Open Peer Review on Qeios

Sustainable Agriculture and Climate Resilience in Türkiye: A Comprehensive Analysis

Mehmet Gökhan Özdemir[1]

1 Kirikkale University

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

Green agriculture, focusing on ecologically responsible and sustainable methods, is essential to ensure food security while mitigating the negative ecological impacts. The Food and Agriculture Organization (FAO) defines green and climate-resilient agriculture as practices enhancing productivity in a sustainable manner, increasing resilience, reducing greenhouse gas emissions, and ensuring higher incomes for small-scale producers. This paper explores the concept of "Green Solutions" in agriculture, emphasizing environmental sustainability and the preservation of biodiversity, while addressing food security and population growth.

Sustainable agriculture is a cornerstone in this pursuit, conserving natural resources and fulfilling the needs of current and future generations. It employs techniques that mimic nature to maintain soil fertility, prevent water pollution, and safeguard biodiversity. Sustainable agriculture practices include polyculture, soil-conserving tillage, natural pest control, natural fertilization, efficient water management, and the preservation of agricultural biodiversity. Moreover, it seeks to ensure the economic sustainability of farmers.

In Türkiye, climate change has significantly affected agriculture, leading to challenges such as drought, flooding, erosion, soil salinization, and plant diseases. Sustainable agriculture plays a pivotal role in addressing these challenges. The environmental policies of Türkiye are also discussed in depth in this study. These policies are carefully adjusted to comply with international decisions, legal guidelines, and plans for economic development. To ensure that environmental preservation and economic growth may coexist peacefully in the Turkish agricultural sector, it is crucial to evaluate the economic implications and sustainability of these policies.

This study's main objective is to evaluate how well sustainable agricultural methods may be used to lessen the effects of climate change on Turkish agriculture. It aims to examine the interactions between Türkiye's environmental policies and economic development plans while taking into consideration important economic indicators and worldwide choices and legal laws.

This study uses a thorough research methodology that combines economic modeling, policy analysis, and literature reviews. It studies the results of sustainable agricultural practices, assesses Türkiye's environmental regulations, and evaluates the impact of economic indicators on the climatic resilience of the agricultural sector.

According to the study, sustainable agricultural methods like polyculture, soil-conserving tillage, and effective water management greatly help Turkish agriculture reduce the effects of climate change. Türkiye's ecologically responsible measures, when in accordance with the law, show a favorable effect on environmental preservation and economic growth. Economic data also reveal how economically viable various ideas are.

The study is anticipated to conclude that climate resilience in the Turkish agricultural sector can be greatly increased through sustainable agriculture, which is supported by policies and economic indicators that are ecologically conscious. This study offers insights and suggestions for a more sustainable agricultural landscape in Türkiye, contributing to the continuing discussion on the cohabitation of environmental preservation and economic development.

Mehmet Gökhan ÖZDEMİR

Research Assistant & PhD candidate, Kırıkkale University, Faculty of Economics and Business Administration, Economics Dep., Major in Economic Theory.

Email: mgozdemirera@kku.edu.tr, ORCID iD: (0000-0002-6756-7285)

Keywords: Sustainable agriculture, Climate resilience, Türkiye (Türkiye), Green agriculture, Environmental policies, Economic indicators.

Introduction

The term "green agriculture," which can also apply to organic farming or sustainable farming, refers to an agricultural paradigm that is firmly based in ecological responsibility and conservation. Principles including environmental sustainability, the preservation of biodiversity, and the responsible use of natural resources are given top priority in this approach to agriculture. Self-sufficiency, localism, rejection of synthetic chemicals, and support for rural agriculture and culture are some of its defining basic characteristics. Green agriculture also makes the most of the proximity between production and consumption nodes, reducing the cost of transportation and the accompanying carbon emissions produced during the logistics process.

