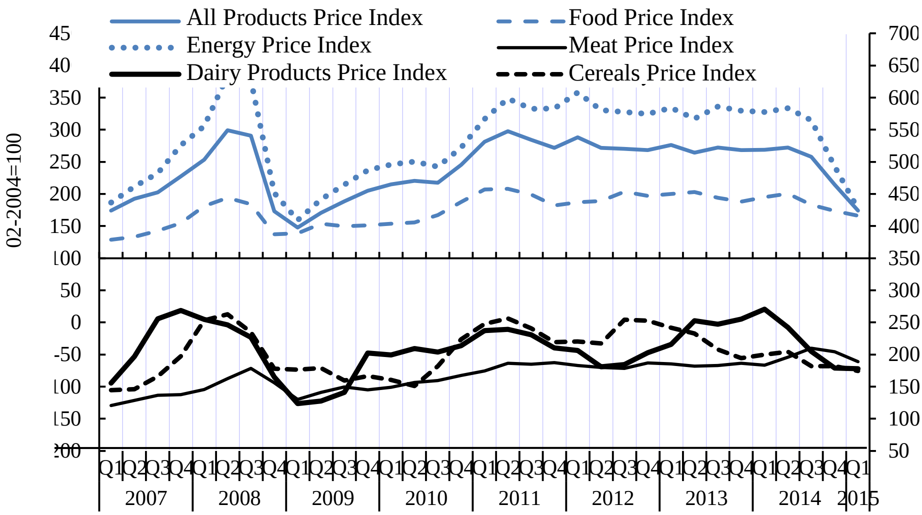
Source: FAO

*Net production values are obtained by subtracting animal feed and seed production values from gross production values.

It is expected that the world's agricultural production will regularly increase in the next decade, but at a slower rate as compared to the previous decades. However, it is estimated that the population increase rate will more slowly increase in the world during the next 50 years. However, decremental increase of the population increase rate makes it necessary to provide at least an increase in the net agricultural production at an equal level in the world as well. However, when one studies the existing data, the fluctuating course of the rate of change of the net agricultural production does not seem to have the sustainability potential to satisfy food production which will feed the increasing population in the next 50 years. What will be the impact of this conjuncture on food prices appears before us as a significant question.

World prices of agricultural products have been moving in an upward direction after 2000 and such fluctuations are experienced more frequently and for long terms. This trend continues at a more apparent manner in the post-2009 period. Graph 7 shows the movements of some price indexes in the world during the last decade.

Graph 7 World Price Indexes



Source: (OECD, 2015)

In the Agricultural Sector report issued by Aşarkaya (2015), the factors affecting price increases are listed in the following way:

- ***Loss of speed experienced in agricultural production increase:*** It was observed that the increase rate of the agricultural products, including but not limited to cereals, started to reduce in the post-1990 period. Reduction of governmental intervention particularly in the developed countries, reduction of agricultural areas by the increase in the rate of urbanisation due to the global population increase and drought experienced from time to time have been fundamental factors affecting such reduction.

- ***Reduction in cereal stocks:*** The fact that cereal stocks and wheat stocks had reduced to the minimum levels since 1982 and 1977 respectively in 2008 caused increases at high rates in cereal prices in 2008. While the stock-keeping costs' course increasing by years adversely affected the stock levels, proliferation of foreign trading led countries to review their stock policies and reduce their stock levels.

- ***Increase in costs:*** Increased oil prices had an adverse effect on the energy costs of the sector and carriage costs and fertiliser prices increasing at so high rates in the same period were also effective in the increase of costs in the sector.

- ***Demand increase originated from developing countries:*** Increase in per capita income in the developing countries, including but not limited to China and India, has substantially increased the number of people included in the medium income group which is the class most liable to agricultural products in those countries.

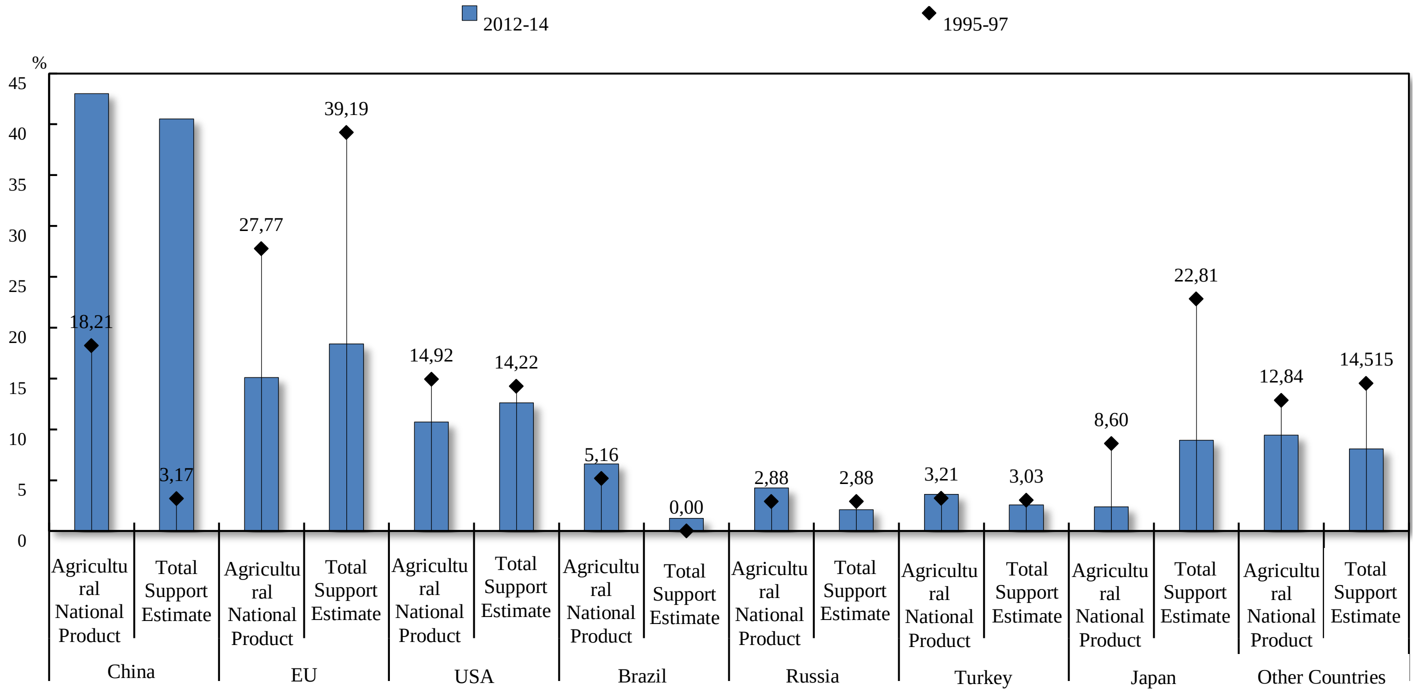
- ***Biofuel policies of developed countries:*** Production increasing as a result of the support given to biofuel in the USA and EU in recent years has caused an upward pressure in the prices of the cereals used in the production of this product.

- ***Speculative purchased in financial markets:*** In the 2000s, it was observed that prices increased in the "futures" market once investment and hedge funds were traded more in the commodity markets. While the removal of purchasing quotas accelerated speculative purchases, positive course of liquidity conditions supported prices in an upward direction in this period.

Present status and trends of agricultural production is directly related with how much countries support agriculture. Supports and incentives will keep being one of the most important instruments of agricultural policies during the next 50 years during which need for food will gradually increase. China, USA and Japan, together with the European Union, were leading countries in the generation of agricultural added value until the mid-1990s. Relationship between agricultural production potentials and total support estimates of these countries may be observed in Graph 8. It is seen that China has recently constituted more than 43% of the world's agricultural GDP and that contributions of the European Union, USA and Japan are 15%, 11% and 2% respectively.

Total support estimate represents the burden of the support given to agriculture on the economy. In Graph 8, the total support estimate (TSE) is represented in percentage in national product. TSE, which is one of the most comprehensive indicators in order to study the development of the relative weight of the countries in supporting the agricultural sector is consisted of the combination of the Producer Support Estimate (PSE), General Services Support Estimate (GSSE) and Consumer Support Estimate (CSE).

Graph 8 Contribution of Agricultural Product to World's Total Agricultural Product and Pct of Total Grant Estimates in Selected Countries (%)



Source: (OECD, 2015)

EU countries, Japan and USA appear to be leading ones in terms of transfers to agriculture by the mid-1990s. While their percentages in total TSE are 40%, 23% and 14% respectively, that of China is relatively small in terms of providing policy support to the agricultural sector in this period. However, when one studies the Total Support Estimates for the 2012-2014 period, it is seen that China's agricultural supports has risen to 41% of the total TSE. Such increase explains the source of the sharp increase in the contribution of China's agricultural added value to the national product to a great extent. Among the countries seen in Graph 8, Turkey is the country which uses TSE least as an agricultural support instrument next to Brazil as compared to the other countries. Percentage of Turkey's agricultural support estimates in the national product reduced from 3% to 2.5% in the 21012-2014 period. In this context, supporting forms and investment incentives are pre-eminent among the subjects which should be significantly dwelled upon under the agricultural policy in Turkey.

2.2. Developments in Agricultural Policies in Turkey

Before making a more detailed analysis concerning investment incentives in Turkey, it will be useful to present first a brief summary of the changes that have occurred in the agricultural policies from the 1990s to the present day. Therefore, an overview of the policy changes in the Turkish agriculture after 1990 will be presented first and then a present status analysis on investment incentives carried out. And finally, to be considered under all these policy changes and incentives, an analysis will be presented as to the export potential of vegetative and animal production in Turkey.

2.2.1. Agricultural Policies in Turkey after 1990

Changes started to be experienced in the Turkish Agricultural Policies depending on the developments in the world in the 1990s. One of the most important factors causing changes in the Turkish Agricultural Policies is the signing of the Agriculture Agreement with the World Trade Organisation in 1994. Under this agreement which became effective in 1995, Turkey made changes in its agricultural policies in several subjects such as domestic supports, exports subsidies, protectionism in imports and multi-functionality of agriculture. By the late 1990s, the Turkish Agricultural sector was driven by using the short-term, forward price-weighted supporting policy instruments in the form of input subsidy and price support not containing structural measures.

As a result of the fact that such policies implemented in the Turkish agricultural sector failed to make the agricultural sector successful but brought heavy burdens to the budget, some new practices were brought into being particularly for the revision of the supporting policies that are among the agricultural policy instruments with pressure from international organisations. In this period, the most important impact in terms of the modification in agricultural policies was made by the Agricultural Reform Implementation Project (ARIP), which was signed with the World Bank in 2001.

Three basic supporting instruments of this agricultural reform put into practice with support from the World Bank in order to mitigate the pressure on the budget and to encourage growth in the agricultural sector are the following:

1. Direct income support (depending on the amount of land),
2. Gradual removal of price and input supports,
3. Privatisation of state-owned enterprises in agriculture (TEKEL, ÇAYKUR, ŞEKER and TMO, etc.) and reduction of governmental intervention in the processing and marketing of agricultural products.

Thus, Turkey's agricultural support policy substantially changed and, depending thereupon, the agricultural structure was also affected to a great extent. One of the significant innovations coming with the project is the formation of a register of producers under the designation "farmer registration system (FRS)". This registration system is effectively used in the transfer of supports to farmers in the present day as well.

In the 2000s, one of the two important developments which affected the change in the Turkish Agricultural Policies is the "Agriculture Strategy Paper" covering the 2006-2010 period, which was issued on the basis of the Harmonisation to the European Union Common Agricultural and Fisheries Policies and World Trade Organisation Agriculture Agreement in 2004. And the other one is the Agriculture Act No. 5488 which became effective in 2006. By the Agriculture Strategy Paper, supporting instruments were re-identified for agricultural production not to disturb the market mechanisms. Supporting instruments are the following:

- Direct income support, differential pay (Bonus Support)
- Compensatory payments (Alternative Product Programme)
- Animal husbandry supports
- Agriculture insurance payment

- Rural development supports
- Agricultural land protection programme for environmental purposes (ÇATAK) supports
- Other supports (R&D services, export incentives, loan supports, some input supports, etc.) (Ministry of Development).

"Agricultural Reform Implementation Project" terminated in 2009. A new agricultural policy was put into practice under the designation "Production and Supporting Model for Agricultural Basins of Turkey" on 1st June 2009. Direct income support which started with the Agricultural Reform Implementation Project was also abrogated this year. However, a similar practice is still in progress under the designation diesel oil, fertiliser and soil analysis support. Differential pay supports continuing on product basis continued to be implemented on the basis of 30 agricultural basins (TOBB, Turkish Agricultural Sector Report, 2013: 34).

The "National Agricultural Policy" was put into practice in 2017. By this new policy, significant changes were made in vegetative production, livestock and agricultural supports.

Region-based supporting practice started in livestock. For this purpose, "Pasture Livestock Breeding Area", "Breeder Heifer Production Centres", "Breeder Ram and Billy-Goat Production Centres" and "Breeder Water Buffalo Production Centres" were identified.

And in vegetative production and agricultural supports, 941 agricultural basins, considering each town where agricultural activity takes place to be an agricultural basin were identified by the "Basin-

Based Supporting Model" (GTHB, 2018). Number of basins was increased from 30 to 941 basin/towns by the "Basin-Based Supporting Model" and the distribution of the products to be supported was determined by this number of basins. Supports announced by the Agricultural Supporting and Steering Committee started to be determined for a period of 3 years. This practice is one which is important in terms of production planning and enabling farmers to decide what to grow before planting.

Agricultural supports provided by the Turkish Ministry of Agriculture Food Animal Husbandry are the following:

- *Area-Based Agricultural Supports*

Vegetative Production Supports: Diesel oil and fertiliser support, hazelnut support. Basin-Based Differential Pay Supports, Certified Seed, Seedling and Sapling, Organic Agriculture and Good Agricultural Practices Supports.

- *Animal Husbandry Supports*

Fodder Plants, Apiculture, Water Products, Milk Powder Supports, Per Animal Supports, Angora Wool Production, Silkworm, Protection of Animal Germplasm Supports, Shepherd Employment and Vaccine Support, Support of Breeder Ram and Billy-Goat Breeding Investments, Support of Breeder Water Buffalo Breeding, Heifer Purchasing Support, Support of Breeder Heifer Breeding, apiculture, sericulture, goose and turkey investments support are supports for the GAP-DAP-KOP –DOKAP Regions.

- *Rural Development Supports*

Support of Rural Development Investments Programme (2016-2020), Support of Young Farmer Projects under Rural Development Supports, Support of Small Family Enterprises Carrying out Vegetative Production, EU Grant Supports Provided under IPARD.

- *Loans with Discounted Interest*
- *Other Supports for Agricultural Purposes*

Use of domestically certified seed support, Production of domestically certified seed support, Use of domestically certified seedling/sapling and standard sapling support, Production of domestically certified sapling support, Agricultural Insurance (TARSIM) Premium Support (TGHB, Support Bulletin, 2018; Official Journal, 2018).

A total of 21 products are supported for 2018. Of those 21 products, differential pay (support bonus) has been being paid to wheat, barley, rye, paddy, sweetcorn, triticale, oat, lentil, chickpeas, dry beans, cotton, soybean, sunflower, canola, safflower, tea and olive oil for many years. And for hazelnut, support is provided per decare on area basis.

- *R&D Supports*

Ministry of Agriculture Food and Animal Husbandry provides R&D projects with non-recourse direct support payment in order to improve information and technologies in any prioritised subjects which the agricultural sector requires, to transfer the same to farmers, agricultural industrialists and exporters and to develop the R&D capacities of the organisations in the agricultural sector.

Within the scope of the Communiqué Concerning the Research and Development Support Programme issued under the Agriculture Act No. 5488, any R&D projects implemented in any subjects which the agricultural sector requires by universities, non-governmental organisations, professional organisations, farmers' organisations and the private sector.

The Ministry started supports for R&D projects as from 2007 and secretarial operations for the project application, evaluation of projects and tracking the accepted projects are implemented by TAGEM.

2.2.2. Investment Incentives in Turkey

In Turkey, investment incentives are one of the most important policy instruments for the identification of sectoral priorities and for sectoral support. Manners and rules of implementation of incentives frequently change. However, in this study, it will be studied how incentives are distributed between vegetative production and livestock in their most general outlines but not the implementation differences of incentives. Table 2 shows the distribution of investment incentives in agriculture in Turkey. It further forms a proper basis to study the distribution of investment incentives and to make political deductions regarding the incentive to sectors.

Incentive certificates awarded to agriculture vary by years. In the 2002-2017 period, the 2010 -2011 period are the years in which incentive certificates awarded for both vegetative production and livestock reached their highest level. As a general trend, in the post-2010 period, the number of certificates and amount of incentives awarded for inciting the vegetative and animal production started to follow an increasing trend. However, at this point, it is useful to remind an important issue which should be paid attention in evaluating the investment incentive statistics. As these data are only calculated on incentive certificates, they fail to provide any information as to whether or not any investment so incited has taken place. Therefore, any disclosure may not be made as to how much incentives given to vegetative production and livestock support production or, in other words, as to the realisation rate of investments. However, it should be underlines that an increase –even so small– is observed in Turkey's net agricultural production after 2010.

Table 2 Distribution of Investment Incentives in Turkey

	Number of Certificates			Fixed Investment (Million TL)			Employment			Total Incentives		
	Vegetative Production	Animal Husbandry	Agriculture Total	Vegetative Production	Animal Husbandry	Agriculture Total	Vegetative Production	Animal Husbandry	Agriculture Total	Number of Cert.	Total Investment	Empl
2001	9	41	**54**	10	56	**71**	241	2.406	**2.703**	**2.050**	**12.367**	
2002	12	18	**36**	25	58	**89**	2.022	1.447	**3.690**	**2.654**	**11.668**	
2003	17	37	**56**	26	52	**81**	762	1.522	**2.320**	**3.175**	**11.679**	
2004	19	18	**44**	32	63	**109**	797	3.279	**4.368**	**3.460**	**15.878**	
2005	27	25	**61**	30	34	**72**	651	1.518	**2.298**	**3.551**	**16.054**	
2006	22	18	**44**	57	53	**116**	496	1.629	**2.245**	**2.475**	**13.298**	
2007	53	18	**72**	85	34	**122**	1.409	400	**1.839**	**2.241**	**19.939**	
2008	50	16	**71**	80	29	**114**	1.303	230	**1.618**	**2.445**	**20.826**	
2009	40	19	**67**	62	144	**215**	818	920	**1.817**	**2.073**	**23.606**	
2010	111	128	**251**	308	940	**1.261**	3.360	3.767	**7.269**	**3.551**	**67.818**	
2011	58	131	**207**	209	864	**1.111**	1.557	3.569	**5.433**	**3.963**	**48.950**	
2012	43	55	**108**	222	429	**668**	1.312	1.368	**2.810**	**3.990**	**62.419**	
2013	36	56	**103**	230	568	**827**	1.403	1.466	**3.011**	**4.619**	**96.383**	
2014	32	58	**94**	177	486	**667**	974	1.179	**2.196**	**3.923**	**63.853**	
2015	83	55	**150**	342	361	**750**	1.429	1.081	**2.668**	**4.528**	**100.302**	
2016	69	53	**133**	275	463	**784**	1.418	1.271	**2.875**	**5.137**	**97.562**	
2017	34	35	**75**	113	541	**704**	459	2.591	**3.105**	**3.043**	**41.810**	

Source: Undersecretariat for Treasury

2.2.3. Foreign Trading of Agricultural Products in Turkey

It is seen that, while rapid ascend of the manufacturing industry and services continues in the world, agriculture maintains its importance on relative basis in Turkey. Turkey has been integrated to the world by exporting agriculture-based industrial products and textile products to a great extent from the Ottoman period to the present day. Considering that agricultural production is also determined by such external variables as weather changes, condition of soil, etc., it may be said that agricultural production is of a more fragile/more exposed to external shocks as compared to the production in the other sectors. Under these conditions and considering it with the information that agriculture-based industries have had great importance in Turkey's exports for approximately 100 years, to study the distribution of Turkey's foreign trade by commodity groups is quite important in order to be able to reveal the importance of agricultural production for Turkey.

