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CLIMATE RESISTANT AGRICULTURAL PRACTICES AND CONSERVATION OF NATURE

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Abstract
The agricultural sector in Turkey is one of the most climatically affected sectors. The results showed that agricultural productivity was directly affected by changes in temperature and precipitation rate and duration. On the other hand, the agricultural sector is one of the primary and crucial sectors for Turkish economy, human nutrition and livestock feed. Therefore, the capacity and ability of the agricultural sector for climate-resistance is of great importance for sustainability of food production, natural resource usage and ecosystem maintains. Agricultural production is being decreasing in various rates due to extreme weather events such as drought, flood, hail, frost, etc. that have increased in number and severity in recent years. It is necessary to quickly determine the measures that can be taken against these adverse events that cause yield and productivity losses. In line with these purposes, this review will focus on agricultural practices that can alleviate adverse climate effects on crop plants and strategies that can protect the crops from adverse climatic conditions by emphasizing on the importance of these environmentally friendly practices.

Keywords: Organic Farming, Alternative Production System, Climate Change, Nature Protection.

1. INTRODUCTION

The development of climate-based agricultural production systems is very important to reduce the effects of climate change on agricultural production. Another important issue about climate change is to increase the number of producers adopting agricultural practices that can minimize the negative effects of climate change. Despite the importance of the climate change, it is very important to develop new projects and reach the target farmer groups. In this context, a project called “Climate Resistant Agricultural Network Project” was put forward and supported by the European Union Delegation to Turkey. The Nature Conservation Center Foundation (DKM), Agricultural and Food Ethics Association (TARGET) and Konya Leader Farmers Association (KOCD) took part in the project as local stakeholders, and civil society, public and private sector organizations, universities, farmers, working in the field of adaptation to climate change in agriculture. An exemplary study was conducted in which unions and local government representatives came together. Farmer awareness about the negative effects of climate change should be increased by making these and similar projects.

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Another issue that is as important as developing agricultural practices on climate change is to adopt climate change practices to farmers who will reflect them on production and to find solutions by reducing the negative effects of global climate change.

Even if all the activities that cause greenhouse gas emissions in the world today are stopped, climate change will continue to show its effects for many years. This determination has become clear in the scientific community. This situation, which has caused and will continue to cause changes in all components of the climate system, clearly shows the importance of adapting to the effects. It is now inevitable that the temperatures expected to increase as a result of climate change, will affect natural processes, ecosystems and life, negatively affecting life, especially agricultural production, on Earth (Karaer and Gürlük, 2011; Bennett, 2017).

It is predicted that increasing temperatures will cause sudden precipitation in some regions, frequent floodings, or decrease in precipitation in other regions or change the precipitation patterns. In both cases, there will be changes in agricultural areas and farmers, the water problem will grow, the trade balances will change, and this will affect all economies. Increasing extreme meteorological events such as storms and hurricanes, drinking water problem, altered ecosystem and sea water level increases will accelerate migration and bring the fair sharing of natural resources to the agenda again. It is already seen that many city infrastructures are inadequate as a result of meteorological and hydrological events caused by climate change (Akalin, 2015).

Adaptation studies have started to gain importance day by day all over the world in efforts to prevent climate change. It can be said that with the Paris Agreement, adaptation policies have become equivalent to emission reduction policies. In the new global climate regime, the place of the adaptation policies that should be implemented in addition to the greenhouse gas emission reduction targets of the states has become quite evident. Adapting to the effects of climate change is also a social problem that closely concerns all individuals and communities with its political, economic, commercial, social, vital, sociological and cultural effects. Adaptation to climate change; it can be explained as the process of strengthening and implementing strategies and policies in this area in order to prevent and manage the effects of climate change. Adapting to the changing climate means both reducing the negative effects of climate change and turning these effects into opportunities when necessary (Parlakay et al., 2016).

Turkey's "National Intended Contribution Statement (INDC) document does not include the "National Climate Change Adaptation Strategy and Action Plan" among the existing strategies that support the national climate change policy, fuel saving through land consolidation in rural areas, improvement of pastures, controlling the use of artificial fertilizers and supporting minimum tillage methods. In terms of international responsibilities, Turkey continues to fulfill its international commitments to less impact the nature as a party to the United Nations Framework Convention on Climate Change (2004) and the Kyoto Protocol (2009) and the Paris Agreement (2016).