The Organization for Economic Co-operation and Development (OECD) claims that issues like pollution, biodiversity loss, soil degradation, nutrient loss, erosion, water scarcity, salinity, the high carbon footprint of industrial agriculture, and the depletion of natural resources, including groundwater, are all obstacles to green and sustainable agriculture.

It is possible to overcome these obstacles by employing green agricultural practices, giving access to nutrient-dense food while also addressing the pressing climate problem. It is significant to remember that many people living below the poverty line, the agricultural sector is their main source of income. There is a potential route for boosting the well-being of these economically underprivileged populations through the prevention of monopolization and the development of localized alternatives.

Green agricultural techniques can be governed by several principles, proving that it is possible to produce and consume food while still respecting the limits of the earth. These principles include the use of environmentally friendly farming techniques, the reduction of reliance on chemical or non-renewable inputs, the improvement of farmers' productivity through investments in human capital instead of material resources, the development of a collective awareness of production processes, and the utilization of natural resources for production while simultaneously protecting the

ecosystem.

Small changes in energy prices have a direct impact on food prices because modern agriculture technology is so dependent on energy. Taking this into account, it becomes clear that the poor's ability to access food is in jeopardy. Producer costs will be lower as a result, and consumers will gain benefits including food security and inexpensive access to wholesome food. Additionally, the agriculture sector's significant carbon emissions will be reduced by the energy revolution in production.

The ability of agriculture to feed the predicted 9 billion people on the planet by 2050 depends critically on the development of sustainable agricultural systems. Future food and agricultural systems must successfully address urgent sustainability issues that have a negative impact on both food production and the environment. Increased land demand, sustainable synthetic nitrogen use, a dwindling soil carbon pool, and biodiversity loss are some of these issues. The various methods for enhancing the environmental sustainability of agricultural systems around the world are highlighted in this collection of research topics (Hoshide et al., 2023).

Following the energy sector (including transportation), agriculture is the second-largest contributor to global greenhouse gas emissions (*Climate Change Data | Climate Watch*, n.d.). Although stronger on paper, Turkey's amended NDC, which was filed in April 2023, will still result in higher emissions and is incompatible with the Paris Agreement's 1.5°C warming objective. The NDC update for Turkey may already be accomplished with the country's current policies, which result in a sizable increase in emissions, showing that they will also not lead to real-world emission reductions. If the Turkish government is serious about its pledge to achieving net zero carbon emissions by 2053, it will need to design a coal phase-out strategy for the electricity industry, which studies have indicated is doable by 2030. The Climate Action Tracker assessment for Turkey is still "Critically insufficient" on all counts (*Country Summary: Türkiye*, n.d.).

The crops, hedgerows, and trees found on farmland capture carbon from the atmosphere through photosynthesis, and correctly managed soils provide carbon storage, so agriculture has a positive and significant role to play in mitigating climate change. Particularly, two kinds of greenhouse gases are connected to agricultural practices (European Union, 2023):

Nitrous oxide (N_2O) comes from agricultural soils with organic and mineral nitrogen fertilization as well as manure management. Methane (CH_4) is produced during the digestion of cattle, during the management of manure, and during the growing of rice.