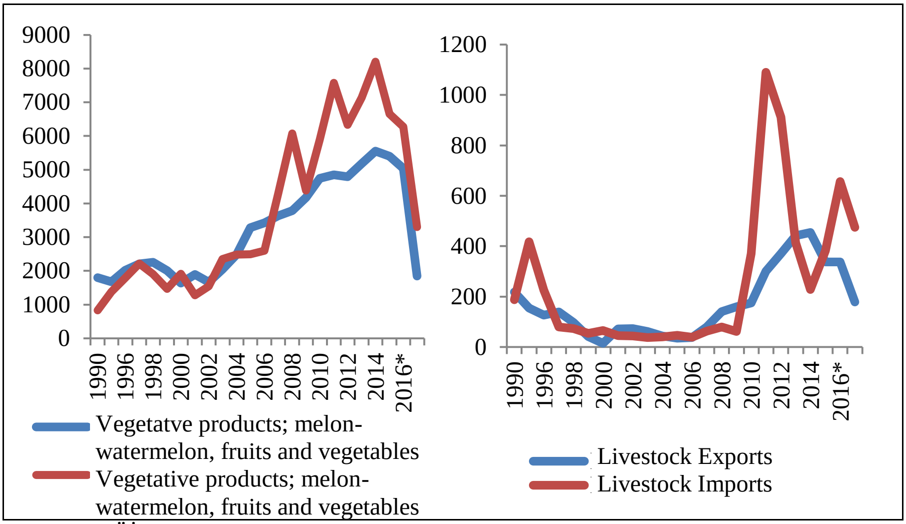
According to the Statistical Territorial Units Classification Revision 3, Vegetative products bearing the code no. 011 and 012, melon-watermelon, fruit and vegetable as well as livestock items have been included into the analysis. Graph 9 presents foreign trade statistics related to vegetative production and livestock. In the light of these data, in the 1990-2017 period, Turkey is in the position of a net importer in foreign trading of melon-watermelon, fruit and vegetable items of vegetative products for the first time in 1997.

In Turkey, which is a net importer in 2003 as well, this process became chronic after 2007 and it has been an importer of vegetative products since that year. While the export/import coverage ratio was

216% in melon-watermelon, fruit and vegetable items of vegetative products in 1990, it reduced to 85% in 2000 and even if it started to rise afterwards, the export/import coverage ration continuously kept reducing as from 2007. This ratio is 80% according to the 2016 temporary data.

When one studies livestock foreign trading, development of external dependence in livestock goes back to the early 1990s. Turkey appears to be an externally-dependent country in livestock item as compared to the vegetative production. Livestock imports substantially increased after 2009 as it is seen in Graph 9. In 2016, export/import coverage ration reduced to 51% in livestock foreign trading.

Graph 9 Agricultural Production Foreign Trade in Turkey, Billion $



Source: TÜİK

* 2016 and 2017 data are temporary. Note: Items bearing code no. 011 and 012

It is not only the volume of foreign trade that is important in these sectors but also the markets in which this trading takes places. Therefore, important markets in Turkey's vegetative production and livestock exports and imports have been identified. While studying the fundamental markets in Turkey's agricultural foreign trading, all export and import data for the relevant items have been complied for 1990-1995-2000-2005-2010 and 2015 by countries and five countries of which export and import values were the highest in a relevant year were selected as the most important agricultural trade partners, and the percentages of these countries in the total exports and imports value in the relevant item of the relevant year were calculated. At this point, it attracts attention that the percentage of these five countries is 50% and above in all years.

Table 3 Basic Partners in Exports of Agricultural Products in Turkey (ISIC Rev.3), % Percentages

Top 5 Countries		Countries with Highest Percentage in Vegetative Production Exports (%)	Countries with Highest Percentage in Livestock Exports (%)	
1990	Germany	21.3	Saudi Arabia	58.2
	USA	14.6	Kuwait	16.0
	Italy	6.6	Syria	12.9
	France	4.0	Lebanon	3.1
	UK	3.5	France	2.1
1995	Germany	24.8	Saudi Arabia	40.9
	Italy	8.4	Lebanon	23.0
	USA	8.2	Libya	16.8
	France	5.2	France	4.5
	Saudi Arabia	4.7	Germany	3.3
2000	Germany	18.6	Germany	21.4
	USA	7.4	France	15.1
	Italy	6.6	Saudi Arabia	12.9
	Russian Fed.	5.2	Georgia	8.7
	Netherlands	4.3	UK	8.2
2005	Italy	17.9	Georgia	10.2
	Germany	11.4	Germany	9.9
	Russian Fed.	9.4	Azerbaijan	9.2
	USA	5.9	France	7.7
	France	5.6	Italy	7.2
2010	Russian Fed.	18.2	Iraq	62.6
	Germany	9.2	Syria	17.3
	Italy	7.8	Israel	4.1
	Iraq	5.1	Azerbaijan	3.0
	France	4.4	Germany	2.4
2015	Russian Fed..	18.1	Iraq	57.6
	Italy	12.1	Syria	16.5
	Germany	8.8	USA	4.6
	Iraq	7.1	Azerbaijan	3.8
	France	5.3	Israel	3.8

Source: Calculated using TÜİK data by the authors.

Table 4 Basic Partners in Imports of Agricultural Products in Turkey (ISIC Rev.3) % Percentages

Top 5 Countries	Countries with Highest Percentage in Vegetative Production Imports (%)		Countries with Highest Percentage in Livestock Imports (%)	
1990	USA	23.4	Poland	30.6
	France	17.1	Australia	19.3
	Argentina	12.4	New Zealand	11.8
	South Africa	4.5	Czech Republic	9.5
	Malaysia	4.4	Hungary	6.5
1995	USA	28.7	Germany	39.2
	Turkmenistan	7.3	Ukraine	19.0
	Malaysia	5.9	Australia	9.6
	Russian Federation	5.2	France	7.0
	Argentina	4.8	Netherlands	5.2
2000	USA	34.9	Australia	22.5
	Greece	4.1	USA	16.8
	Syria	4.1	UK	16.0
	Russian Federation	4.1	Germany	8.1
	Turkmenistan	3.2	New Zealand	6.0
2005	USA	31.9	UK	17.4
	Greece	7.4	Germany	17.0
	Brazil	5.7	Canada	10.2
	Bulgaria	4.9	Australia	8.6
	Argentina	3.5	Lebanon	8.2
2010	USA	25.2	USA	17.1
	Russian Federation	6.6	Russian Federation	14.9
	Greece	6.1	Ukraine	7.1
	Ukraine	5.0	Brazil	6.0
	Brazil	4.6	Canada	4.2
2015	USA	17.1	France	17.6
	Russian Federation	14.9	Netherlands	17.2
	Ukraine	7.1	Germany	7.4
	Brazil	6.0	Italy	5.8
	Canada	4.2	UK	5.6

Source: Calculated using TÜİK data by the authors.

Table 5 Distribution of Turkey's Foreign Trading of Tractors and Equipment (Thousand $, 2016)

	Exports	Pct	Pct excluding Tractors	Imports	Pct	Pct excluding Tractors
Irrigation Equipment	11.703	1,9%	4,2%	19.443	2,8	**6,5**
Disinfestation Equipment	14.603	2,4%	5,3%	8.033	1,2	**2,7**
Irrigation & Disinfestation Parts-Components	8.005	1,3%	2,9%	28.959	4,2	**9,6**
Loaders	266	0,0%	0,1%	4.465	0,6	**1,5**
Tilling, Planting, Fertilising and Plant Care Equipment	81.424	13,2%	29,3%	18.806	2,7	**6,3**
Harvesting, Threshing, Mowing, Baling and Classifying Equipment	60.243	9,8%	21,7%	176.419	25,6	**58,8**
Milking Equipment		2,8%	6,2%	12.970	1,9	**4,3**
Other Agricultural Machinery*	75.951	12,3%	27,4%	28.234	4,1	**9,4**
Agricultural Trailers	6.900	1,1%	2,5%	169	0,0	**0,1**
Tractors	338.701	55,0%		390.224	56,5	**0,0**
Walking Tractors	1.279	0,2%	0,5%	2.711	0,4	**0,9**
Total	**616.169**			**690.433**		

Source: TARMAKBİR, Turkish Agricultural Machinery Sector, Sectoral Statistics Report, 6th October 2017

*Seed Disinfestation, Hedge Trimming, Feed Preparing, Forestry, Poultry and Apicultural Machinery

Turkey’s most important import item is tractors which constitute 56.5% of the total machinery and equipment imports. When one studies imports excluding tractors, it is seen that harvesting, threshing, mowing, baling and classifying equipment constitute 26.6% of the imports. In the light of these data published in 2016 by TARMAKBİR, the export/import coverage ratio is calculated as 89% in this year.

As it is expected that the rapid transformation that started in industry will create significant transformations in agricultural machinery and equipment as well, it is emphasised in the scenarios developed for the future of agricultural machinery industry in Turkey published by TARMAKBİR (2018) that agriculture will be carried out by machinery with higher capacities in the near future. Reason for such expectation is the new laws to be put into effect for the prevention of the fragmentation of agricultural fields by way of inheritance. Another important emphasis is that the importance of information technologies and R&D will increase in the designing of agricultural machines and therefore university-industry cooperation will become more important. Therefore, it may be expected that the production and, accordingly, imports and exports of agricultural machinery and equipment will also undergo qualitative changes in the near future.

CHAPTER 3

REGIONAL DEVELOPMENT OF AGRICULTURE IN TURKEY

3.1. General View of Regions in Turkey

In this chapter, sectoral and regional distribution of employment in Turkey is first discussed in the Level 1 regions by the Statistical Regional Units Classification (İBBS) and then the general status of the production of vegetative and animal products in the Level 2 regions in 1995 and 2016 is summarised. While 1995 was the very first year in which data at regional level may be accessed, the statistics published latest were published for 2016. Therefore, these two years are studied by considering them to be the term's beginning and term's end values.

In 2016, 20% of total employment is still in the agricultural sector. Further, considering it within the scope of Level 1 regions, agricultural employment constitutes more than 20% of total employment in the Mediterranean, Central Anatolia, Western Black Sea, Eastern Black Sea, Northeastern Anatolia, Mid-eastern Anatolia and Southeastern Anatolia regions. This picture is important in that it shows agriculture is still the basic sector in a rather large area while certain regions are specialised in the industrial and service sectors in Turkey. The fact that agriculture relatively maintains its importance in Turkey makes it necessary to mention regional differences in the agricultural sector in Turkey.

Table 6 Sectoral and Regional Distribution of Employment (İİBS Level 1, +15 employed ones, %)

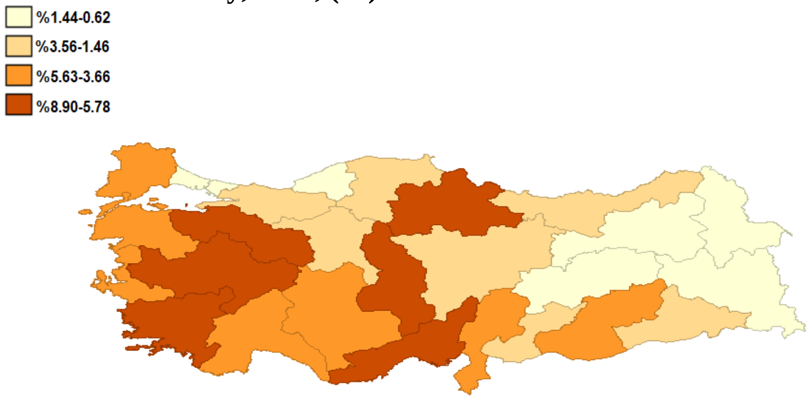
	Agriculture		Industry (*)		Service	
	2005	**2016**	**2005**	**2016**	**2005**	**2016**

TOTAL	**25.7**	**19.5**	**26.3**	**26.8**	**48.0**	**53.7**
İstanbul (TR1)	0.4	0.9	42.7	32.8	56.9	66.3
Western Marmara (TR2)	35.6	22.7	22.5	30.3	41.9	47.0
Aegean (TR3)	28.7	23.1	27.4	27.9	43.9	49.0
Eastern Marmara (TR4)	14.4	11.9	40.5	39.1	45.1	49.0
Western Anatolia (TR5)	11.6	10.1	23.4	25.6	65.0	64.3
Mediterranean (TR6)	26.0	23.3	21.1	21.0	52.9	55.6
Central Anatolia (TR7)	36.7	30.5	20.3	23.7	43.0	45.8
Western Black Sea (TR8)	47.1	39.9	16.4	18.7	36.5	41.4
Eastern Black Sea (TR9)	57.1	42.2	9.5	15.5	33.5	42.2
Northeastern Anatolia (TRA)	63.7	50.8	5.1	11.9	31.2	37.3
Mid-eastern Anatolia (TRB)	46.0	35.3	12.6	18.4	41.5	46.3
Southeastern Anatolia (TRC)	27.0	22.7	22.4	24.6	50.6	52.8

Source: TÜİK, Workforce Statistics

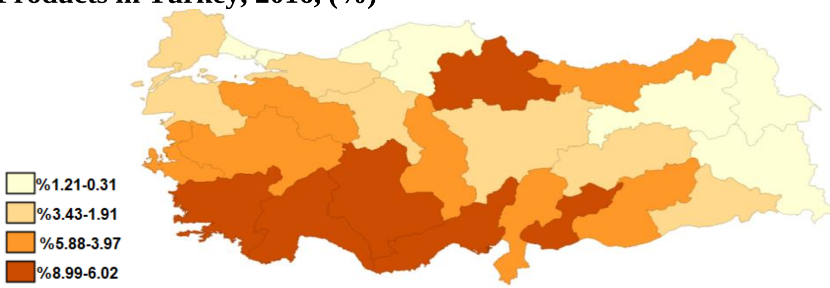
Table 6 shows the sectoral and regional distribution of employment in Turkey. Accordingly, the region where the agricultural employment was the highest was the Northeastern Anatolia (TRA) region in 2005. And the region where the agricultural employment is the lowest is İstanbul. When one studies the 2005-2016 periods, the agricultural employment experienced a sharp decline in all regions (except İstanbul) in all regions.

Map 1 Regional Distribution of Production Value of Vegetative Products in Turkey, 1995, (%)



Source: Drawn from TÜİK data by the use of GeoDa programme.

Map 2 Regional Distribution of Production Value of Vegetative Products in Turkey, 2016, (%)



Source: Drawn from TÜİK data by the use of GeoDa programme.

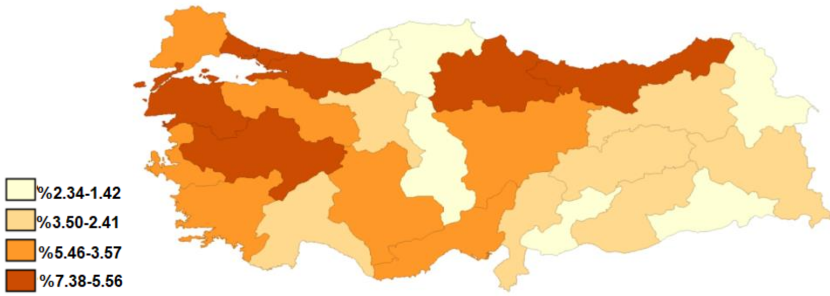
To see how vegetative and animal production values are distributed across the regions of Turkey is important in that it gives some idea on the policies to be pursued in the implementation of the regional incentive programmes. Accordingly, data obtained at Statistical Regional Units Classification (İBBS) Level 2 26 regions have been compiled in consideration of the oldest (1995) and the most current (2016) accessible data and mapped by the use of the GeoDA programme.

In 1995, the regions with the highest production value are TR62 (Adana, Mersin), TR33 (Manisa, Afyon, Kütahya, Uşak), TR32 (Aydın, Denizli, Muğla), TR83 (Samsun, Tokat, Çorum, Amasya), TR71 (Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir) and TR41 (Bursa, Eskişehir, Bilecik).

And in 2016, the regions with the highest production value are TR62 (Adana, Mersin), TR61 (Antalya, Isparta, Burdur), TR52 (Konya, Karaman), TR32 (Aydın, Denizli, Muğla) and TR83 (Samsun, Tokat, Çorum Amasya). When the production values in 2005 and 2016 are compared, it may be said that the regional distribution of vegetative production in Turkey substantially changed between these years.

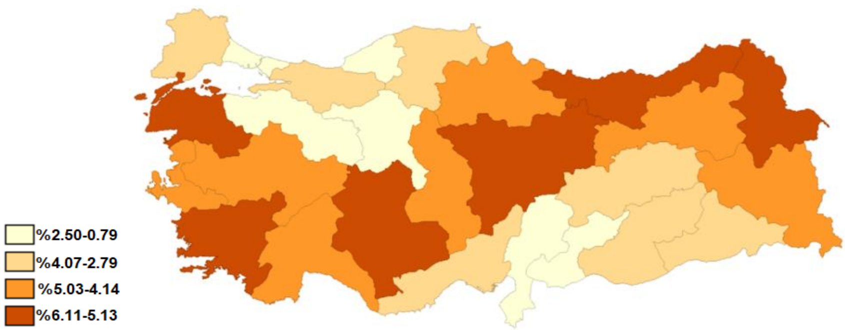
When one studies the total cultivated agricultural areas in Turkey in 1995, we encounter TR52 (Konya, Karaman) as the region which possesses the most cultivated agricultural areas. This regions is followed by TR72 (Kayseri, Sivas, Yozgat); TRC2 (Şanlıurfa, Diyarbakır); TR71 (Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir); TR33 (Manisa, Afyon, Kütahya, Uşak; TR83 Samsun, Tokat, Çorum, Amasya) regions. From this picture, it is understood that there is not any direct relationship between the vegetative production value and the cultivated areas. For instance, while the Konya-Karaman region possesses the most cultivated agricultural areas in 1995, its vegetative production value is in the 7th place among 26 regions. And in 2016, Konya-Karaman (TR52) region possesses the largest cultivated agricultural areas. This time, the same region is in the 3rd place in the list of vegetative production value.

Map 3 Regional Distribution of Production Value of Animal Products in Turkey, 1995, (%)



Source: Drawn from TÜİK data by the use of GeoDa programme.

Map 4 Map 3 Regional Distribution of Production Value of Animal Products in Turkey, 2016, (%)



Source: Drawn from TÜİK data by the use of GeoDa programme.

In 1995, TR42 (Kocaeli, Sakarya, Düzce, Bolu, Yalova) region is the most important one for the production of animal products. This region is followed by TR33 (Manisa, Afyon, Kütahya, Uşak); TR22 (Balıkesir, Çanakkale); TR83 (Samsun, Tokat, Çorum, Amasya); TR90 (Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane) and TR10 (İstanbul) regions. When one looks into the production values (1.000 TL), the values are TL 28.393, TL 25.189, TL 23.609, TL 22.659, TL 21.415 and TL 21.399

respectively and there is so small a difference involved between the production values of the regions occupying the first and the last place among the regions possessing the highest production. In the same year, when one studies the production values of five regions having the highest percentage in the vegetative production values, the difference is quite small as well (TL 96.602, TL 87.590, TL 76.959, TL 72.471, TL 64.685 and TL 62.698 respectively).

When one studies the 2016 animal products production values, TR33 (Manisa, Afyon, Kütahya, Uşak) region possesses the highest production value. The regions following this region may be listed in the following manner: TRA2 (Ağrı, Kars, Iğdır, Ardahan); TR52 (Konya, Karaman); TR22 (Balıkesir, Çanakkale; TRB2 Van, Muş, Bitlis, Hakkari); TR83 (Samsun, Tokat, Çorum, Amasya).

3.2. Agricultural production in İzmir (Tr 31) Region: Present Status Analysis

İzmir constitutes a portion of approximately 3-5% of Turkey's vegetative production value in the 1995-2017 period. Approximately 1% of the total cultivated agricultural areas is located in İzmir. Animal products value constitutes 0.01% and 4.68% of the livestock value of the sum of Turkey as of 2016.