2. EFFECT OF CLIMATE CHANGE ON AGRICULTURE SECTOR

In addition to being the source of climate change, the agricultural sector is also one of the sectors most affected by climate change. The effects of climate change on agricultural activities have a special importance due to the relationship between production and nutrition. In general, all agricultural crops need soil, water, sunlight and temperature to grow. Climate is a dynamic component that affects all of the listed components. For this reason, the risk it creates for the agricultural sector is at a very high level due to the unknown constituents. In line with the predictions made for the future, the change of all meteorological parameters, including both the

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global average temperature and precipitation, has begun to affect the type and place of agricultural production in the world from today (Anonymous, 2021).

2.1. Effects of Climate Change on Agriculture

Deterioration of water and soil quality
Degradation of the ecosystem and reduction of biodiversity
Ecological shifts
Decrease in agricultural production and quality
Increase in pests and diseases
Fertilization and pesticide spraying problems
Sustainable food security issues

2.2. Effects of Climate Change on Agricultural Businesses

Sowing and transplanting problems
Harvest-threshing problems
Tillage problems
Fertilization problems
Spraying problems
Cultural problems (hoeing, pruning etc.)
Yield problems
Quality problems
Problems in the supply of water/irrigation water
Plant diversity problems
Plant growth increase due to increased CO_2 concentrations

With the Industrial Revolution, better quality and productive agriculture is being achieved day by day. It seems that the agricultural industry will become more important than ever in the next few decades and the place of technological developments is inevitable in the agricultural sector. Advanced technology and smart agriculture systems that have already been implemented in some developed countries are being adopted. Technology has been more and more importend in the agricultural sector with each passing day and becomes an integrated part of the sector. With the support of progressive technologies in agriculture that increase productivity, profit, quality, climate-friendly smart farming practices have become increasingly widespread in the world (Pakdemirli et al. 2021).
Thanks to high-tech agricultural techniques and technologies, farmers/producers can access data from changing variables such as soil acidity and temperature, as well as the topography and resources in their regions, future weather conditions and climate forecasts, control natural elements such as humidity, temperature with digital sensors, and water and electricity to get the opportunity to prevent unnecessary use of resources. Thus, R&D and software development studies gained importance. The interaction of climate change and agriculture is no longer a reality that cannot be ignored. In addition to the decisions to be taken and the regulations and changes to be made, multi-disciplinary R&D studies to be developed also gain great importance. Climate Smart Agriculture approach and the role of the UN, the projects implemented in Central Asian and African countries continue to work on harmony, capacity building and awareness in agriculture. It is predicted that the changes in the climate as a result of global warming will be a technology sector in agriculture in the

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future and the countries that have these technologies will be able to direct agriculture (Pakdemirli et al. 2021; USDA, 2023).

The agricultural system known as the Green Revolution or the Food Revolution, which is defined as the rise of industrial agriculture from the middle of the 20th century to the present, has created the production form of hybrid varieties and genetically modified plants that increase the yield in plant production. In this process, which is supported by global food companies, it has found a more intense application area in developing countries. On the positive side, this trend, which saved millions of people from hunger, helped to develop productive cereal species, improved irrigation opportunities, modernized conservation techniques, and facilitated the provision of inputs such as hybrid seeds, GMO seeds, artificial fertilizers, herbicides and pesticides to farmers (Külcü, 2021).

It is predicted that the changes in the climate as a result of global warming will be a technology sector in the future and the countries that have this technology can lead agriculture. Policies regarding Industry 4.0, smart agriculture technologies and innovative approaches (use of renewable energy resources in agriculture, etc.) should be produced, and these policies should be rapidly integrated and expanded into agriculture and food safety practices within the scope of adaptation to climate change.

In Turkey, agricultural water use and drought are among the leading problems in mainstreaming the adaptation of climate change to national agricultural policies. One of the important steps to gain/increase the allocation of water resources and the efficiency of use as an economic value is to adapt to the effects of climate change. Considering that 75% of the total water assets in Turkey are used for irrigation in agriculture and a significant part of the water is lost on the way as a result of uncontrolled surface irrigation at the rate of 88.5% in agriculture, it is clearly seen that the rational management of the agricultural sector and water resources is at the top of the agenda for adaptation to climate change (Raza et al. 2012; Wang, 2019). In terms of the vulnerability of the sector, the water crisis triggered by climate change is known as the most important threat. For this reason, most of the studies carried out in Turkey within the scope of the adaptation of the agricultural sector to the effects of climate change are related to the protection of water resources, the support and dissemination of modern irrigation techniques for water saving purposes, the establishment of flood early warning systems and the development of drought-resistant species.