A GHG with a significant potential for global warming is nitrous oxide. N_2O emissions made up about 7.7% of Turkey's total GHG emissions in 2020, excluding Land Use, Land-Use Change, and Forestry (LULUCF). N_2O gas is emitted as a result of manure management, agricultural soils, and field burning of agricultural waste. The sector of agriculture generated 109.03 kt N_2O emissions (32.5 Mt CO_2 eq.), or 44.4% of all agricultural emissions, 80.3% of all N_2O emissions in Turkey (excluding LULUCF), and 5.6% of all emissions in Turkey in 2020. From 20 480 kt CO_2eq. in 1990 to 32 491 kt CO2 eq. in 2020, N_2O emissions increased by 12 011 kt CO_2 eq. (58.6%). Agricultural soils are the primary source of N 2 O emissions, accounting for 84.5% and 84.3%, respectively, of all agricultural N_2O emissions in 1990 and 2020. Agricultural soils were the largest source of N_2O emissions in 1990, 15.1% in 2020, and 15.6% in 2020. Field burning of agricultural wastes was 0.4% in 1990 and 0.1% in 2020. While increases in N_2O emissions in agricultural soils by 10 075 kt CO_2 eq. are to blame for up to 84% of the rise in nitrous oxide emissions, manure management is in charge of the remaining 16.5% increase with 1 977 kt CO_2 eq. of N_2O emissions. Between 1990 and 2020, the N_2O emissions from field burning of agricultural residues decreased by 50.1% (0.3% of agricultural N_2O emissions by a quantity of 41 kt CO_2 eq.) Between 1990 and 2020, the agriculture sector's emissions increased by a total of 27 102 kt CO_2 eq, or a net 12 011 kt CO_2 eq increase. This growth accounted for 44.3% of the total increase in emissions (*Turkey. 2022 National Inventory Report (NIR) | UNFCCC*, n.d.).

Methane emissions are produced via enteric fermentation, manure management, rice farming, and field burning of agricultural waste. Turkish agriculture sector generated 1560.3 kt CH_4 emissions (39 Mt CO_2 equivalent), which is equal to 53.3% of all agricultural emissions, 61% of all CH_4 emissions in Turkey (excluding LULUCF), or 7.4% of all emissions in Turkey in 2020. From 1990 levels of 25 114 kt CO_2 eq to 39 007 kt CO_2 eq in 2020, CH_4 emissions have increased by 13 893 kt CO_2 eq (55.3%). This rise is mostly the result of higher CH_4 emissions from enteric fermentation, which increased by 12 218 kt CO_2 eq., manure management, which increased by 1 647 kt CO_2 eq., and rice cultivation, which increased by 161 kt CO_2 eq. Between 1990 and 2020, the agriculture sector's emissions increased by a total of 27 102 kt CO_2 eq., or 51.3%. The total rise could reach 13 893 kt CO_2 eq. All CH_4 emissions from the agriculture sector account for 89.2% of emissions in 1990 and 88.7% of emissions in 2020. Manure management came in second with 9.4% in 1990 and 10.3% in 2020, after enteric fermentation. As a percentage of all CH_4 emissions from the agriculture sector, field burning of agricultural leftovers decreased from 1.1% in 1990 to 0.3% in 2020. In 1990 and 2020, rice agriculture contributed 0.4% and 0.7% of CH_4 emissions, respectively (*Turkey. 2022 National Inventory Report (NIR) | UNFCCC*, n.d.).

Food security for vulnerable populations, particularly those in areas severely hit by climate change, might be put at risk due to rising food prices brought on by reduced agricultural yields. According to the Intergovernmental Panel on Climate Change (IPCC), if emissions are not reduced until 2080 (RCP 6.0), the price of grain might increase by up to 29% by 2050 as a result of climate change. This would have a substantial impact on the price of food globally (*Global Crop Monitoring*, n.d.).

Agricultural Targets of Türkiye's National Climate Change Adaptation Strategy and Action Plan 2011-2023

According to Türkiye's First National Communication on Climate Change, which was prepared in 2007, the text underlines the effects of climate change in Türkiye. Among these effects are (Çevre ve Şehircilik Bakanlığı, 2012):

- Türkiye is witnessing rising summer temperatures, which may have a variety of repercussions on ecosystems, agriculture, and water supplies.
- Winter Precipitation Declining: Western provinces of Türkiye are experiencing less winter precipitation. Water availability may suffer because of this decline, particularly in areas where winter precipitation makes a large contribution to water supplies.
- Loss of Surface Water: Surface water is being lost because of climate change, which has consequences for industrial use, home water supply, and agriculture.
- Increased Frequency of Droughts: Türkiye is concerned about the increased frequency of droughts since it affects agricultural output and the availability of water for diverse applications.
- The quality and productivity of the soil can be impacted by land degradation, which can be made worse by climate change.
- Floods and Coastal Erosion: Coastal communities and places are at risk from floods and coastal erosion because of climate change.