Even if İzmir's contribution to Turkey in agricultural production appears to be relatively low, İzmir constitutes 22% of Turkey's total agricultural and forestry exports in 2002. Such contribution still maintains its importance even though it has reduced over time. In 2015, 15% of Turkey's total agricultural and forestry exports are achieved by İzmir.

Table 7 Present Status of Agriculture in İzmir (2016, %)

	Aegean Region's Percentage in Turkey (%)		İzmir's Percentage in Turkey (%)		İzmir's Percentage in Aegean Region (%)	
	1995	2016	1995	2016	1995	2016
Total Cultivated Agricultural Area (ha)	9.79	9.60	0.91	0.88	9.31	9.15
Vegetative Production Value (1000 TL)	18.90	16.55	3.72	4.10	19.68	24.74
Livestock Value (1000 TL)	14.78	13.56	2.92	4.68	19.78	34.52
Animal Products Value (1000 TL)	15.41	6.58	4.99	1.81	32.38	27.42

Source: TÜİK, Agricultural Statistics

When one studies cereals and vegetative production values in Turkey and İzmir, while the most cultivated crops in terms of cultivated area in Turkey are wheat, sugar beet and barley, they are wheat, unginned cotton and fibre cotton. In 2016, a change is involved in the most cultivated products in Turkey. While silage corn, sugar beet and unginned cotton had the largest cultivated area throughout Turkey in 2016, silage corn, wheat and unginned cotton were planted in İzmir.

Studying in terms of yield, the products with highest yield (kg/da) in Turkey in 2016 are sugar beet, fodder turnip and sugar cane. And in İzmir, they are Italian grass, fodder turnip and silage corn.

Studying in terms of fruits, while the most produced products are apple, seeded grapes and olive in Turkey in 2000, they are table seeded grapes, Washington orange and green tea in 2016. And in İzmir, the products with highest production in 2000 are olive, seedless grapes and tangerine, they are table seedless grapes, oil olive and satsuma in 2016.

Considering average yield per tree, banana, strawberry and raw red pepper for spice are the products with highest yield in Turkey in 2016. And in İzmir, table seeded grapes, strawberry and seedless grapes for drying. Studying vegetables, while the most important three vegetables are table tomato, watermelon and melon in terms of cultivated area in Turkey in 2016, they are paste tomato, watermelon and table tomato in İzmir. Considering in terms of the quantity produced, the vegetables with the highest quantity of production in Turkey and İzmir in 2016 are paste and table tomato and watermelon (TÜİK, Agricultural Statistics, 2016).

Within the National Agricultural Project, 941 agricultural basins have been identified across Turkey and evaluated in terms of supply deficit of strategic products, strategic and regional importance, human nutrition and health and their importance for animal production and consequently comprehensive lists containing products to be supported have been issued.

Supporting policies have been created on the basis of 19 products consisting of wheat, barley, rye, paddy, sweetcorn, triticale, oat, lentil, chickpea, dry bean, cotton, soybean, oil sunflower, canola, safflower, tea, hazelnut, olive oil and fodder plants. Table 8 shows a distribution of the products to be supported in İzmir and its townships.

Table 8 Distribution by Townships of Products to Be Subsidised in İzmir under National Agricultural Project

Aliağa	Barley, Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil, Potato	7
Balçova	Wheat, Fodder Plants, Olive Oil	3
Bayındır	Barley, Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil, Potato	7
Bayraklı	Wheat, Fodder Plants, Olive Oil	3
Bergama	Wheat, Sweetcorn, Cotton (Unginned), Sunflower (for Oil), Fodder Plants, Olive Oil, Potato	7
Beydağ	Barley, Wheat, Triticale, Fodder Plants, Olive Oil, Potato	6
Bornova	Wheat, Fodder Plants, Olive Oil	3
Buca	Wheat, Sweetcorn, Triticale, Fodder Plants, Olive Oil	5
Çeşme	Wheat, Chickpea, Fodder Plants, Olive Oil	4
Çiğli	Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants	4
Dikili	Wheat, Sweetcorn, Cotton (Unginned), Chickpea, Sunflower (for Oil), Fodder Plants, Olive Oil, Potato, Onion (Dry)	9
Foça	Wheat, Sweetcorn, Dry Beans, Cotton (Unginned), Fodder Plants, Olive Oil, Onion (Dry)	7
Gaziemir	Barley, Wheat, Fodder Plants, Olive Oil	4
Güzelbahçe	Wheat, Fodder Plants, Olive Oil	3
Karaburun	Barley, Wheat, Fodder Plants, Oat, Olive Oil	5
Karşıyaka	Wheat, Fodder Plants, Olive Oil	3
Kemalpaşa	Barley, Wheat, Triticale, Fodder Plants, Olive Oil	5
Kınık	Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil	5
Kiraz	Wheat, Fodder Plants, Olive Oil, Potato	4
Menderes	Barley, Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil	6
Menemen	Wheat, Sweetcorn, Cotton (Unginned), Sunflower (for Oil), Fodder Plants, Olive Oil	6
Narlıdere	Wheat, Fodder Plants, Olive Oil	3
Ödemiş	Barley, Wheat, Cotton (Unginned), Triticale, Fodder Plants, Olive Oil, Potato, Onion (Dry)	8
Seferihisar	Wheat, Fodder Plants, Olive Oil	3
Selçuk	Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil	5
Tire	Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil, Potato	6
Torbalı	Wheat, Sweetcorn, Cotton (Unginned), Fodder Plants, Olive Oil	5
Urla	Barley, Wheat, Chickpea, Fodder Plants, Olive Oil	5

Source: www.tarim.gov.tr

CHAPTER 4

ANALYSIS OF TURKISH AGRICULTURE IN TECHNOLOGICAL TRANSFORMATION PROCESS

4.1. Determination of Present Status in Technological Transformation in Agriculture: Intermediate Workshop

It is quite important to develop policy suggestions for the identification, implementation and proliferation of the ecosystem elements necessary for Turkey's integration to the Agriculture 4.0 process. An intermediate workshop in which all stakeholders would be together under this project in order to share the analyses made with such groups as agricultural technology users, providers, etc. and to discuss different points of view on the matter was organised. The focal point of this workshop is to put forth the impacts of technological transformation in agriculture and to identify problems and solution suggestions. For this purpose, a common platform was established in which the present status and development potentials of Agriculture 4.0 may be discussed with the participation of producers, technology companies, cooperatives, chambers, unions, public organisations and universities.

Workshop was held at two phases. Attendees to the workshop were divided into 4 basic groups in accordance with the areas they represented so that discussions might be carried out effectively in the first phase. These groups were identified as producers (2 tables-12 representatives), technology companies (2 tables-13 representatives), chambers and unions (1 table-6 representatives) and public and universities (2 tables-18 representatives).

Each group was asked 5 questions, 2 common questions and 3 questions specific to the area they represented. While the common questions were focused on the awareness of smart agricultural practices and their contributions to agricultural production and sustainability, the other three questions were related to the basic problems the representatives encountered in the course of the implementation of the Agriculture 4.0 practices in their own respective areas, solution suggestions, supports and their expectations for the future of the agricultural sector.

First phase table results from discussions were presented to all participants by the table moderators. At the second phase, mixed tables were created and the tables were requested to state their solution suggestions within the framework of the results obtained at the first phase.

Basic findings obtained from the intermediate workshop of the project "Global Integration of Turkish Agriculture and Agriculture 4.0" may be summarised as follows:

Round 1: Group Discussions by Common Area Representatives

- ***Round One Common Question 1****: "What do smart agricultural practices mean to you?"*

Producers defined smart agriculture as forecast of weather conditions and fight against pests by satellite and warning systems, reduction in labour and production costs, effective use of agricultural inputs and resources, increase in product quantity and efficiency thanks to technological equipment and production placing importance on the nature and human health.

According to **technology companies**, smart agricultural practices or technologically based practices in agriculture means the use of digital technologies at each and every phase of agricultural production, provision of automation, digitalisation and synchronisation and reduction of costs in the process from field to table and increase in efficiency and effectiveness.

Unions and cooperatives stated that smart agricultural practices were the use of such information technologies as proper computer technology, drones, sensors, etc. at each and every phase from production to harvesting and processing technologies and marketing in agriculture.

According to the **public and university representatives**, smart agricultural practices mean the management of the variability of the nature unlike traditional agriculture, traceability, use of sensors, sustainability, quality management, cost forecasting, protective agriculture and effective use of resources thanks to big data analysis from planning to the arrival of products at the end user's in agricultural production.

- ***Round One Common Question 2****: "For what problems of yours do you think you can find solution in agricultural production and the sustainability thereof by smart agricultural practices?"*

Producers emphasised that smart agricultural practices would reduce gradually increasing input costs, that it would enable to track product development and any losses which might occur due to sudden problems might be overcome by early warning systems. According to producers, ability to track phenological and vegetative processes via analysis applications will bring continuity.

According to **technology companies**, smart agricultural practices will facilitate production's adaptation to weather conditions and climate, ensure fight against pests and establish an uninterrupted smart production ring in the process from the decision-making phase to the fork at the table. Thanks to these practices, efficiency will increase in production, costs will reduce, profitability will be augmented, living standard of farmers will increase, migration to urban areas will reverse, dependence on imports will reduce, improvements will be enjoyed in food safety, big data (big database) of agriculture will be created and it will be possible to reach information fast and at a lower cost. Further, it is also stated that food prices may reduce in line with such developments. Additionally, technology companies underline that a production process which is more friendly to the environment will be possible and that sustainability of agricultural production may be ensured to a great extent by the application of smart technologies to agriculture.

Unions and cooperatives stated that soil and water quality might be enhanced, that rational use of water might be achieved and that more reliable data might be accessed thanks to smart agricultural practices.

Findings obtained from the table of **public and university representatives** are of a nature which is a summary of those main topics discussed at the other tables. In this context, the basic points emphasised by the public and university representatives may be summarised under the following sub-headings:

- *Production increase and efficiency:* Smart agricultural practices will ensure correct collection of agricultural production data and thus production increase by proper equipment and methods. Further, efficiency, thereby income increase may be created by the practices also used in agricultural marketing.
- *Input optimisation*: They will ensure production planning to be made in a more effective manner, thus achieving input optimisation.
- *Energy issue and carbon emission:* Use of energy will be more effective and carbon emission reduce thanks to smart agricultural practices. Sudden climatic changes may be forecasted.
- *Remigration:* They will assist in improving the human resource working in agriculture and in preventing migration from rural to urban areas.
- *Food safety:* It will be easier to track the food production phases and to ensure food safety thanks to smart agricultural practices. Further, it will be ensured to more clearly identify and reveal problems at the operational phase as well.

Following the common questions in the Round 1 of the workshop, representatives at each table were asked specific questions. Discussions made within the framework of the specific questions asked to the representatives of each table are summarised below.

- ***Round One Producer Table Question 1****: "Why do you think new technologies should be used in agriculture and what kinds of problems do you think will be encountered in case of failure to use them?"*

According to ***producers***, the most significant obstacles before the increase in agricultural production are that the particularly high age average of those who work in agriculture, lack of any qualified workforce to work in agriculture and lower worker efficiency. Producers emphasise that basic obstacle before increase in agricultural production will get deeper and that in such a case competitive power will reduce in case of failure to adapt to the use of new technologies in agriculture beside these basic problems. In their arguments, producers answered this question as follows: use of technology in agriculture will

- provide efficiency increases;
- enhance the quality of the production and products;
- contribute to the increase in international competitive power.

Another issue addressed in the discussions is that the implementation of these technologies will make significant contributions to the "ecological sustainability".

- ***Round One Producer Table Question 2:*** *"What are the basic obstacles you encounter in having access to and implementing agricultural technologies?"*

Basic problems identified from the producer discussion may be summarised as follows:

- Failure of imported machines used in production to respond to the requirements of production in our country;
- Encountering such deficiencies as spare parts, technical support, etc. in long-term use of imported machines;
- Problems experienced in data reading and interpretation due to limited technical knowledge of a farmer;
- Inadequacy of educated population working in agriculture;
- Lack of information support to be provided by reliable organisations so that a farmer may assess the technology and purchase the one most suitable for him in the selection of the technology to be used in agriculture;
- High costs of using agricultural technology due to the fragmented and small structure of agricultural fields;
- Problems experienced in government support and access at the phases of introduction, promotion and implementation of agricultural technology.

- ***Round One Producer Table Representatives Question 3***: *"What are the technological and financial supports you need to shift to smart agriculture?"*

It has been revealed that the supports which producers basically require are the supports required for purchasing production tools not contained in the scope of government support; support for meteorological forecasting on a farmer's own field; VAT support; tax-free diesel oil support and product support. Further, it has been emphasised as the common view of the table that cooperatives and farmers' organisations should be supported and machines may be jointly purchased for small land owners through the former and that smart agricultural practices may be thus spread. It has been said that R&D expenses and governmental incentives remain at insufficient level. It has been dwelled upon that individuals should be provided with training while incentives are given under the young farmer project. And finally, it has been stated that it will be more useful if such financial supports as the European Union projects will be oriented to those provinces where they may be more effective.

- ***Round One Technology Companies Representatives Table Question 1**: "What are the basic difficulties you encounter in the production of agricultural technology?"*

Problems encountered by technology companies may be summarised as follows:

- Insufficient grants and supports;
- Difficulties in bringing the existing supports into being and using the same;
- Inadequacy of qualified workforce.

Representatives of technology companies have stated that demand for advanced technologies in agriculture is lower as farmers do not have any established perception and knowledge for such technologies and that the companies producing technology have not entered the agricultural sector as they do not see any future in this sector.

It has been emphasised as a solution suggestion that it is important to promote smart agricultural practices through trainings, meetings, courses and trade fairs so that the use of technology in agriculture may be spread. They have further proposed that incentives to agricultural projects should be increased, support mechanisms should be re-regulated and intellectual property rights should be protected.

- ***Round One Technology Companies Representatives Table Question 2****: "What are the elements that are effective in spreading the use of new technologies in agriculture?"*

The basic emphasis of the representatives is that those companies producing technology with government support should be increased in number. However, the importance of bringing up innovative pioneer farmers and farmers' experiencing the feasibility of the technology in pilot projects and creating the environment in which they may access to information about its profitability has also been emphasised. They have stated that description and infusion of any projects, seminars, various trainings and courses and social events in this area to farmers will increase the use of technology in agriculture. Further, they have stated that finding the ways of convincing farmers through farmers is also important. It has been emphasised that those producers who see the practices and the profitability thereof in their near vicinity may be more easily convinced as compared to others and that it is the most effective method to learn by seeing, touching and experiencing.

- ***Round One Technology Companies Representatives Table Question 3****: "What are the supports you need as a sector in smart agricultural practices?"*

According to the representatives of technology companies, farmers must first be ensured to have confidence in Agriculture 4.0 and smart agricultural practices. Therefore, contact meetings should be held more locally. The importance of the necessity of describing the projects to farmers and changing the farmers' perception besides financial support to technology companies has been emphasised and it has been stated that public service announcements will be effective in the matter. Other suggestions are shortening of the patent, registration and research process, development of research institutes and upgrading of the same to a level from which service may be obtained.

- ***Round One Union and Cooperative Representatives Table Question 1:*** *"What are the obstacles before the members to unions and cooperatives in accessing to agricultural technologies?"*

Basic problems as identified by the table representatives are listed below:

- Insufficiency of the existing policies in accessing to agricultural technology;
- Inadequacy of the educational level of the population working in agriculture;
- Insufficient financial capacity of producers in being able to use smart technologies alone;
- Insufficiencies in the introduction and spreading good examples in practice;
- Insufficiencies in the production of agricultural technology and external dependence in agricultural technology;
- Problems in information flow between producers, policy makers and the other elements of the ecosystem.

- ***Round One Union and Cooperative Representatives Table Question 2:*** *"What are your suggestions for spreading the smart agricultural practices?"*

Representatives have proposed that the weak structure of the small-sized family enterprises should be supported in order to spread the smart agricultural practices. Additionally, they have stated that strong farmers' organisations should be guided to cooperation and collaboration with such institutions as cooperatives and chambers which will support the farmers' organisations.

- ***Round One Union and Cooperative Representatives Table Question 3:*** *"What are the roles and responsibilities of producers' organisations in spreading the agricultural practices?"*

They have said that unions and cooperatives should focus their attention on training the producers and members. They have stated the importance of providing producers with support in such issues as inputs, etc. Further, representatives propose that public authorities should transparently communicate all processes and information related to technology supports and that they should carry out joint project studies so that they may benefit from such technology supports.

- ***Round One University and Public Organisations Representatives Table Question 1****: "What should be done by public/ public research and universities for smart agricultural practices?"*

Table representatives have stated that Agriculture 4.0 practices should be improved and spread at techno-parks and that the relevant public organisations should support guided projects related to Agriculture 4.0. Participants have stated that local governments should accomplish policies for putting into practice any technologies produced under the smart agricultural practices. They have underlined that financial support should be provided and that municipalities should carry out studies to support the Agriculture 4.0 practices through pilot projects. They have mentioned the idea that, in this context, an agricultural satellite town with special government support will be established in the regions that are at the implementation phase and even a silicon valley specific to Turkey will be created. They have further emphasised the importance of the elimination of the infrastructural deficiencies, concentration on smart agricultural practices in R&D studies and encouragement of interdisciplinary research, thus ensuring resources to be used more effectively.

Other points emphasised in connection with the question at the table are the following:

- That awareness studies are to be carried out on the matter for employees at public organisations;
- That a higher committee is to be established in order to provide integration between organisations;
- That training works are to be performed at farmer, intermediate worker, specialist and consumer levels;
- That open source systems are to be installed under the partnership of organisations.

- ***Round One University and Public Organisations Representatives Table Question 2****: "What are the elements that are effective in spreading the smart agricultural technology practices? What is/should be the role of the public and universities on the matter?"*

According to the table representatives, promotion should first take place in order to spread smart agricultural technologies. On one side, it is important to create awareness through such works as public service announcements which may be prepared by the Ministry of Agriculture and, on the other, promotion should be achieved through the works of the companies producing smart agricultural technologies. They have further stated that it will be effective to spread such events as trade fairs, congresses, panels, producer meetings, etc. promoting smart agriculture.

In terms of technological infrastructure, they have dwelled upon the necessity of spreading the agricultural internet infrastructure and wireless data transfer network and the creation of agricultural cloud and database. Regulation of training works, reduction of input and infrastructural costs, development and implementation of proper policies by relevant ministries, supporting of the NOGs such as cooperatives, chambers and exchanges that are in direct contact with producers and encouragement of entrepreneurship have been counted among the other elements which will ensure smart agricultural technologies to spread by the representatives at the table.

- ***Round One University and Public Organisations Representatives Table Question 3****: "What are the supports you need to be able to produce R&D to be used in smart agricultural practices?"*

Supports required by the public and university representatives may be summarised as follows:

- Financial supports in the form of technology, grant programmes and tax credit are required.
- Such institutions as TÜBİTAK, TAGEM, etc. should make calls under thematic support programmes and create new grant programmes.
- It is important to support overseas training programmes in order to specialise in Agriculture 4.0.
- It is necessary to provide R&D staff members and support undergraduate, graduate and doctorate students to be employed in legal projects.
- It is necessary to record well and provide access to agricultural data and statistics in order to be able to carry out effective scientific research; to create a researcher data bank on the matter; to support interdisciplinary studies; to use laboratories of public organisations and, when necessary, ensure such laboratories to be jointly used.
- Inter-organisational coordination should be provided.

Round 1: Discussion by the Mixed Group Consisting of the Representatives of Different Areas

In the first round, results have been collected after two common questions asked to all tables and three different questions specifically asked to the representatives of the sector, and all views and suggestions shared with the workshop attendees by the moderator of each table.

In the second round, the table order has been established again. Attention has been paid to the fact that at least one individual who represents each sector/area at the tables established anew. It has been aimed at putting forward common solution suggestions from different points of view in this way.