2.3. Priority Issues in Adaptation of the Agriculture Sector to Climate Change

The effect of climate change on productivity, hydrological balances, input resources and a number of other agricultural system components in agricultural production is still felt today and its future effects are tried to be estimated with the help of models. According to the results of the models, a series of practices are carried out in the world for food safety, such as the protection of agricultural biodiversity, prevention of land degradation, reduction of carbon emissions, and sustainable management of the soil (Zaimoğlu, 2019).

In an assessment made by the World Bank on Turkey's green growth policies in 2013, it was predicted that nature protection policies handled in the ongoing structural change in the agricultural sector could create "climate-smart triple wins". This triple win; i) reduction through carbon sequestration, ii) better climate resilience, and iii) higher competitiveness and employment (Anonymous, 2013).

Since agricultural activities depend on nature and meteorological conditions, the agricultural sector is one of the most sensitive and directly affected sectors in Turkey against climate change. Agricultural sector is a sector that provides raw materials to affiliated industries and creates

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employment as well as food supply. For this reason, the effects of climate change on agriculture can have important social and economic consequences. While the prevention of climate change comes to the fore in terms of the use of agricultural lands, which are the production areas, the regulation of agricultural activities and the measures and opportunities to be taken against risks gain importance in terms of adaptation to the effects of climate change (Anonymous, 2021).

It would be beneficial to consider the following issues for adaptation action to climate change in the agricultural sector in Turkey:

2.3.1. The importance of soil organic carbon - Soil organic carbon is an extremely important and effective indicator in terms of balancing land degradation, sustainable use of the country's land and reducing and/or eliminating the negative effects of climate change. Identifying and mapping the types of land use where soil organic carbon stocks are low, sufficient or high at the national scale is also necessary for the development of national land use policies. In the context of determining the existing organic carbon stocks of Turkish soils, it is available in the Carbon Budget Map of Turkish Soils, which is produced by TAGEM using the organic carbon values of agricultural soils and is currently put into service and use by FAO (Tolunay & Çömez, 2008; Anonymous, 2017; Anonymous, 2018a; Topcu et al. 2022).

Prolonged dry periods and unpredictable climatic conditions can lead to short-term managing strategies such as deforestation and overgrazing. Improper agricultural practices and overgrazing reduce soil and air organic carbon, leading to a reduction in soil carbon. This decline in organic matter leaves the land even more vulnerable to desiccation and erosion caused by heavy rainfall, which becomes more common as the climate changes. It also adversely affects various physical, chemical and biological soil properties that affect land fertility, biodiversity and ecological function. Changes in soil cover can also cause changes in local climatic conditions due to different surface reflectivity and water transpiration (Tolunay & Çömez, 2008; Anonymous, 2021).

2.3.2. The importance of pasturelands - Since pastures are hot spots of the country in terms of organic carbon sequestration, food security and protection from erosion, improvement efforts in these areas need to be expanded (Tolunay and Akça, 2018).

2.3.3. Adaptation and reduction synergy in energy production from agricultural waste - Today, agricultural wastes (vegetable wastes + animal wastes) can be converted into solid, liquid and gaseous fuels with different technologies and appropriate processes. There are millions of biogas plants in the world that produce energy from agricultural wastes with traditional or modern technologies. Studies show that the largest share in global renewable energy consumption belongs to biomass with 73%. Approximately 1 billion kWh of electricity is produced annually from 265 biomass plants based on agricultural wastes in the USA. These figures also show the raw material value of agricultural waste, which is an important source of biomass (Anonymous, 2018b). Liquid biofuels (bioethanol, biodiesel) that directly use vegetable raw materials in their production are also used in Turkey. İzmir, Adana, İstanbul and Kocaeli are the provinces with the highest number of facilities. Although hazelnut and corn stalks are burned in ovens and homes, there are also modern facilities where rice hulls, animal wastes, sunflower stalks, olive residues and sunflower stalks are used (Fidan & Alkan, 2015).