- ***Round Two Mixed Tables Question 1:*** Considering the results obtained in the first round, the first question asked to the tables is: *"What are your common solution suggestions for the basic problems identified in your capacity as stakeholders of smart agriculture?"*

Discussions made and suggestions provided in this context are summarised below:

- *Suggestions for the importance of cooperation between stakeholders:* Primary solution suggestion presented by the representatives attending the workshop is that stakeholders must work together in cooperation. For such cooperation, it is quite important to create a good organisational model which includes all stakeholders and which meets at a supra-structure. It has been stated that the establishment of multidisciplinary and self-sacrificing teams will enhance functionality in this organisational model. It has been further stated that intra-sector relationships should be regulated as well.
- *Suggestion for the elimination of the lack of trained workforce:* Such suggestions may be studied on two axes. The first axis is the radical changes required to make in order to bring up qualified young farmers to work in agriculture. The second axis

is the practices which will facilitate the existing farmers to adapt to the times and which will give them new qualifications. In the discussions, mention has been particularly made of the inadequacy of the individuals who can use technology among those who work in the public sector and further emphasis has been placed on training.

The basic goal of the solution suggestions presented at this phase is to make agriculture a prestigious profession. It has been stated that technical intermediate staff members who may interpret and transmit technological information to producers should be brought up and should follow the process. It has been emphasised that starting agricultural training as from the primary school is an important step to be able to bring up qualified workforce. Need for the establishment of institutions and agricultural technical schools to bring up individuals for this area with the logic of “Rural Institutes” has been further emphasised. Further, it has been proposed that students of agriculture should be given software courses.

It has been stressed that various trainings are needed in order to bring up qualified individuals and to make it easier for first trainers and then farmers to adapt to new technologies. It has been significantly underlined that training programmes must be definitely compatible with practices as the existing experience shows that institutions providing training usually remain insufficient at the implementation phase. It has been stressed that field surveys should be carried out in order to transmit any technological devices, software, methods and research results to farmers. It has been stated that a data bank in which researchers, data obtained from research and results of research are recorded should be created in a corporate structure.

It has been stated that the number of individuals that will effectively implement Agriculture 4.0 and organise this system in a competent manner is rather low in Turkey. Due to insufficient level of training on Agriculture 4.0, it has been emphasised that trainer and user trainings should be provided and that universities and research organisations should take place in such trainings. It has been stressed that trainings should be certified and sustainable.

- *Suggestions for creating a public opinion to change the negative prejudices developed against Agriculture 4.0 by potential Agricultural Technology Implementers:*

That negative prejudices developed in relation with the new technological practices for various reasons should be changed constitutes one of the important points emphasised in the “suggestions” section.

In this sense, it is quite important that practices should be more inclusive for both small- and large-sized producers. It has been stated that the Ministry of Food, Agriculture and Livestock and municipalities should carry out studies to enhance awareness in order to provide such inclusiveness and that introduction of successful examples as role models is quite important for awareness. It has been presented as another solution suggestion that an organisation or manual should be created by which producers may draw a road map and that the producers should even be interviewed individually and told about such information.

- *General suggestions for Corporate Infrastructure and Supports:*

First, attention has been drawn to the fragmented structure of agricultural areas in Turkey and then to the difficulty in installing smart agricultural system in such areas. Second, it has been significantly emphasised that intermediate organisations to which producers can file their wishes, suggestions and complaints should be strengthened. It has been therefore dwelled upon the importance of ensuring farmers to establish cooperatives. At the same time, it has been proposed to support and strengthen the existing cooperatives and unions. It has been presented as another suggestion that the Ministry of Food Agriculture and Livestock should increase its joint studies with cooperatives, unions and chambers.

At this phase of the workshop, legal regulations and supports have been one of the issues that have been dwelled upon most at the tables. The point which has been primarily stated is the necessity of the identification of a strategy covering all stakeholders under Agriculture 4.0. When compared with the examples abroad, it is clear that neither technological development nor dissemination of technology has not yet reached the desired level in Turkey. It has been stated that any technology suitable for small farmers has not yet been produced, but technology is imported and such imports are not sustainable in the long run. Further, it has been told that there are few companies working in smart agricultural technologies and therefore competition remains at a lower level. In consideration of all these facts, it has been proposed that a structure and strategy similar to the Silicon Valley in which those stakeholders who may be aware of the importance of Agriculture 4.0 should be established and that the government should support such strategy through effective policies. Importance of making legal regulations for this purpose and the concentration of financial supports and grants on this area has been stressed. It has been particularly underlines that it is necessary design and/or develop legal regulations which will prevent any loss in production and consumption, which will ensure the development of the socioeconomic structure and assist in developing the technological infrastructure.

It has been stated that increase in research and development supports, grants and incentives will be effective in the creation and dissemination of technology. It has been particularly proposed to spread such practices as "Young Farmer project" in order to increase young farmers. Another point which has been emphasised is that the incentives provided should be monitored and controlled at each step and specialist support be provided whenever necessary. Finally, it has also been stressed that wordings of communiqués should be clearer and more comprehensible in any incentive-related issues as the level of perception in the matter of incentives is lower in terms of communiqués and implementation.

- ***Round Two Mixed Tables Question 2:*** *"What are your suggestions in order to develop the network of cooperation in your capacity as stakeholders that are expected to take place in the production of the technological infrastructure of smart agriculture, its implementation in the fields and in the creation of public opinion on the matter?"*

On this question, all stakeholders have emphasised that intermediate organisations should be created in order to organise, follow up and create public opinion on this whole process. In this context, it is seen that there is a common mind on the necessity of creating various communication platforms and coordination units. Suggestions regarding the general structure of communication platforms and coordination units are summarised below:

- *Creation of communication platforms and coordination units:* Creation of a communication platform by and between the stakeholders is pre-eminent among the suggestions for the development of the communication network of the stakeholders of smart agriculture in this area. It has been said that development is slowed down by the fact that some stakeholders are not aware of the special studies carried out by the other stakeholders as there is not any effective communication network between the stakeholders. It has been stated that any studies carried out and data obtained will be facilitated to share with the overall ecosystem if it is possible to be in continuous communication with a common platform. It has been stressed that a coordination unit should be established in order to provide inter-corporation integration. One of the suggestions presented in this context is the establishment of the Directorate of Smart Agriculture by the Ministry of Customs and Commerce and the Ministry of Food Agriculture and Livestock and the other one is the creation of a department under the Ministry of Agriculture. It has been dwelled upon that representatives from different sectors should be brought together through such works as congresses, symposiums, workshops, panels, etc., thus enhancing communication and cooperation. Further, other suggestions on the matter are the establishment of government-supported "agricultural satellite towns" specific to regions, increase of awareness efforts and creation of different disciplines such as agricultural mechatronics.

Briefly, the basic goals of this intermediate workshop designed as the first phase of the project "Global Integration of Turkish Agriculture and Agriculture 4.0" may be listed as follows:

- To share with the representatives of the agricultural sector the present status and development potential of agriculture in Turkey and the developments experienced in the Agriculture 4.0 practices in the world and Turkey.
- To bring together the stakeholders of the Agriculture 4.0 ecosystem in different sectors/areas and create public opinion on the Agriculture 4.0 practices.
- To identify the development potential of the Agriculture 4.0 practices, existing problems and solution suggestions for such problems with contribution from the representatives of the sector.

In this context, of the stakeholders of the Agriculture 4.0 ecosystem, producers have attended the workshop with 12 representatives, technology companies with 13 representatives, chambers and unions with 6 representatives and public organisations and universities with 18 representatives. Considering the distribution of the attendees to the workshop by areas and the stakeholders, it may be said that the intermediate workshop has taken place in quite an inclusive context.

Results obtained from the questions asked for the awareness of Agriculture 4.0 in the round one of the workshop may be summarised as follows:

- Attendees to the workshop are aware of the Agriculture 4.0 practices even if at different levels.
- They think that the Agriculture 4.0 practices will make an affirmative contribution to the production processes and have not developed any negative prejudices against the use of technology in agriculture.

Affirmative developments for which answers are sought and which are expected to occur in the agricultural sector upon the increase of the use of technology in agriculture may be summarised as follows:

- Acceleration of decision-making and production processes in production;
- Increases in efficiency and quality in production, increase in international competitive power and advancement in food safety by this means;
- Increase in the quality of agricultural employment and acceleration of remigration;
- Advancement in such issues as energy, carbon emission, etc. and provision of significant developments in “ecological sustainability”.

The greatest obstacles before the transition to the Agriculture 4.0 practices may be listed as follows:

- Fragmented structure of agricultural areas and high costs of the use of technology;
- Lack of training and capability of working in harmony with technology of the agricultural population;
- Farmers'/producers'
  - ✓ Lack of capital stock;
  - ✓ Failure to follow up bureaucratic formalities;
  - ✓ Such constraints experienced in access to agricultural technology as insufficiency of government supports and lack of adequate information about the existing government supports;
- Failure of information flow between all stakeholders of the Agriculture 4.0 ecosystem to be transparent enough.

In consideration of all these tendencies, the suggestions of the sectoral representatives about what should be done for the spreading of the Agriculture 4.0 practices are quite important. Such suggestions may be summarised in outline as follows:

- Preparation of the Agriculture 4.0 strategic plan by obtaining the opinion of representatives and provision of all stakeholders with information on the process in a transparent manner;
- Organisation of trainings, seminars, etc. for farmers to enhance the awareness of the Agriculture 4.0 practices; increase of the inclusiveness of the existing trade fairs;

- Bringing up qualified human capital that will improve the quality in agricultural employment and establishment of “agricultural technical schools” which may take a role in specialisation;
- Prioritisation of the “young farmer training” project and programmes which will speed up remigration;
- Revision of the government supports by considering the needs of the sector and to cover the Agriculture 4.0 practices; review of the legal background thereof;
- Establishment of such intermediate organisations/units as “communication platforms, coordination units” which will provide communication between stakeholders and which may act as intermediaries in communication with higher organisations on such issues as problems, requests, etc.

All information obtained as a result of the discussions of the sectoral representatives has revealed the overall development potential of, obstacles before, the problems and solutions of the sector. Further, contribution has been provided for the establishment of cooperation and taking of common action by the stakeholders of the agricultural sector in the solution of such problems. At the subsequent phase, findings and solutions will be supported and improved through questionnaires to be made on a larger group of stakeholders. Results so obtained shall act as reference for model and policy suggestions specific to Turkey and/or regions concerning the Agriculture 4.0 practices at the subsequent phase of the project.

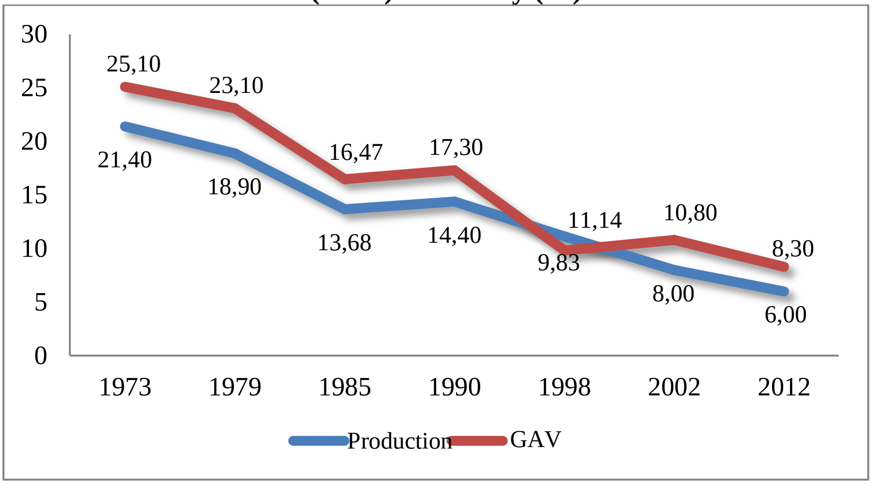
4.2. Input-Output Analysis

Input-Output analyses are based on mathematical models which allow economy to be studies both as a whole and in consideration of dealings between sectors. And the input-output tables constituting the basis of the models are those which show any kinds of dealings between the sectors of an economy in a given year. Each sector takes place in the table twice, once in a line and once in a column. Lines show how the output of the sector in that line is used and the columns shows the inputs which the sector requires in order to generate its own output. Each cell represents interindustry dealings (Aydoğuş, 1999: 15-18).

Before starting the detailed analysis in this chapter of the study, the development of the agricultural sector of Turkey between 1973 and 2012 will be generally analysed by the use of the 1973, 1979, 1985, 1990, 1998, 2002 and 2012 Input-Output tables published by TÜİK. Then, detailed analyses will be made by the use of the 2012 Input-Output Table which is the last one published by TÜİK and the 2012 Imports Input-Output Table. In the analyses, the agricultural sector includes both forestry and fisheries sectors so that harmony may be ensured between the input-output tables and healthier results may be obtained.

Relative percentages of the agricultural sector in the Turkish economy have been dealt with in order to study the development of the agricultural sector of Turkey between 1973 and 2012.

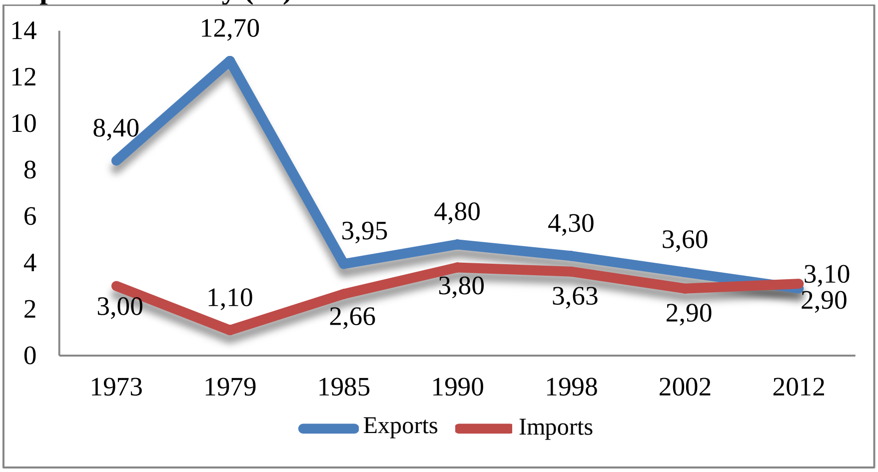
Graph 10 Relative Percentages of Agricultural Sector in Production and Gross Added Value (GAV) in Turkey (%)



Source: Calculated by the authors by using all Input-Output Tables of Turkey.

Graph 10 shows percentages of the agricultural sector in the total production and gross added value (GAV) in the 1973-2012 period. It is seen that the relative percentages of agriculture both in total production and added value reduced in the studied period. Percentage of agriculture in the total production which was 21.40% in 1973 reduced to 6% in 2012 and percentage of agriculture in GAV which was 25.10% in 1973 reduced to 8.3% in 2012.

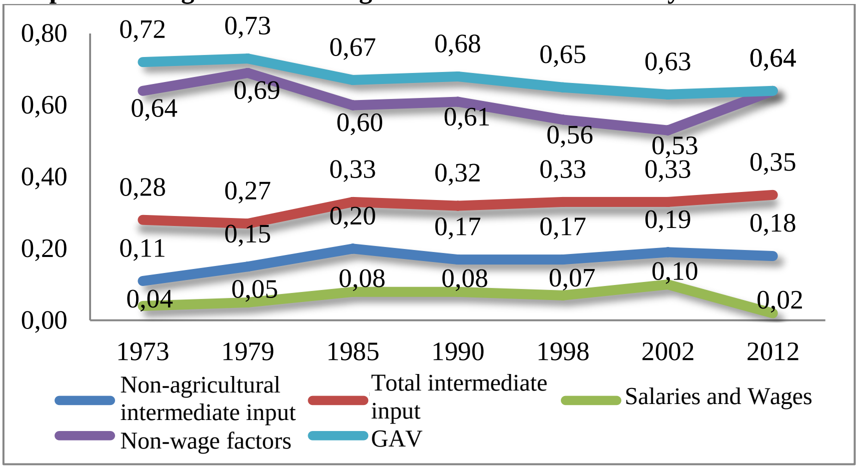
Graph 11 Relative Percentages of Agricultural Sector in Exports and Imports in Turkey (%)



Source: Calculated by the authors by using all Input-Output Tables of Turkey.

Change of the relative percentages of the agricultural sector in the total exports and imports is shown in Graph 11. Several developments come to the fore in this period. While the relative percentage of agriculture in total exports was 8.4% in 1973, it rose to 12.70% with a sudden leap in 1979 and then reduced to 3.95% with a sudden drop in 1985. It is seen that such percentage is only 2.90% in 2012. There are leaps and drops in the relative percentage of agriculture in imports as well, but they are not so sharp changes as in exports. This percentage which was 3% in 1973 reduced to 1.1% in 1979 and displayed a reducing rend until 1990 and reached 3.10% in 2012. In 2012, the agricultural sector is now in a net importer position.

Graph 12 Change of Costs of Agricultural Sector in Turkey



Source: Calculated by the authors by using all Input-Output Tables of Turkey.

Graph 12 describes the changes observed in the costs of agriculture in the same period. In other words, it presents the percentages of total intermediate input, non-agricultural intermediate input, GAV, salaries and wages in the value of production. Percentages of the total intermediate inputs and non-agricultural intermediate inputs in the total production value usually have an increasing trend in the 1973-2012 period. While the percentage of the non-agricultural intermediate inputs was 0.11 in 1973, this value became 0.18 in 2012. Such increase means an increase in the percentages of non-agricultural intermediate inputs in the total production costs as well. Another attention-drawing aspect in the period subject to analysis is that there was a reduction in the percentage of the added value while the percentage of the intermediate inputs in the production costs increased. Percentage of the added value in the total production value which was 0.72 in 1973 reduced to 0.64 in 2012. While increase was observed in the percentage of salaries and wages until 2002 and then a reduction, there is an increasing trend in the percentage of the non-wage factors. In other words, almost all of the added value of 0.64

TL generated in 2012 was consisted of non-wage factors while 0.53 TL of the added value of 0.63 TL generated in a production of 1 TL obtained from non-wage factors and 0.10 TL from salary and wage incomes in 2002.

Following the study of the change in agriculture in Turkey between 1973 and 2012, Turkey's 2012 Input-Output Table has been analysed in detail in order to reveal the structural characteristics of the sector. The 2012 Table containing 64 sectors was consolidated and reduced to 21 sectors in order to be able to both make healthy comments and study the effect of technology on the sectors. In order to calculate the effects of the information and communication technologies (ICT), OECD's ICT sector classification has been used and 2 sectors, namely *ICT Production* and *ICT Services*, have been established. In Table 9 are contained the sub-sectors covered by these 2 ICT sectors.

Table 9 ICT Consolidation Key

ICT Production	ICT Services
Computers and electronic and optic products	Publishing services
Electrical equipment	Cinema films, video and TV programme production services, sound recording and music broadcasting; programming and publishing services
	Telecommunication services
	Computer programming, consultancy and related services; information services

Source: Established by using OECD's ICT classification.

Using Turkey's 2012 Input-Output Table, the intermediate input uses of the sectors have been obtained by calculating the input coefficients matrix and the results are presented in Table 10.

Figures in the first column of the table show the use of input from other sectors by the agricultural sector. Sectors from which the agricultural sector uses most inputs are agriculture, chemical products, food production, services, refined oil products respectively. That is to say, the agricultural sector should use inputs of 0.1647 TL from its own sector and inputs of 0.477 TL from the chemical products sector in order to be able to achieve a production of 1 TL. Considering that the chemical products sector contains fertilisers and agricultural chemical products as well, the result satisfies the expectations. Besides, it is among the results obtained that the agricultural sector uses the ICT services sector as intermediate input more than the ICT production sector. Second column of the table shows the demand for the output of the agricultural sector from the other sectors. Sectors which need agricultural intermediate inputs most in order to be able to make a production of 1 TL are food production, agriculture, timber and wood products and textile production respectively.

Table 10 Sectoral Intermediate Inputs

	Intermediate Inputs of Agriculture	Agriculture as Intermediate Input
Agriculture	0.1647	0.1647
Mining	0.0025	0.0041
Food production	0.0356	0.3271
Textile production	0.0006	0.0392
Timber and wood products	0.0006	0.1200
Paper products	0.0006	0.0118
Refined petroleum products	0.0250	0.0000
Chemical products	0.0477	0.0037
Rubber and plastic products	0.0024	0.0099
Other non-metallic mineral products	0.0007	0.0006

Base metals	0.0000	0.0000
Fabricated metal products	0.0004	0.0000
ICT Production	0.0004	0.0002
NEC machinery and equipment	0.0007	0.0002
Motor vehicles	0.0015	0.0000
Furniture	0.0016	0.0006
Electricity, Gas, Water	0.0081	0.0001
Construction	0.0020	0.0004
Transportation	0.0149	0.0001
ICT Services	0.0008	0.0000
Services	0.0355	0.0052

Source: Calculated by the authors by using the 2012 Input-Output Table.

In Table 11 are given the coefficients obtained from Leontief Inverse Matrix calculated from the input-output table. The reason why the food production, ICT production and ICT services sectors have been chosen for analysis is that these sectors only show the sectoral production increases leads to 1 unit increase in the final demand in them.

Table 11 Sector- and Economy-Wide Production Multipliers

	Food Production	**ICT Production**	**ICT Services**	**Economy Production Multiplier**
Agriculture	0.4676	0.0103	0.0057	1.6906
Mining	0.0553	0.1328	0.0232	1.8136
Food production	1.1848	0.0099	0.0071	2.3559
Textile production	0.0084	0.0116	0.0044	2.5220
Timber and wood products	0.0027	0.0081	0.0015	2.3777
Paper products	0.0300	0.0255	0.0531	2.5106
Refined petroleum products	0.0361	0.0433	0.0123	2.4926
Chemical products	0.0921	0.1412	0.0195	2.5168
Rubber and plastic products	0.0313	0.0687	0.0063	2.6822
Other non-metallic mineral products	0.0090	0.0203	0.0041	2.3003
Base metals	0.0114	0.3320	0.0122	3.0192

Fabricated metal products	0.0087	0.0438	0.0048	2.5659
ICT Production	0.0049	1.2237	0.0198	2.8489
NEC machinery and equipment	0.0023	0.0375	0.0023	2.6551
Motor vehicles	0.0027	0.0048	0.0061	2.9473
Furniture	0.0106	0.0156	0.0073	2.3689
Electricity, Gas, Water	0.0569	0.2434	0.0452	2.6866
Construction	0.0095	0.0146	0.0149	2.4409
Transportation	0.1028	0.1265	0.0417	1.9536
ICT Services	0.0135	0.0263	1.1896	1.7008
Services	0.2150	0.3089	0.2198	1.6762

Source: Calculated by the authors by using the 2012 Input-Output Table.

In this context, reviewing the values in the first column of Table 11, a mere increase of 1 unit in the final demand from the food production sector in economy will primarily create a production increase of 1.1848 units in the food production sector and 0.4676 unit in the agricultural sector. Likewise, while an increase of 1 unit in the final demand from the ICT production sector creates a production increase in the Base metal sector next to its own, ICT services sector will create a production increase most in the services sector next to its own. Final demand increases in the ICT production and ICT services sectors will create a production increase of 0.0103 unit and 0.0057 unit in the agricultural sector respectively. And this result represents that the agricultural sector is not technology-based at an adequate level yet. Production multiplier values as contained in the last column of the table represent the total production increase which the increases in the production values of the sectors will create economy-wide. In other words, how much increase a sector of which final demand increases by 1 unit will create in the total production in the economy is shown. In this context, the sectors which will provide the most production increase by an increase of 1 unit in their final demands are base metal industry (3.0192) and motor vehicles (2.9473) respectively. While the ICT production creates a production increase of 2.8489 units throughout the economy, the ICT services sector creates a production increase of 1.7008 units.

Table 12 Inverse Import Matrix Coefficients

	Agriculture	Food production
Agriculture	0.0046	0.0622
Mining	0.0395	0.0442
Food production	0.0027	0.0337
Textile production	0.0007	0.0014
Timber and wood products	0.0004	0.0006
Paper products	0.0012	0.0066
Refined petroleum products	0.0217	0.0187
Chemical products	0.0690	0.0623
Rubber and plastic products	0.0020	0.0054
Other non-metallic mineral products	0.0002	0.0010
Base metals	0.0020	0.0041
Fabricated metal products	0.0007	0.0023
ICT Production	0.0017	0.0032
NEC machinery and equipment	0.0012	0.0016
Motor vehicles	0.0012	0.0012
Furniture	0.0006	0.0009
Electricity, Gas, Water	0.0018	0.0036
Construction	0.0001	0.0001
Transportation	0.0011	0.0026
ICT Services	0.0002	0.0005
Services	0.0013	0.0034

Source: Calculated by the authors by using 2012 Input-Output Table and 2012 Imports Input-Output Tables.

Coefficients of the agricultural and food production sectors of the inverse imports matrix calculated by using 2012 Turkish Input-Output

Table and 2012 Imports Input-Output Table are contained in Table 12. Coefficients of each sector in the table show how much import should be directly and indirectly made from each sector in order to achieve production to satisfy a demand increase when the final demand for the output of such sector increases one unit. When the final demand of the agricultural sector increases one unit, it is the chemical products sector (0.0690) from which most imports should be made so that the production to cover the demand can be achieved. In this context, the ICT production sector occupies the 9th place. When the demand of the food production sector increases one unit, the sectors from which most imports should be made are the chemical products sector (0.0623) and agricultural sector (0.0622). These results also show on what imported inputs the production of the sectors dependent more.

Vertical specialisation percentages showing the rate of imported intermediate inputs in the total exports quantity of a country are given in Table 13. Direct vertical specialisation percentage in the total exports gives the rate of dependence on the imported intermediate inputs which a sector uses in order to produce an output of one unit for export purposes. As it is seen in Table 13, the sector in which exports are dependent on imported intermediate inputs most is the base metal sector with 0.0983. This sector is followed by the motor vehicles sector (0.0657), textile production sector (0.0575) and ICT production sector (0.0427). Among 21 sectors, the food production sector (0.0144) occupies the 11th place while the agricultural sector (0.0045) occupies the 15th place.

Table 13 Vertical Specialisation Percentages of Sectors (Dependence of Exports on Imported Inputs)

	Vertical Specialisation Percentages
Agriculture	0.0045
Mining	0.0035
Food production	0.0144
Textile production	0.0575
Timber and wood products	0.0013
Paper products	0.0045
Refined petroleum products	0.0330
Chemical products	0.0247
Rubber and plastic products	0.0220
Other non-metallic mineral products	0.0063
Base metals	0.0983
Fabricated metal products	0.0168
ICT Production	0.0427
NEC machinery and equipment	0.0250
Motor vehicles	0.0657
Furniture	0.0085
Electricity, Gas, Water	0.0015
Construction	0.0023
Transportation	0.0271
ICT Services	0.0001
Services	0.0056

Source: Calculated by the authors by using 2012 Input-Output Table and 2012 Imports Input-Output Tables.

When one reviews the development of the Turkish agriculture sector between 1973 and 2012 with the input-output tables which both reflect the whole of the economy and cast a light upon the inter-sectoral dealings, it is seen that the relative percentages of the agricultural sector in production, added value and exports have reduced by years. In addition, as a result of the increase of the percentage of agriculture in imports, Turkey had reached the position of a net importer in the agricultural sector by 2012. Increase of the percentages of non-agricultural inputs used in the agricultural sector in the total production value in the 1973-2002 period is an evidence of the fact that dependence of agriculture on the other sectors increased as well. After the review of the overall appearance of the agricultural sector, more detailed analyses have been made by using the 2012 input-output table which is the last issued input-output table of Turkey and 2012 imports input-output table. It has been found out as a result of these analyses that the production of the agricultural sector is dependent on the chemical products sector which is one of the non-agricultural sectors. Even if the agricultural sector uses the ICT services sector more than the ICT production sector as intermediate input, an increase of one unit to be experienced in the production of these two sectors affects the agricultural sector at so low a rate. This result is an indication of the fact that the agricultural sector is not still technology-based at a sufficient level in our country.

4.3. Assessment of Farmer Questionnaire on Agricultural Innovation Potential of İzmir Region

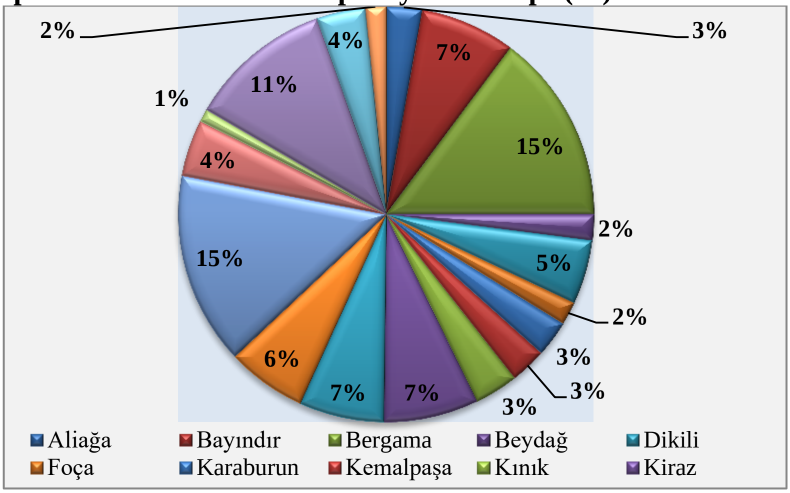
In order to be able to analyse any opportunities and threats for the accomplishment of a technological transformation in agriculture, it is quite important to understand the production organisation and techniques available in the region. Therefore, a questionnaire study has been carried out by the face-to-face interview method with 500 farmers in 18 townships of the province of İzmir in order to reveal the existing status of agricultural production and potential of adaptation to new technologies in İzmir and its townships. Results obtained in this questionnaire implemented in the townships of Aliağa, Bayındır, Bergama, Beydağ, Dikili, Foça, Karaburun, Kemalpaşa, Kınık, Kiraz, Menderes, Menemen, Ödemiş, Seferihisar, Selçuk, Tire, Torbalı and Urla are studies under the following basic headings:

- ✓ Demographic Structure
- ✓ Structure of Production
- ✓ Continuity of Production
- ✓ Governmental Supports
- ✓ Use of Technology
- ✓ Cooperation between Actors

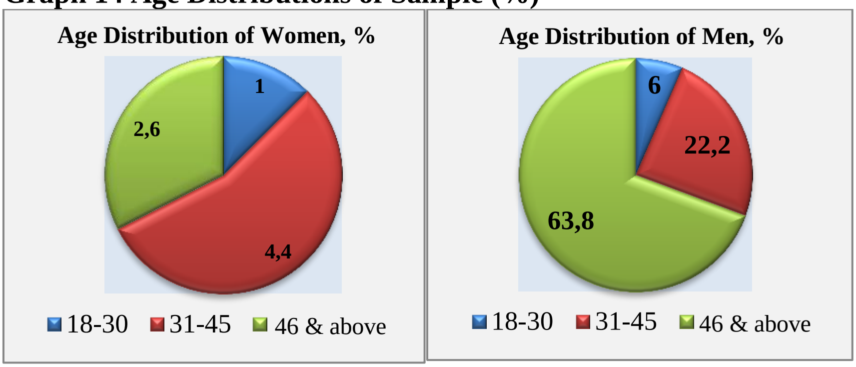
Demographic Structure:

A total of 500 farmers have participated in the questionnaire study. When one reviews the distribution of the farmers participating in the study by towns, Bergama occupies the second place with 74 farmers while Ödemiş occupies the first place with 74 farmers. The lowest participation is from Selçuk with 5 farmers. Graph 13 presents the distribution of all farmers who have participated in the study by towns. While 40 female farmers who have participated in the study constitute 8% of the sample, it is understood that agricultural production is carried out by male farmers to a great extent. And 92% of the total sample is consisted of male farmers. Of the sample, 27% is consisted of farmers of 32-45 years of age and 7% of 18-30 years of age. And 332 farmers are those of 46 years of age and above.

Graph 13 Distribution of Sample by Townships (%)

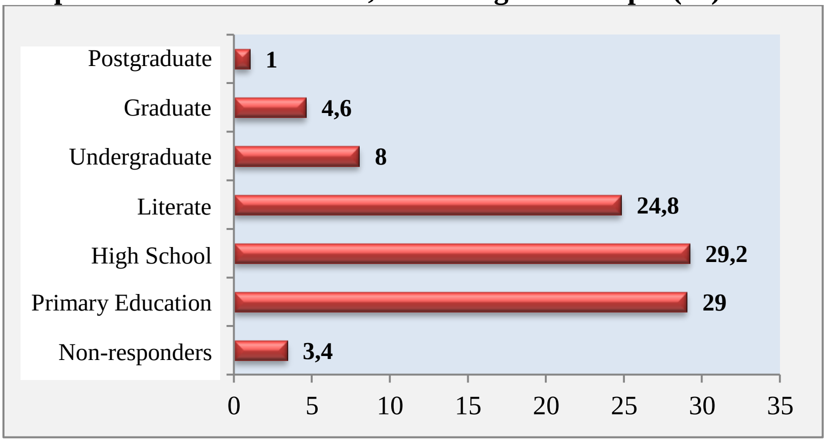


Graph 14 Age Distributions of Sample (%)



When one studies the educational statuses of farmers, it is found out that the farmers who are primary and high education are higher in number in the total sample. Accordingly, 29.2% of the farmers are high school graduates and 29% primary school graduates. Farmers who have completed their undergraduate and graduate degrees are at too low a level. Only 5.6% of the farmers who have taken place in the study have completed their undergraduate or graduate studies.

Graph 15 Educational Status, Percentages in Sample (%)



Although the number of farmers who are included in the study is 500, when one studies the number of the individuals living in the houses of such farmers and the population of such houses working in agriculture, it is seen that the population working in agriculture is 1.436 people while the number of those living the house is 2.226. Approximately 64% of the total population living in the houses of those farmers are working in agriculture.

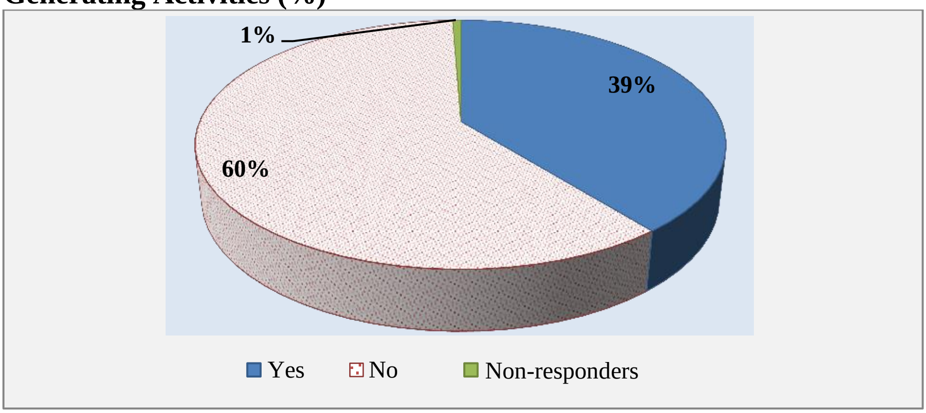
Table 14 Household Information (Number of People)

	Number of People to Whom Questionnaire Is Applied	Total Population Living in House	Population Working in Agriculture
Aliağa	14	85	43
Bayındır	37	178	126
Bergama	74	313	199
Beydağ	10	42	30
Dikili	25	108	64
Foça	9	32	18
Karaburun	14	51	34
Kemalpaşa	14	70	27
Kınık	17	71	53
Kiraz	37	151	108
Menderes	33	149	76

Menemen	31	181	107
Ödemiş	75	358	237
Seferihisar	22	84	45
Selçuk	5	20	13
Tire	56	250	175
Torbalı	19	94	63
Urla	8	29	18
Total	500	2.266	1.436

Considering the household sizes (Table 14)[1], the high number of people working in agriculture should be evaluated together with the fact that farmers earn a substantial portion of their income from agriculture (Graph 16). Of such farmers, 60% would not get engaged in any income-generating activity other than agriculture. The fact that 60% of farmers maintain agriculture as an activity for livelihood strengthens the fact that information to be obtained from such farmers will provide important information in presenting a framework as to the overall development trends and problems of the agricultural sector in the region.

Graph 16 Status of Dealing with Non-Agricultural Income-Generating Activities (%)



[1] Further, households consisting of 4-6 members are higher in number with 287 households. Number of households with 10 and more members is only six.

Structure of Agricultural Production

Farmers are engaged in vegetative production and greenhousing activities to a great extent. It is found out that livestock breeding is carried on at smaller scales along with vegetative production and greenhousing to a great extent. However, it should be remembered that this result reflects the general trend of 500 farmers included in the sample. It is known that the population engaged in livestock breeding in İzmir, especially in towns like Ödemiş, is high in number. While 405 farmers are engaged in vegetative production, 93 farmers are engaged in greenhousing. Number of households engaged in livestock breeding is 71 and usually engaged in bovine breeding (Table 15). Briefly, approximately 7.5% of the production is consisted of vegetative production and 12.5% of livestock breeding.

Table 15 General View of Animal Husbandry Activities

Livestock Breeding Type	Number of Households
Bovine	62
Ovine	5
Bovine-Ovine	2
Milking Cows	1
Non-Responders	1
Poultry Breeding	1
Those Not Engaged in Livestock Breeding	428
Grand Total	500

Considering the sizes of the land where production takes place, it shows that production takes place in land in the range of 50-100 decares to a great extent. While the number of farmers producing in a land of 100-500 decares is 82, the number of farmers producing in a land of more than 500 decares is only one and constitutes 17% of the sample. Product diversity is high in vegetative production. Some of the vegetables and fruits produced are such vegetables and fruits as olive, cherry, lettuce, silage corn, potato, cauliflower, peach, satsuma, okra, black-eyed pea, cotton, wheat, watermelon, melon, tomato, pepper, eggplant, chickpea, almond, walnut, cabbage and ornamental plants.

Considering that the fact that land per capita is small and fragmented in Turkey is counted among the basic problems in agricultural production (Albayrak, 2017), it may be said that the small size of the agricultural land in the İzmir region presents a picture compatible with the general view throughout Turkey. Ownership structure of agricultural land shows that the farmers participating in the study produce in their own land to a great extent. While 440 farmers produce in their own land, 36 farmers lease the land and 21 farmers maintain agricultural production as sharecroppers. A total of 3.314 agricultural workers are employed in agricultural production carried out in 18 townships. O such agricultural workers, 1.125 are family members and 2.189 are non-family people. Of the production, 34% is provided by family labour.

Farmers have been asked the question “How much of your vegetative/animal production potential do you think you use with the land and facilities you possess?”, thus trying to reveal the extent of their need for the improvement of the production processes. At this point, it has been found out that farmers do not usually have any idea about their production potential. 167 farmers have replied that they do not know how much of their agricultural production potential they can use; 87 farmers have stated that they use 100% of their production capacity. 12 farmers gave emphasised that they can use approximately 25% of their existing production capacity.