Another remarkable opportunity is the production of biogas, which is one of the important steps in getting rid of the wastes that damage the soil by burning stubble. Since the residue left as a result of fermentation is a valuable and ready-to-use organic fertilizer, the reuse of this fertilizer, which is obtained as a waste as a result of the process, in agriculture is also important in terms of agricultural sustainability and climate-smart agriculture practices (Şenol & Açikel, 2019).

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2.3.4. The link between stubble burning and climate change adaptation - In the agricultural sector in Turkey, burning stubble is one of the most ecologically unsuitable agricultural practices. In terms of soil tillage practice for the second crop for better seedbed preparation, weeds, pests, etc. is an extremely wrong and scientifically unaccepted method, mainly in terms of modern agricultural techniques, as well as in terms of ensuring the adaptation of the agricultural sector to changing climatic conditions. The most basic damage caused by burning stubble is the destruction of organic matter in the soil, and it is often not possible to compensate for this loss. The organic matter in the soil not only provides the source of some of the plant nutrients needed for the development, but also ensures the absorption and retention of precipitation waters in the soil, and prevents its transport by erosion by ensuring aggregation in the soil. With the burning of stubble, microorganisms on the soil surface die, the biological quality of the upper part of the soil is deteriorated, the moisture of the soil cannot be preserved, agricultural biodiversity is damaged, and the loss of soil organic carbon and nitrogen, which promotes plant growth, increases. In addition, stubble fires cause air pollution and forest fires (Rodriguez et al. 2004; Ashbudak, 2008; Bootle et al. 2010; Bulut & Çağlar, 2022).

2.3.5. Industrial agriculture and adaptation to climate change - While industrial agriculture continues to grow rapidly in the field of grain production, animal husbandry and fisheries, it is debated whether this process really increases agricultural production (many health problems due to nutrition, commodification of food and non-nutritional use, especially bio-fuels). From the perspective of nature conservation and combating climate change, these artificial inputs in agriculture in the focus of these discussions have caused ecological problems on their own and started to cause serious costs for both the producer and the nature. Thus, in the uniform predictability of industrial modern agriculture, these problems, which were unpredictable at the beginning, brought along new threats created by industrial agriculture and compatible with its scale (Kaçmaz, 2021).

2.3.6. Regenerative agriculture and adaptation to climate change - Soil degradation is both a cause and a consequence of climate change. While the increased carbon released into the atmosphere causes the destruction of the soil and the loss of biodiversity, on the other hand, intensive agricultural production increases greenhouse gas emissions as it is known. Since the soil is also an important and safe sink area for carbon, it is known that the carbon retained by the soil is lost as a result of intensive agricultural activities and mistakes in soil management. This situation is one of the important risks for Turkey (Topçu et al. 2022).

Within the framework of the studies of the Ministry of Agriculture and Forestry, General Directorate of Combating Desertification, it is stated that the soil lands in Turkey are faced with the risk of erosion and desertification intensively in the Inner, Eastern and Southeastern Regions. Mismanagement of soil and terrestrial ecosystems in Turkey raises the problems of soil impoverishment, loss of water retention, loss of biodiversity, desertification and increasingly starvation. New techniques such as regenerative agriculture that integrates soil and agriculture in the fight against climate change have started to be on the agenda in Turkey (Anonymous, 2018a).

The following points stand out in regenerative agriculture for soil management;

a) Soil analysis,
b) Control of mineral fertilizer applications,
c) Increasing the soil carbon sequestration capacity with compost applications,
d) Reproduction of no-till agricultural practices,
e) Reuse of agricultural wastes with high carbon content in the soil.

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2.3.7. Ensuring climate change in agriculture with resistant seeds - It is seen that the long-abandoned nature-friendly production traditions in Turkey are starting to revive to control climate change in the countryside. The crop seeds commonly used in agricultural production in Turkey are hybrid seeds. Hybrid seeds are preferred or have to be preferred in terms of market demands and high crop yield obtained at the first planting, with the effect of policies and legal and institutional regulations in this field. Due to the production efficiency of the traditional varieties, which are named according to their region and/or shape as part of the Turkish traditions coming from history, few of them reach big markets and disappear within the system, they are no longer used and preferred (Raza et al. 2019; Tucker, 2019).