Table 16 Structure of the Production

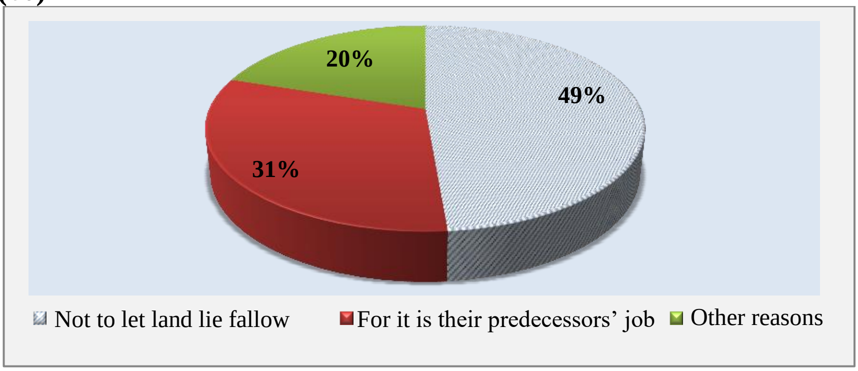
	Land Sizes (Decares)							Number of Those Making Vegetative Production	Number of Those Making Animal Production	Ownership Structures of Agricultural Land		
Township	**< 5**	**10-25**	**100-500**	**25-50**	**5 - 10**	**50-100**	**500 and above**			**Of My Own**	**I Lease**	**I Am a Sharecropper**
Aliağa		1	2	5		6		14	0	12		2
Bayındır	2	6		12	7	10		37	9	30	5	1
Bergama	1	8	20	16	5	24		74	9	67	4	3
Beydağ			2	4		4		10	5	10		
Dikili		1	8	3		13		25	2	24	1	
Foça		1	1	3		4		9	1	9		
Karaburun		5	3	2	2	2		14	0	14		
Kemalpaşa	1	5		3	1	4		14	3	11		3
Kınık			8	2		7		17	0	16		1
Kiraz		2	7	9	2	17		37	10	36		
Menderes	7	7		7	12			33	0	24	8	1
Menemen		5	4	6	2	13	1	31	2	21	7	3
Ödemiş	6	9	8	20	5	27		75	8	71	2	1
Seferihisar			5	5		12		22	0	21	1	
Selçuk				2		3		5	0	4	1	
Tire		5	13	11	2	25		56	19	51	1	4
Torbalı	1		1	6	3	8		18	3	11	6	2
Urla				4	3	1		8	0	8		
Grand Total	**18**	**55**	**82**	**120**	**44**	**180**	**1**	**499**	**71**	**440**	**36**	**21**

Sustainability of Agricultural Production

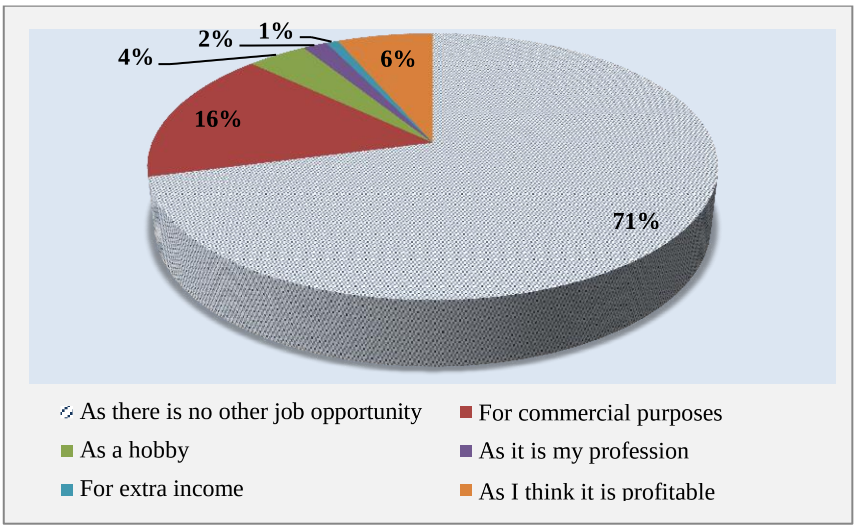
Sustainability in agriculture is quite a comprehensive subject and, considering it together with the increasing population and need for food all over the world, appears before us as an area of study which should be very carefully analysed. Sustainability of agricultural production may be brought up for discussion in many aspects. While this issue may be addressed with such variables as demographic factors, land structure, use of technology, etc., it is further so important an agenda item to bring it up for discussion again in terms of environmental sustainability. First of all, it is necessary to put forward the coverage of the issue of the sustainability of agricultural production in this study. In this study, the sustainability of agricultural production will be analysed by the help of such variables as farmers' reasons for getting engaged in agricultural activities, basic difficulties encountered in production, number of children working in agriculture an potential of such children of turning into a new generation of farmers in the future, percentages of investing the existing profits earned from agriculture in agriculture again and use of imported inputs.

First, replies to the question why farmers are engaged in agricultural production have been reviewed. In this context, 48% of the farmers have stated that they are engaged in agricultural production so that their land/agricultural areas will not lie fallow. And 31% of them maintain agricultural production because it is their predecessors' job. Twenty percent of the farmers describe their engagement in agriculture with different reasons. Of this group of 20%, 76% have stated that they are engaged in agricultural production because they think there is no other employment opportunity. It has been earlier stressed that farmers are graduates of primary and high education to a great extent. Considering it together with this information, it is understood that the farming population concentrating in the lower steps of education think that they cannot/will not be able to find employment in any employment generating higher income. Those who think agriculture is profitable is only 1 percent.

Graph 17 Basic Reasons for Maintenance of Agricultural Production (%)



Graph 18 Other Reasons for Maintenance of Agricultural Production

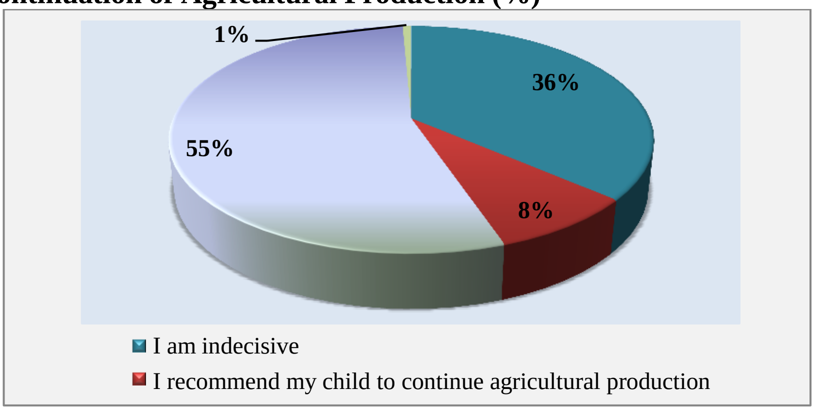


When one studies the reasons for the maintenance of agricultural production, that the agricultural land will not lie fallow and that they should continue their predecessors' job come to the fore. These two basic motivations reveal that the existing farmers may substantially influence their children's decision to continue agricultural production as well. Accepting this fact, recommendations of the farmers to their children to continue agricultural production have been studied. Of 500 farmers, 55% have replied "I do not recommend my children to continue agricultural production" while 8% have replied "I recommend it". The first striking result is that the farmers would not recommend farming in which they are substantially engaged so that the agricultural areas will not lie fallow and because it is their predecessors' job to their children. The second important point is that 36% of the farmers are indecisive.

While 60% of the farmers (301 farmers) do not have any non-agricultural income, 39% of them (196 farmers) have non-agricultural income. Number of the farmers whose children work in agriculture is 127 people and 41 of them have non-agricultural income while 85 farmers o not have any non-agricultural income and the number of the farmers whose children work in agriculture and who have failed to reply the question as to whether or not they have non-agricultural income is one. Further, those farmers whose children work in agriculture have given affirmative replies to the premise "I will continue agricultural production during the next decade" to a great extent. Of such farmers, 84 are also decisive and willing to continue agricultural production during the next decade while 40 farmers are indecisive. Three farmers have stressed that they will not continue agricultural production during the next decade.

Young people's continuation of agricultural production may be expected to substantially shape the Turkish agriculture in the subsequent years. High number of the farmers who are indecisive to continue production is attention-grabbing. Therefore, it is clear that efforts should be made in order to ensure the indecisive farmers to enhance the motivation of the next generations to continue agricultural production. It may be said that this is substantially dependent on the mitigation of the difficulties which farmers encounter in production. Projects for supporting young farmer candidates intended for encouraging the young people to get engaged in farming, which are supported by ministries, local governments and non-governmental organisations under the rural development supports and the scopes thereof bear critical importance.

Graph 19 Farmers' Recommendations to Their Children on Continuation of Agricultural Production (%)



Effects of the number of children working in agriculture on the sustainability of agricultural production are presented in Table 17. When the rate of sustainability is taken as 50 percent, it is determined in Table 17 that the percentage of those working in the agricultural sector is 27,10% and that of those who do not work in the agricultural sector is 72,89% by the number of the children living in household. It has been found out that the higher ate of those who do not work in agriculture has an adverse effect on sustainability.

Table 17 Sustainability Effect by Number of Children Working in Agriculture

Household	Number of People	Number of Those Working in Agricultural Sector	Number of Those Who Do Not Work in Agricultural Sector	Number of Children	Number of Children Working in Agriculture	Number of Children Not Working in Agriculture
500	2.226	1.436	830	856	232	624
	%100	%63.37 ↑	%36.62 ↓	%100	%27.10 ↓	%72.89 ↑
		%50 +/-			%50 +/-	

Table 18 presents a detailed distribution of the educational status of the children of 500 farmers. When one reviews the educational status of the children bearing young farmer potential, it is seen that the children have substantially completed their primary and high school education. However, when compared with the educational status of the farmers, it is clear that the percentage of the children to attend undergraduate, graduate and post-graduate education is higher.

This picture is important in terms of emphasising two significant points. First, it may be said that encouragement of the farmers' children to continue agricultural production may contribute to the elevation of the educational level of the people engaged in farming and thus raising of the attraction of the farming profession for young people. Secondly, although the educational level of the children is higher than that of the existing farmers, the fact that the children who are primary and high school graduates are the majority requires that young people should be encouraged in continuing their education as well.

Table 18 Educational Status of Farmers' Children (Number of Children Studying at Respective Grades)

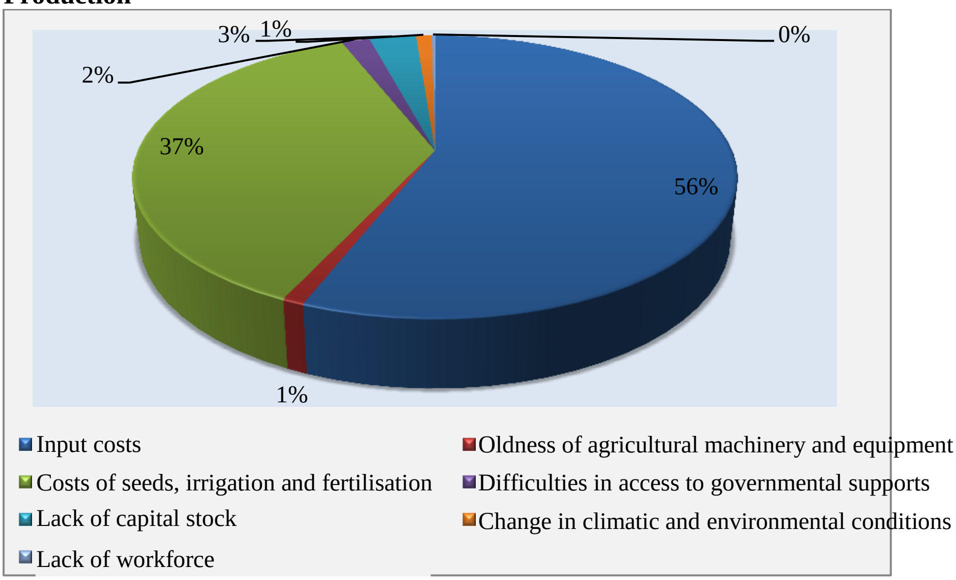
Educational Status	Household	Educational Status	Household
Primary	99	High School-Graduate	37
Primary-High School	82	High School-Graduate-Postgraduate-Doctorate	3
Primary-High School-Undergraduate	5	High School-Postgraduate-Doctorate	2
Primary-High School-Undergraduate-Graduate	2	Literate	4
Primary-High School-Undergraduate-Postgraduate-Doctorate	1	Literate-Primary	4
Primary-High School-Graduate	14	Literate-Primary-High School	1
Primary-High School-Postgraduate-Doctorate	1	Literate-Undergraduate	1
Primary-Undergraduate	13	Undergraduate	12
Primary-Undergraduate-Graduate	3	Undergraduate-Graduate	2
Primary-Graduate	9	Graduate	24
High School	45	Graduate-Postgraduate-Doctorate	2
High School-Undergraduate	26	Postgraduate-Doctorate	6
High School-Undergraduate-Graduate	2	Non-responders	100

Provision of the sustainability of agricultural production is also dependent on the solution of the problems encountered in agricultural production as well as on the creation of new generation young farmers. Farmers who have participated in the study have been first asked what the basic problems they encounter in the continuation of agricultural production are in order to identify the problems encountered in the sustainability of agricultural production. In the replies to the question, it is seen that the most basic problem is the high input costs. Input costs are followed by the costs of seeds, irrigation and fertilisation.

All of these sub-headings represented as two separate problems by the farmers may be basically addressed under the problem of high production costs. It should be underlined that 92% of the farmers have emphasised that the most basic problem in the sustainability of agricultural production is costs. And the problem occupying the third place is the lack of capital stock which also points out a financial constraint.

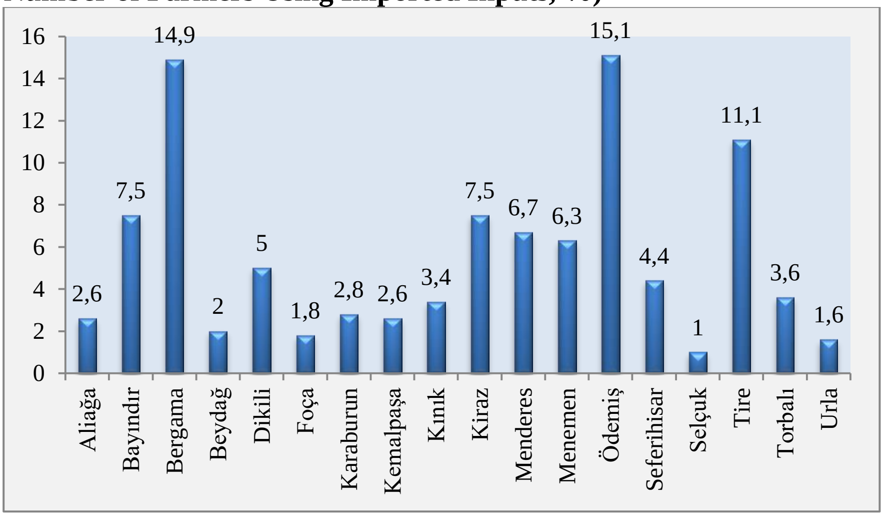
Lack of workforce, old agricultural machinery and equipment, difficulties in access to government supports and changes in climatic/ environmental conditions have been listed as the most insignificant problem in the sustainability of agricultural production.

Graph 20 Basic Problems in Provision of Permanence of Agricultural Production



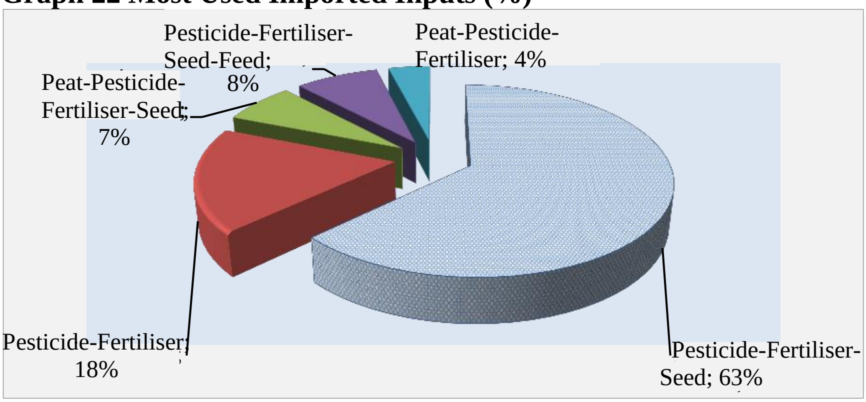
Sustainability of agricultural production is closely associated with how much of their annual income the farmers spare to re-finance agricultural production. Out of 500 farmers who have participated in the study, 338 farmers re-invest a portion of their annual profit in agriculture. This corresponds to 68% of the total sample. And the number of those who re-invest at least 50% of their annual profit constitutes 55% of the total sample. In the sample, there are only 2 people in Menderes and Menemen who re-invest the whole of their annual profits in agriculture.

Graph 21 Use of Imported Inputs by Townships (Percentage in Number of Farmers Using Imported Inputs, %)



Considering the input costs as the most basic problem in the sustainability of agricultural production makes it necessary to open another parenthesis related to the domestic/imported nature and types of such inputs. Graph 21 reveals the replies to the question “Do you use imported inputs?” asked to the farmers on town-by-town basis. The graph shows how many of the farmers included in the sample use imported inputs. Accordingly, 99% of the farmers who have participated in the study use imported inputs in order to achieve production. This information does not show the percentage of imported inputs in the total quantity of inputs used by farmers, but when one reviews the replies to this question, it may be concluded that part of the production is achieved by using imported inputs. When one reviews the imported inputs used, it is seen that 63% of the farmers use imported seeds, fertilisers and pesticides. By this table, it may be concluded that production is achieved by imported input support to a great extent. Eight percent of the sample import pesticides, fertilisers, seeds and animal feed. Considering the percentage of those who are engaged in livestock breeding among the farmers who have participated in the study, it is revealed that these farmers use imported feed to feed their animals and it is understood that continuity of animal production is substantially dependent on imported inputs.

Graph 22 Most Used Imported Inputs (%)



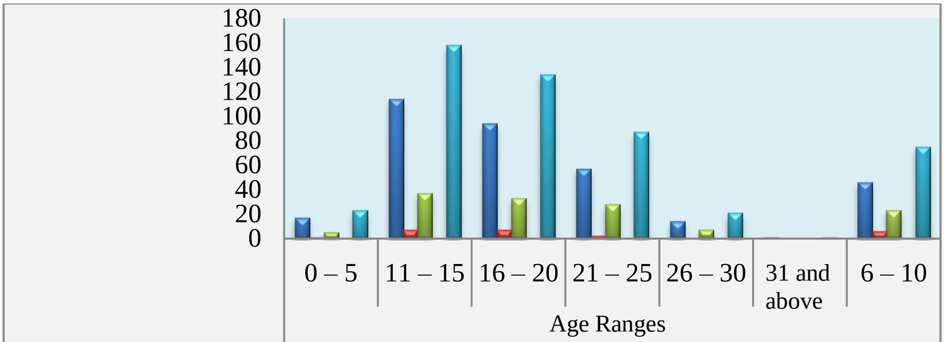
This dependence on imported inputs in agricultural production tallies with the farmers' emphasis on the input costs as the most basic problem in the sustainability of production. Considering it with the devaluation of the Turkish lira in recent years, failure to reduce the dependence on imported inputs in agricultural production will increase the production costs.

Use of Technology in Agricultural Production:

In this section of the study, it is intended to determine the present status of the new technologies used in agricultural production by the farmers producing in İzmir and their potential to adapt to the smart agricultural technologies. Use of technology in agriculture is quite a large matter of debate. Principal purpose in this study is not the measurement of the capacity of agricultural technology of the machinery and equipment but the determination of the general trends of the farmers to use agricultural technologies.

Graph 23 presents the ownership status and age ranges of the agricultural machinery. Asking the ownership status of the agricultural machinery is intended to be able to find out their trend of common use of machinery, equipment, software, etc. to be used in production within the scope of smart agricultural practices. Reviewing in this context, the fact that common use of agricultural machinery and equipment is quite widespread is important in that it reflects the trend of common use.

Graph 23 Status of Ownership and Age Ranges of Agricultural Machines



	0 – 5	11 – 15	16 – 20	21 – 25	26 – 30	31 and above	6 – 10
My own property	17	114	94	57	14	1	46
Leased	1	7	7	2	0	0	6
Common use	5	37	33	28	7	0	23
Non-responders	0	0	0	0	0	0	0
Grand Total	23	158	134	87	21	1	75

Table 19 Relationship between Age Ranges of Agricultural Machinery and Equipment and Ages of Farmers (Number of People)

Age Ranges of Agricultural Machines and Equipment	**Age Ranges of Farmers**			
	18-30	**31-45**	**46 & above**	**Grand Total**
0-5	3	10	10	23
6-10	7	26	42	75
11-15	8	52	97	157
16-20	11	25	97	133
21-25	4	17	66	87
26-30	1	2	18	21
31 and above	1	0	0	1
Non-responders	1	1	1	3
Grand Total	**36**	**133**	**331**	**500**

Although the age ranges of the agricultural machinery and equipment give a general view on the age of the technology used, they fail to provide adequate information in presenting a detailed view of the technological structure of agricultural production. For instance, high age ranges of tractors and various conventional reaping machines should not be construed that the agricultural innovation potential of the region is lower. As a general consideration, it is seen that the agricultural machinery and equipment used by 500 farmers in the İzmir region is 11-25 years to a great extent.

Table 20 Number of Technological Devices/Equipment Used in Production (Number of Farmers Using Them)

Townships	Smart Phone	Computer	Tablet	Sensor-fitted machines	Unmanned air vehicle	Software
Aliağa	13	1	1	0	0	0
Bayındır	30	8	5	0	0	0
Bergama	60	20	9	2	0	0
Beydağ	9	2	2	0	0	0
Dikili	20	4	7	0	0	0
Foça	6	2	2	0	0	0
Karaburun	13	3	5	0	0	0
Kemalpaşa	14	0	0	0	0	0
Kınık	14	1	3	0	0	0
Kiraz	35	8	7	0	0	0
Menderes	28	6	0	0	0	0
Menemen	27	5	4	0	0	0
Ödemiş	61	18	17	1	0	0
Seferihisar	18	7	9	0	0	0
Selçuk	4	0	1	0	0	0
Tire	45	11	8	0	0	0
Torbalı	18	2	0	0	0	0
Urla	7	3	4	0	0	0
Total	**422**	**101**	**84**	**3**	**0**	**0**

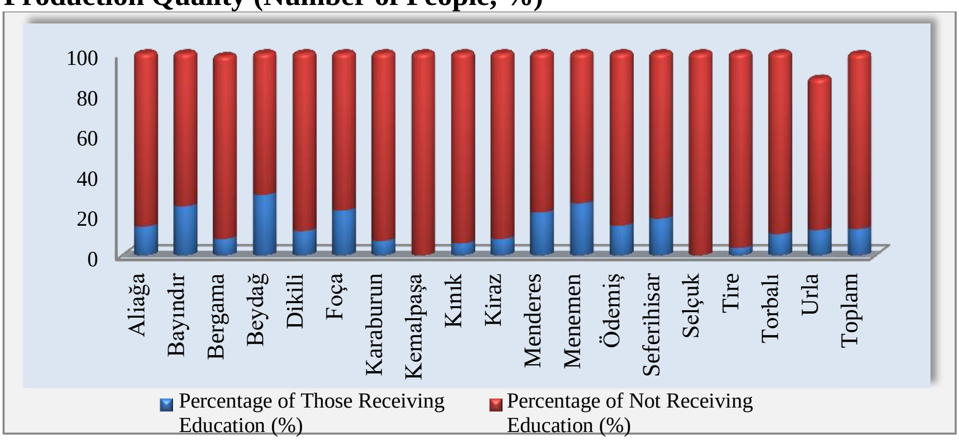
Farmers have been asked whether or not they use smarts phones, computers, tablets, sensor-fitted machines, unmanned air vehicles and software controlling the production processes. According to the findings, use of smart phones, computers and tablets is widespread among farmers, but the use of technologies intended for the automation of production is rather limited. For instance, while unmanned air vehicles are not used in the production processes at all, there are only 3 farmers who use sensor-fitted machines. Of these farmers, 2 carry out production in Bergama and 1 in Ödemiş.

Table 21 Status of Access to Information via Smart Agricultural Technologies

Weather Condition	Fertilisation Time	Disinfestation Time	Irrigation and Draining	Number of Steps of Bovines	Milk Measurement and Monitoring	Poultry House Tracking	Other - Moisture Meter
266	120	115	25	0	32	1	2

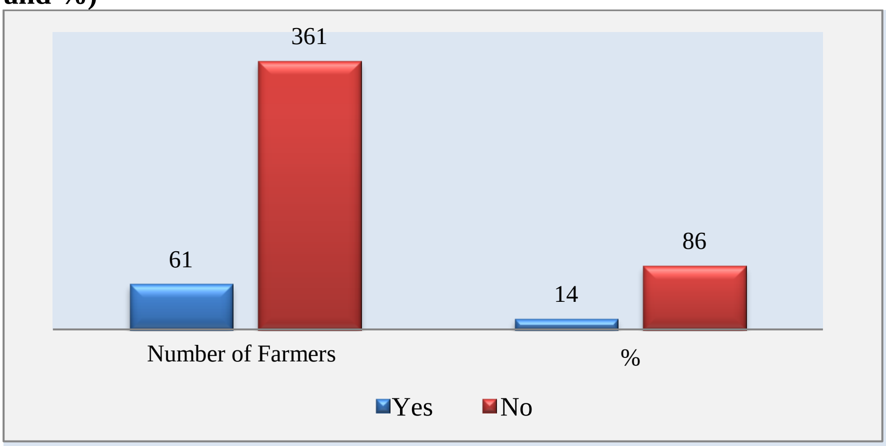
While the information presented in Table 20 show that the farmers do not have software, Table 21 shows that the farmers using smart agricultural technologies may access to information on weather condition, fertilisation time, disinfestation time, milk measurement and monitoring, irrigation and draining. In terms of access to information, access to weather condition information is in the first place with 47% and fertilisation time and disinfestation time in the second place with 2 percent.

Graph 24 Trainings Received for Improving Production and Production Quality (Number of People, %)



Integration of automation and technological developments in agriculture to the organisation of agricultural production brings together a series of educational needs as well. Considering that a majority of the farmers is consisted of literate, elementary and high school graduate individuals, education to be organised for the improvement of the production and production quality and enhance the technological integration bears critical importance. However, when all farmers have been asked their status of receiving education accordingly, 87% of all farmers have stressed that they have not received any education and only 13% of the total sample have received education. Percentage of those who have received education is the highest with 17% in the town of Ödemiş and this town is followed by Bayındır with 14 percent.

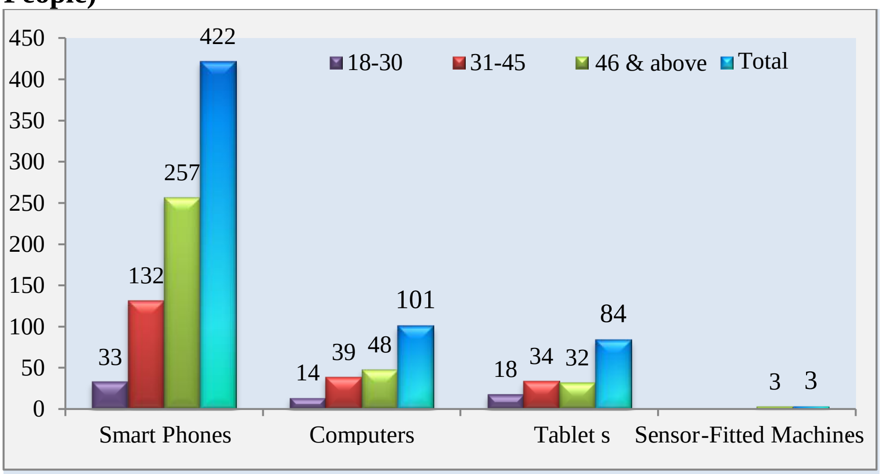
Graph 25 Educational Status of Farmers Using New Technologies for Enhancing Production and Production Quality (Number of People and %)



When the same question has been asked to 422 farmers who have stressed that they use new technologies in production, 86% of the farmers have stressed that they did not attend any education for the improvement of agricultural production.

Graph 26 presents the technological machines or equipment used by the ages of farmers. Accordingly, technologies preferred by the ages of farmers do not vary. It is because the farmers basically prefer using the technology only focusing on access to information such as weather condition, fertilisation time, disinfestation time, etc. This picture shows that the farmers have first integrated to the agricultural technology via smart phones and computers. All this information draws attention to the limited level of using agricultural technology in the organisation of agricultural production within the scope of the sample.

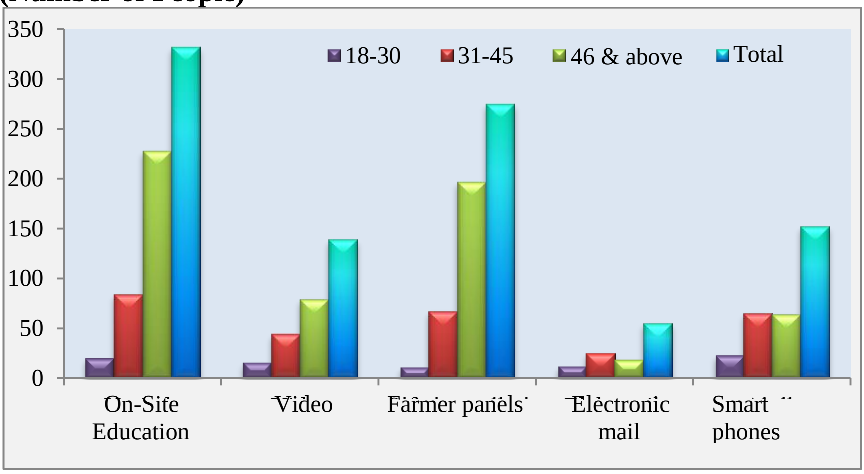
Graph 26 Technologies Preferred by Ages of Farmers (Number of People)



Graph 26 presents the distribution by age of their choices via what channels the farmers want to access to information in the acceleration of the process of adaptation to agricultural technologies in the improvement of the production processes.

One of the important points here is that the farmers prefer being informed through on-site education/information and via farmer panels in the replies to this question although a majority of them uses smart phones. This is important information for the İzmir region, which may be considered at the first step of technological integration in agricultural production processes. This picture shows that the farmers are open to face-to-face communication channels at the first phase in the dissemination of information.

Graph 27 Farmers' Choices for Access to Information by Ages (Number of People)



By the educational status of the farmers, their choices for the channels to access to information vary. Those farmers who are at the literate level prefer farmer panels, those at primary education level prefer on-site education/information, those at high school level prefer smart phone software and those at undergraduate, graduate and postgraduate level prefer electronic mail bulletins.

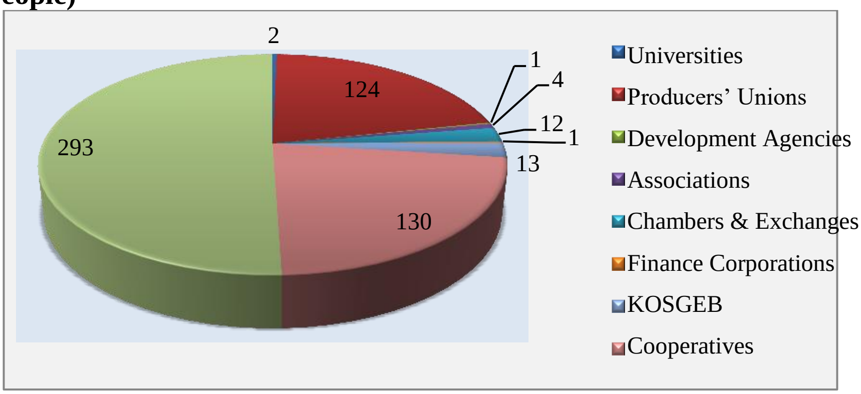
Cooperation Between Actors

Nature and sustainability of agricultural production and spreading of agricultural technologies are closely associated with the development levels of the relationships between the farmers and the other elements of this ecosystem. Capacity of producing region-specific products, demographic dynamics and differences in educational levels make it necessary to generate original policies and develop cooperations not only at the governmental level but also at the regional level.

The present status should be analysed in order to develop the channels of cooperation with the local actors particularly in the integration of agricultural technologies to production. Therefore, farmers have been asked questions concerning their cooperation with the local actors.

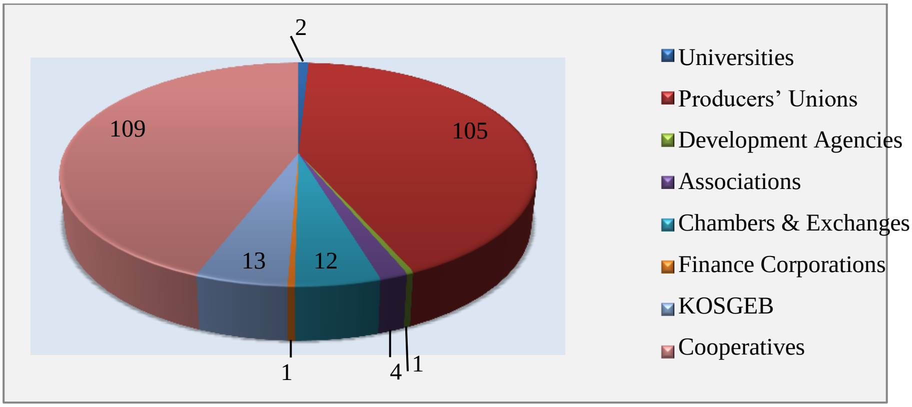
Out of 500 farmers, 293 farmers do not have any cooperation with any local actors. That is to say, 59% of the farmers do not cooperate with any actor. Cooperatives and producers' unions are among the organisations with which farmers cooperate most. Capacity of cooperation with universities, development agencies and associations is rather low. This picture shows that agricultural production is substantially abstracted from local actors.

Graph 28 Status of Cooperation with Local Actors (Number of People)



When one reviews the scope of the existing cooperations, it is seen that cooperation is basically made in product sales and purchases, product sales and marketing, product procurement and finally grants.

Graph 29 Status of Cooperation of Farmers Using New Technologies with Local Actors (Number of People)



Graph 29 only shows the status of cooperation of the farmers using new technologies with local actors. It is understood that those producers who have integrated new technologies to production have more intensive cooperation with cooperative sand producers' unions. In this context, it is necessary to make corporate arrangements to ensure universities, finance corporations, associations, chambers and exchanges to take more active roles in this process and to ensure farmers to contact face to face with the representatives of such organisations.

Supporting Channels

Findings obtained show the weakness of the channels of cooperation with local actors and, therefore, considering the conventional structure of farming, it is inevitable to address the government supports as the most important element in agricultural production ecosystem.

Graph 30 Status of Benefiting from Government Supports (%)

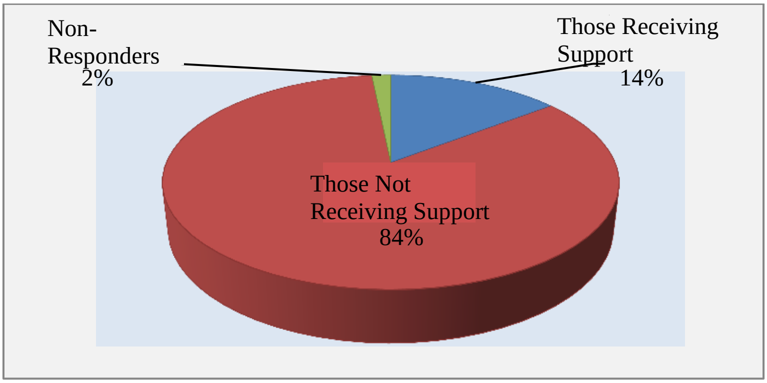


Table 22 Distribution of Status of Benefiting from Government Supports by Townships (Number of People)

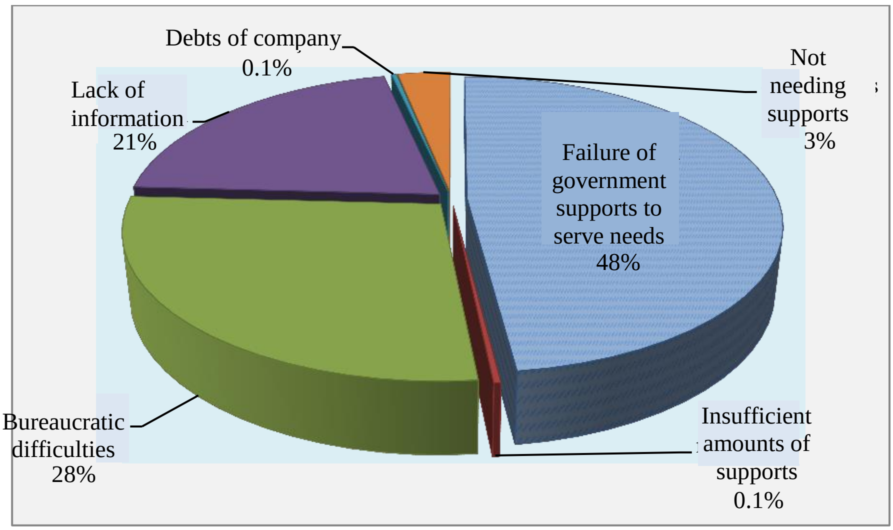
Townships	Those Receiving Support	Those Not Receiving Support	Non-Responders	Grand Total
Aliağa	9	5	0	14
Bayındır	4	31	0	37
Bergama	15	59	0	74
Beydağ	0	8	2	10
Dikili	11	14	0	25
Foça	0	9	0	9
Kemalpaşa	0	14	0	14
Kiraz	1	36	0	37
Menderes	0	33	0	33
Menemen	12	19	0	31
Ödemiş	4	71	0	75
Seferihisar	1	21	0	22
Selçuk	0	5	0	5
Tire	3	50	3	56
Torbalı	5	14	0	19
Urla	0	7	1	8
Kınık	8	9	0	17
Karaburun	0	14	0	14
Grand Total	73	419	8	500

General trend of benefiting from government supports is presented in Graph 30 and the distribution of the number of farmers benefiting from government supports by townships is given in Table 22. While approximately 14% of 500 farmers benefit from government supports, 84% do not benefit from government supports; 2% of the farmers have not replied this question. Considering it on townships basis, percentage of benefiting from governmental supports is higher in Aliağa, Kınık and Menemen in the sample.

The farmers who have participated in the study have been asked the reasons for benefiting from government supports. Of the farmers, 48% have emphasised that the government supports do not serve their needs. At this point, it is understood that the farmers do not consider the amount of support to be sufficient but that they agree on the fact that the government supports fail to make sufficient contribution in overcoming the basic difficulties encountered in agricultural production. Results of the questionnaire show that bureaucratic difficulties occupy the second place in the reasons of not benefiting from government supports. Accordingly, difficulty in the processes of application for government supports, longevity of the process and some bureaucratic obstacles lead to restrictions in accessing to government supports. The third basic reason in not benefiting from governmental supports is the lack of information. Of the farmers, 21% have stated that they could not access to government supports due to lack of information. Emphasis on the lack of information makes it necessary to both review the channels related to the announcement of the supports and provide transparency of the application processes, thus informing all stakeholders synchronously. Other reasons may be listed as not needing any support, failure to access to supports due to the debts of the company and insufficient amount of support. However, the total percentage of all these three reasons is less than 1% in the whole sample.

"The fact that government supports do not serve the needs of the farmers" which is deemed to be the most important reason for not benefiting from government supports requires the supports needed by farmers to be brought forward for discussion as well. Therefore, the farmers have been asked about the most important government supports. In accordance with the replies given, the sequence of importance of the government supports is presented in Graph 31 below.

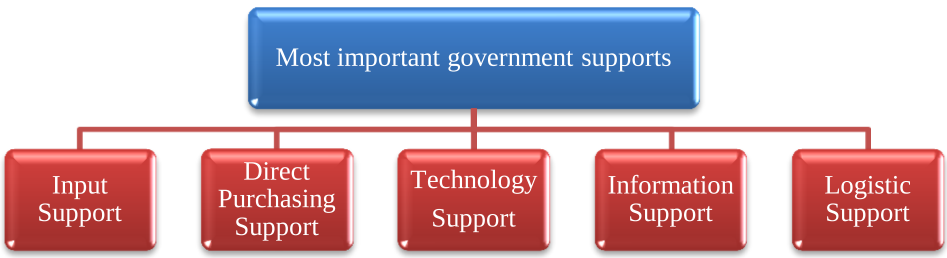
Graph 31 Status of Failure to Benefit from Government Supports (%)



Accordingly, the most important type of support is input supports. Considering that farmers consider input costs to be the most important obstacle in the sustainability of production, emphasising the input support primarily is an expected picture. Farmers think that the second most important type of support is direct purchasing support. Of the farmers participating in the study, 29 farmers have considered the purchasing support to be the most important support. It attracts attention that these farmers are 40 years of age and above.