Due to the effects of climate change, it is necessary to use, develop and increase the diversity of seeds that are resistant to prolonged drought, salinity in the soil or sudden and heavy rains. For this reason, seeds, agricultural techniques, ways of storing and protecting crop products, etc. are transferred from generation to generation. It has become increasingly important to reach memory about local/hereditary seed, which is generally planted by small producers and sold in local has a vital importance in the protection of agricultural gene resources and food security with its adaptation to changing climatic conditions and soil, low water requirement, providing seeds for the next planting year markets in Turkey (Arslan, 2010). Considering the increasing interest in organic agricultural products and native grain types used in bakery products, efforts to develop, protect and expand especially drought-resistant local grain varieties should be supported.

2.3.8. Conservation of Soil and Water Resources - When we look at the laws related to agriculture in Turkey, the first Agriculture Law, Soil Conservation and Land Use Law, Pasture Law, Organic Agriculture Law provide a basis for issues such as the protection of soil and water resources. Climate change is directly referred to in the provision that stipulates taking necessary measures in cooperation with relevant public institutions and organizations, non-governmental organizations in areas exposed to desertification due to various reasons, including climate change and human activities in arid, semi-arid and low-precipitated areas Kocaman & Talu, 2019).

In addition, it is necessary to carry out researches in order to protect and develop soil and water resources and to benefit from these resources in a sustainable way, to determine the problems such as desertification and drought that occur with the effect of climate change at the country and regional scale, and to carry out prospective control and protection for the measures to be taken. Similarly, various projects should be carried out in order to protect soil and water resources from water and wind erosion by determining economical, applicable and acceptable soil conservation methods and to reveal the most appropriate wind erosion prevention methods that will ensure the sustainability of areas under desertification risk.

For the Protection of Soil and Water Resources,

- ✓ Developing methods to maintain soil moisture in order to reduce the risk of agricultural production in arid regions,
- ✓ Developing appropriate methods and technology for the effective use of water in agriculture
- ✓ Various projects and activities should be carried out in order to identify possible changes that climate change will cause on crop production and to develop appropriate adaptation suggestions.
- ✓ Suitable areas for the cultivation of important crops should be re-evaluated according to current climatic conditions.
- ✓ According to future climate projections, activities and crops should be made in line with the determination of suitabil production areas.

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However, in order to achieve these goals in a safe way, it should be known that studies such as climate projections will be needed in order to make and use current and long-term climate assessments on a national and regional scale.

2.3.9. Motivating the use of local and local knowledge in the agricultural sector - Local communities, cooperatives and non-governmental organizations working in this field, which produce according to agro-ecology principles or try to protect supply chains in consumption processes, especially in the agriculture and food sector in Turkey, support adaptation to the effects of climate change.

2.3.10. Climate change adaptation projects of the agricultural sector with cooperative models - When the activities of cooperatives in Turkey related to adaptation to climate change are evaluated, first of all, organizations in the agricultural sector and agricultural development cooperatives can be addressed, questioning the traditional business models of these structures and evaluating their potential in the context of social development and climate may/should come to the fore.

3. CONCLUSIONS

Increased use of pesticides and other synthetic chemicals due to climate change causes serious reductions in farmers income. In traditional agriculture, where more chemicals are used, beneficial insects, microorganisms, water, air, other living things and people are adversely affected. Chemical applications that reduce the capacity to adapt to climate change trigger the thoughts of farmers that if they use more, they will get rid of pests quickly and get more yield. In order to enable local communities to access healthy food and support small local farmers, local food communities operating in some regions aim to grow crops with traditional seeds and natural organic (without using pesticides) methods.

As a result, what needs to be done at the point of Adaptation to Climate Change in the Agriculture Sector;

- ✓ A climate-friendly agricultural support model will be established.
- ✓ Develop crop cultivation strategies in case of drought.
- ✓ To make Land Use Planning to include the ecosystem-oriented food production model.
- ✓ Agriculture Environmental interaction should be taken into account (rain harvesting, establishing a wind screen, organic farming, erosion control)
- ✓ To promote Climate Friendly Agriculture, Conservative Agriculture or Ecosystem Based Agricultural Practices.
- ✓ Establis irrigation systems that will use more water efficiently.
- ✓ To expand the cultivation of crops that use less water and to develop more drought resistand crops.
- ✓ To find solutions to reduce greenhouse gas emissions in the agricultural sector.

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