The third type of support is technology support. This picture reminds that the government should play more roles in both machinery and equipment and information supports in the integration of the organisation of agricultural production to the technological processes.

Figure 7 Government Supports by Order of Importance



Farmers have been asked the issues which they specifically need in order to identify the supporting themes. Table 23 presents these issues together with their degrees of importance. 410 farmers have emphasised the supports for input costs as the most important need. Following this, 321 farmers have stated the extension of market opportunities as the second most important area of support. 257 farmers have stated that they need support for plant diseases and disinfestation.

In terms of types of supports which the farmers operating in vegetative production category by their areas of production consider to be the most important ones of government supports, input support is in the first place with 76%, logistic support in the second place with 13%, purchasing support in the third place with 10%, technology support in the fourth place with 0.70% and information support in the fifth place with 0.20 percent. In terms of the governmental supports of those farmers operating in greenhousing, input support is in the first place with 71%, purchasing support in the second place with 15%, logistic support and technology support in the third place with 6% and information support in the last place with 2 percent.

Table 23 Level of Importance of Issues in Which Farmers Need Assistance Most

Supporting Theme	Percentages of Choice	Degree of Importance of Choice
Input Costs	410	Level 1 Need
Market Opportunities and World Prices	321	Level 2 Need
Plant Diseases and Herbicides	257	Level 3 Need
Soil Analysis and Conscious Fertilisation	218	Level 4 Need
Credits, Subsidies and Agricultural Supports	283	Level 5 Need
Irrigation and Draining	218	Level 6 Need
Agricultural Technologies	274	Level 7 Need

This picture is striking in that it shows that the support least needed in terms of sequence of importance is agricultural technologies. As a matter of fact, the fact that these farmers who have potential in adaptation to agricultural technologies stress that they need less support in agricultural technologies basically stems from their failure to have overcome the problems of cost to maintain the production.

General Evaluation

Main findings of this questionnaire study carried out in the townships of İzmir reveal that a majority of the farmers included in the sample are male and +46 years of age. Production taking place in relatively small agricultural fields (10-100 decares) has usually concentrated on vegetative production and greenhousing activities.

Livestock breeding is usually carried out together with vegetative production and greenhousing activities. Information obtained show that livestock breeding is a side production activity among the farmers covered by this sample. However, this does not reflect the general profile of livestock breeding in İzmir. Therefore, this information should be read as the production trends of the farmers participating in the study.

It has been found out that farmers own the land but are also open to leasing and common use methods. Of these farmers who maintain agricultural production in order not to allow agricultural areas lie fallow and/or because farming is their predecessors' profession, the percentage of getting engaged in any non-agricultural income-generating activity is 39 percent. Sixty percent of the farmers carry on agriculture as an activity for livelihood and state that they will maintain production during the next decade. However, it is seen that the farmers would not recommend their children to continue agricultural production. This picture requires that Turkey-wide and regional policies which should be developed in order to bring up new generation young farmers and to make farming profession more prestigious should be put into practice as soon as possible.

Even though the process of transition to smart agriculture has not yet occurred, there are some threats and opportunities related to integration. First, the fact that the farmers are apt to leasing and common use in the use of the agricultural machines and equipment may be construed as an indication of the fact that similar trends will get stronger in the use of the agricultural technologies in a near future as well. However, farmers seem not to have overcome some production-related very basic problems yet. For instance, the most important problem of the farmers is input costs. Ninety-nine percent of the farmers use imported inputs and, considering the devaluation of the Turkish lira, this basic problem in production should be first solved. Solving the basic cost problems of production will enhance the farmers' motivation to integrate agricultural technologies to their production. It is seen that the idea of the fact that technology should be considered to be a tool for the improvement of the efficiency and quality of production has not yet settled.

In this context, it is intended to evaluate the farmers' general views about agricultural production ecosystem elements and the use of agricultural technology by using the Likert scale. This scale is consisted of 11 questions and the farmers are provided with the options "Strongly Disagree", "Disagree", "Neutral", "Agree" and "Strongly Agree".

According to these question,

- Sustainability of Production: Farmers do not agree to the premise "I would recommend my children to continue agricultural production in the future". There are 316 farmers who will maintain agricultural production during the forthcoming decade; and 165 farmers are indecisive.
- Technological Integration of Agriculture: Farmers do not have any definite judgment on the importance of using technology in agriculture and are indecisive on whether or not agricultural machines and equipment are compliant with the technology of the day.
- They think that enhancement of the use of technology in production will improve efficiency and reduce costs and that they

can adapt to these new technologies. However, they also state that technological innovations are exceedingly costly and that they cannot access to such new technologies due to high costs even if they want to use the technology in production.

- Cooperation with Actors: Farmers think that their cooperation with private corporations and public organisations has sufficiently developed although they do not cooperate with local actors. Fifty-nine farmers are indecisive; and 39 farmers think that cooperation has not sufficiently developed. While 170 farmers agree to the premise “Banks are successful in providing financing channels which will support production with reasonable conditions”, 183 farmers are indecisive. And 156 farmers think that banks do not provide farmers with financing channels with reasonable conditions.

4.5. Assessment of Technological Companies Questionnaire on Agricultural Innovation Potential in İzmir Region

Ten companies have provided feedback to the questionnaires sent to a total of 57 companies within the scope of the questionnaire study carried out to determine the present status of the companies producing agricultural technology. While the results obtained in this section represent a limited sample, they are a guiding light in revealing the present status. Questionnaire results have been presented under the headings “company incorporation and operational structure, business structure, difficulties in carrying on production, R&D structure, cooperation structures, company’s status of benefiting from government supports and general assessment”.

Company Incorporation and Operational Structure

Out of 10 companies participating in the questionnaire, 5 companies are limited liability companies, 4 companies are incorporated companies and 1 company is a personal company. Of these companies, 4 companies operate in R&D, 3 companies in technological equipment production and 3 companies in software. Those companies engaged in R&D activities usually produce multispectral cameras and wireless sensor networks in the area of agricultural production, laboratory equipment for analyses, portable and desktop spectroscopic systems and natural preservers prolonging the shelf life of the products. Those companies producing technological equipment produce greenhouse air-conditioning automation, UAVs and automated steering systems in the area of vegetative production and greenhousing. And those companies engaged in the area of software produce software for livestock breeding, vegetative production and farm management. With such software, herd management, tracking of milk data, SMS information package, issuance of field risk report and agricultural analysis based on satellite imaging are carried out. Out of 10 companies, 6 companies employ people in the range of one to nine.

Business Structure of the Company

It is seen that only one company carries out exports when one reviews the foreign trading structure of the companies. This company exports 25% of its production. Besides, 3 out of 7 companies use imported raw material and intermediate input below 10%, 3 companies at the range of 10%-25% and one company above 50 percent. Further, 6 companies participating in the questionnaire have stated that their products are demanded by farmers, commodity exchanges, greenhouse farmers and dairy enterprises in İzmir.

Basic Difficulties Encountered in the Continuation of Their Production by Companies

Replies given to this question are acceptable as a common reply especially for the first two items of the listing. The first place is occupied by input costs and the second place by difficulties in accessing to government supports in the list of the basic difficulties encountered in the continuation of their production by those companies producing in the area of agricultural technology by the degree of importance thereof. The list continues with insufficient capital stock, lack of qualified workforce and change of consumer profile respectively. Other than this information, emphasis has been also made on the difficulties experienced in accessing to agricultural data and difficulties which farmers experience in the process of adaptation to technology.

R&D Structure of Companies

Out of 10 companies, 8 companies have their own R&D departments and one company further procures external R&D assistance. Half of the companies participating in the questionnaire spare more than 30% of their annual turnover for R&D activities. Out of 10 companies, 6 companies possess at least one patent/utility model. This result is a good indication in that it reveals the importance which the companies place on R&S operations.

Cooperation Structure of Companies

Result of questionnaire show that the companies are open to inter-corporation cooperation to a great extent. Out of 10 companies, 9 companies cooperate with the local actors including, without limitation, universities, TÜBİTAK, KOSGEB, producers' unions and commodity exchanges.

Companies' Status of Benefiting from Government Supports

Out of 10 companies, 7 companies have previously benefited from TÜBİTAK, KOGEB and TAGEM supports. Those companies that have not previously benefited from government supports have stated that they have not benefited from government supports due to bureaucratic difficulties and because they have not needed them. When the companies have been requested to list the government supports which are important for them by their degrees of importance, the first place is occupied by the R&D support, the second place by imported input support, the third place by trade fair support and the last place by information support.

General Evaluation

In the last section of the questionnaire, it is intended to evaluate the technology-producing companies' general views about their present status by using the Likert scale. In this section, the companies have been expected to choose one of the following options: "Strongly Disagree", "Disagree", "Neutral", "Agree" and "Strongly Agree".

According to the replies given to the questionnaire in this context,

- ✓ All companies except one have underlines that the production processes should be integrated to technology.
- ✓ Companies think that they should highly invest in R&D regardless of the contents of their products. Further, 8 companies have

stated that they choose producing technology within their own organisation.

- ✓ Companies usually think that innovation activities enhance the quality of the product.
- ✓ While 5 companies have replied “Disagree”, 2 companies “Agree” and 2 companies “Strongly Agree” to the premise “An innovation is only when it reduces costs”, 1 company has not replied the question.
- ✓ Companies have presented opinion as to the fact that technological innovations are usually costly and that the innovation capacities of the companies may only be improved by government supports.
- ✓ While 6 companies are of opinion that status of agriculture will be better than today within the next 5 years, the other companies have not subscribed to this point of view.
- ✓ While 9 companies definitely believe that they will operate in this sector during the next decade, 1 company has stated that it will go out of the sector.

CONCLUSION AND SUGGESTIONS

With this project, a photograph of Turkey in the Agriculture 4.0 process has been taken. Considering this photograph, existing problems have been identified, suggestions and solutions have been tried to develop for a successful integration to this process.

Findings of the study show that Turkish agriculture has some basic structural problems in terms of its integration to the processes of Industry 4.0 which is qualified as the new industrial revolution.

These problems have been identified under the main headings "unsuitability of the producers' profile for this technological transformation", "costly and difficult use of technology due to small-scale fields", insufficiency of agricultural infrastructure, organisation and cooperation", "underdevelopment of communication and cooperation channels between the actors comprising the ecosystem", "failure of governmental investment in agricultural technologies to meet the existing needs" and solutions have also been developed accordingly.

- ***Producer Profile*:** One of the most important obstacles before the process of adaptation to agricultural technologies is the insufficiency of the qualified workforce in the agricultural sector. High average of age of the workers has an adverse effect on the use of new technologies in agriculture and further speeds up the process of reduction of this efficiency and competitive power. It is particularly understood that those farmers who own small land have a negative viewpoint concerning technology due to the fact that their perception of the necessity of technology has not changed or that innovations are costly. Findings of the questionnaire show that farmers consider the fact that the technology they use is old to be a minor problem in production.

First, it is necessary to change this perception and make the workforce in agriculture more qualified. A great task lies on the part of the government in the establishment of a new generation well-educated farmer profile. It may be ensured to bring up a workforce specialised in this area by establishing Technical Schools of Agriculture, Vocational High Schools and Colleges of Agriculture. It may be only possible to enable the youth and event children to favour agriculture by designing educational modules for the requirements of "seeing, using and rebuilding" the technology. Nevertheless, it may be counted among the other measures which will improve this profile to establish "regional On-Site Educational centres" where the existing farmers' channels of accessing to information are increased, where they are provided with face-to-face education and interviews, where they are taught how to use the agricultural technologies and to interpret data.

Other measures such as encouraging young farmers and making agricultural area attractive, establishing agricultural technology parks or hatcheries to develop agricultural technologies and inciting agro-entrepreneurship may also be brought into being by the government or other organisations. By enhancing the scopes and budgets of the "young farmer training" projects and programmes and government supports which will speed up remigration, the local governments may be ensured to primarily provide these areas with financing and consultancy services.

A great task also lies on the part of the local governments, NGOs, universities and private sector as well as the government in establishing cooperation, informing and training farmers and spreading the use of technology in the integration of the farmers to this process. For instance, with an understanding which will enhance interdisciplinary interaction, universities may both produce and develop their own technologies by bringing together the faculties of agriculture, food, engineering and economics and make use of the fields and centres of the universities as areas of application. Local government-NGO-private sector cooperation is also important in this process.

- ***Lower technological content:*** As known, the new industrial revolution aims at transferring smart systems to agricultural production processes and thus being able to reach healthier and more reliable food at a higher efficiency and lower costs. However, considering it together with both the structure of Turkey's exports and the problems of the farmers to access to technology according to the findings of the questionnaire, it is clear that there are some constraints before the provision of Turkey's automation in production and thus ability to produce products containing higher added value (containing high technology).

At this point, two basic constraints may be mentioned: the first constraint is that the budget allocated to R&D expenses is low. While the percentage allocated to R&D out of GDP was 0,81% in Turkey in 2009, this percentage rose to 0.94% in 2016. Nevertheless, the percentage of the total amount allocated to R&D in GDP is still below 1 percent (TÜİK, 2017). Current data related to the percentages allocated to R&D activities in the world is rather limited. However, OECD presents statistics which serves to reveal the percentage of the R&D expenses allocated to agriculture, forestry and fishery in the total R&D expenses in business enterprises at least for some countries. According to such data, while the Netherlands, which is one of the successful examples in the integration of agricultural technologies to the production processes, allocated 2.8% of its total R&D expenses to the agricultural sector in 2014, Turkey allocated only 0.23% thereof in the same year. This picture shows that the percentage allocated to R&D expenses out of the National Product should be primarily increased in Turkey. Further, considering that the percentage of the agricultural sector in Turkey's total employment and that of the agriculture-based industries in foreign trading is relatively higher at present, the fact that the resource allocated to R&D expenses should be made with a sectoral electivity and that R&D activities for especially agriculture-based industries should be supported accordingly may ensure specialisation and enhance efficiency in this area.

And the second basic constraint is the lack of qualified workforce which is also discussed in the section concerning suggestions concerning producer profile in this chapter. It is clear that there is primarily need for an educational reform compatible with the sectoral specialisation axes in this area.

Table 24 Percentages of R&D Expenses Incurred on Agriculture, Forestry and Fishery in Total R&D Expenses in Commercial Enterprises (%, Fixed 2010 $ and by Purchasing Power Parity)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage of R&D Expenses Allocated to Agriculture, Forestry and Fishery in Business Enterprises in Total R&D Expenses (%)										
UK	0.17	0.13	0.05	0.08	0.07	0.08	0.06	0.07	0.07	
Japan	0.06	0.02	0.03	0.04	0.02	0.02	0.02	0.01	0.02	0.02
Netherlands	1.22	1.35	1.57	2.54	2.02	1.98	2.31	2.81		
Turkey			0.24	0.23	0.27	0.21	0.26	0.23	0.24	
R&D Expenses Allocated to Agriculture, Forestry and Fishery in Business Enterprises, Million $										
UK	40	30	11	19	17	19	14	18	20	
Japan	77	29	27	41	27	17	20	17	19	23
Netherlands	76	78	96	206	165	160	195	243		
Turkey			9	10	13	12	16	17	19	
Total R&D Expenses in Business Enterprises, Billion $										
UK	24	23	23	23	24	24	25	26	28	
Japan	120	119	105	108	112	112	117	123	121	118
Netherlands	6	6	6	8	8	8	8	9		
Turkey			4	4	5	6	6	7	8	

Note: Data about Israel and USA cannot be accessed.
Source: OECDstat

- ***Imported Input Dependence:*** Imported input dependence is also pre-eminent among the most important problems of production in Turkey. Considering the results of the questionnaire and the import and export values of agricultural machinery and equipment together, it is understood that use of imported inputs in agricultural production is high. Considering it together with the unstable position of Turkish lira in the international market, devaluation of Turkish lira directly increases the costs of producers and this has an adverse impact on agricultural production. As a matter of fact, it is seen in the results of questionnaire that the most important risk in the continuity of agricultural production is production costs.

When one generally considers the input-output analysis results covering the 1973-2012 period, the general view of the imported input dependence in Turkey may be put forward. Findings show that the percentage of the agricultural sector in the production and added value has reduced by years.

Agricultural sector became a net importer in 2012; however, it was more dependent on non-agricultural sectors in the 1973-2012 period. Results of the input-output analysis further show that the Turkish agricultural sector is not yet technology-based at sufficient level.

- ***Access to Technology and Financing Problems*****:** The fact that agricultural land is usually small and fragmented both makes the use of technology in agricultural production difficult and increases the costs. The fact that producers do not possess sufficient finance to be able to use smart technologies alone is an important obstacle and has an adverse impact on a farmer's trend for the use of technology. In order to be able to overcome the high cost problem which is one of the most important causes of the failure to popularise the smart agricultural practices, the weak structures of the small-sized family enterprises should be strengthened. Cooperatives and farmers' organisations may be supported and small landowners may be enabled to jointly purchase and use machinery through them. It may be a significant step to bring together farmers with finance resources and other supporting organisations (such as universities, technology companies, energy companies and NGOs) through various channels and to achieve pilot applications in technology-oriented common use.

Another aspect of this matter is investment incentive policies. Findings of questionnaire point out two important results as why farmers think that the existing investment incentive policies fail to encourage production. According to the farmers,

- investment incentive system fails to respond to the requirements of the producers;
- incentives cannot be effectively utilised due to bureaucratic difficulties in access to incentives and possession of insufficient information about the scopes of incentives.

Under these circumstances, it is first necessary to revise the governmental supports to observe the needs of the sector and cover the Agriculture 4.0 practices and to establish the legal framework thereof. Secondly, information flow on the matter should be provided well. It may be one of the steps required to taken on the matter to carry out studies for the mitigation of bureaucracy and establishment of easily accessible regional information centres to which farmers can communicate their problems more easily. Moreover, it is important to bring the supports needed by farmers up for discussion with the participation of all stakeholders. At the stage of the identification of needs, it may be the first step of developing a regional and national policy to hold meetings with large attendance in order to learn the needs of the locals on location/on site.

- ***Insufficiency of cooperation channels between actors:*** Findings of the questionnaire study and stakeholders of the agricultural production ecosystem participating in the intermediate workshop underline that they agree to the fact that the cooperation between the elements of the Agriculture 4.0 ecosystem is weak. Therefore, the very first requirement of good governance in the agricultural sector consists the pluralism-based cooperations networks taking into consideration/including into the process all regional and national actors such as producers, universities, non-governmental organisations, finance and technology providers.

It is quite important to make long-term and sustainable progress by making use of cooperation and scale economies as in the USA and some EU countries that are taken as successful application examples of agricultural technologies in this study. Studies should be carried out so that intermediaries causing agricultural input prices to increase will leave its place to local organisations such as cooperatives. Therefore, it may be an important step to re-design the legal regulations related to local organisations on the basis of facilitation.

Figure 8 Local Elements of Agriculture 4.0 Ecosystem

Solutions and suggestions put forward within the scope of the study reveal that harmonisation of agricultural production with technological developments is a subject which should be handled within an ecosystem covering such actors as producers, consumers, government, local governments, NGOs, universities, technology providing companies and finance providers. It becomes apparent that the government's leading role in the policies to be determined with this understanding is so important, but that other actors should support such policies with a strong cooperation in the ecosystem established recently.

We believe that the accomplishment of pilot applications especially in the İzmir region and assessment of the outcomes thereof in accordance with the problems and solution suggestions put forward by the project will constitute important data in the integration of the agricultural sector to this process in Turkey. Therefore, it gains importance that smart agriculture technologies will put into practice for selected products in pilot regions and provide the sustainability thereof within the general framework as put forward by our project in an interdisciplinary concept and with the participation of all actors of the ecosystem in the subsequent period.

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