It is anticipated that these climate change impacts will have a severe influence on soil and water resources, which are crucial for ensuring the security and production of food. Additionally, a progressive worsening of the situation with potentially grave repercussions is anticipated. For instance, it is predicted that by the end of the century, 50% of the surface waters in the Gediz and Greater Menderes Basins may be gone, resulting in a water shortage for domestic and industrial usage as well as for agriculture. However, the text also notes that, if correctly planned and managed, there might also be opportunities due to climate change in Türkiye. Regarding the strains on natural resources, notably water supplies, and how this can affect various industries dependent on the climate, it emphasizes the significance of tackling climate change. Türkiye is starting to see the effects of climate change, such as dwindling water supplies, forest fires, drought, desertification, and

ecological deterioration. These findings are also supported by climate predictions made as part of the UN Joint Program on Enhancing Türkiye's Capacity to Adapt to Climate Change, which point to observable temperature increases and modifications in precipitation patterns that may have an impact on a variety of economic sectors, habitations, and the dangers of climatically related natural disasters. To sum up, Türkiye is currently dealing with a variety of climate change-related effects that have an influence on its natural resources, water accessibility, agriculture, and the resilience of many sectors. To reduce the negative consequences of climate change and take advantage of any potential benefits it may present, planning and adaption techniques are crucial.

The effects of climate change on Türkiye's agriculture industry and food security are a serious concern. The assertions in the presented report show numerous significant problems with this subject (Çevre ve Şehircilik Bakanlığı, 2012):

- Changes in the Water Cycle and Temperatures: The temperature and water cycle are changing because of climate change. The time and availability of water for agricultural irrigation may be impacted by these changes, which may influence crop growth and overall agricultural production.
- Seasonal Changes: Seasonal variations can mess up crop planting and harvesting schedules, lowering yields. Planning activities might be difficult for farmers due to unpredictable weather patterns.
- Agricultural Pests: Variations in temperature and precipitation patterns may cause the range of agricultural pests to spread. These pests are becoming more common, which could lead to lower crop yields and food production.
- Water scarcity: Agriculture may be badly impacted by declining water supplies and poorer water quality, particularly in areas where irrigation is widely used. Water scarcity can have an impact on crop health and lower agricultural output.
- Loss of Biodiversity and Ecosystem Services: Ecosystems and biodiversity may be harmed by climate change. The resilience and sustainability of agriculture in the face of shifting environmental conditions may be impacted by the loss of these services.
- Farmers may find it difficult to change their agricultural operations and select more resilient crop varieties in response to the changing climate conditions. Food production and agricultural harvests may suffer as a result.
- Food Security: As the primary source of food for Türkiye's population, the agriculture industry is crucial to the country's ability to maintain food security. Food security is at danger if there is a decline in agricultural productivity and yield as a result of climate change.
- Challenges with Water Resources: By the end of the century, there will be a 50% decline in surface waters, which may cause serious water shortages in some parts of Türkiye, such as the Gediz and Greater Menderes Basins. Agriculture, as well as communities and industries that depend on water resources, may be directly impacted by this.
- Long-term Impacts: Given that these issues are long-term in nature, it is urgent to take steps to reduce their effects and prepare the agricultural industry for climate change.

Türkiye is aggressively attempting to safeguard sensitive coastal regions, manage water resources, and modify agricultural techniques in response to the changing climate considering these difficulties. This entails initiatives to enhance water management, advance sustainable farming methods, and aid farmers in adjusting to the changing environment. In order to address the effects of climate change on agriculture and guarantee food security for their populations, Türkiye and other nations must continue their efforts (Çevre ve Şehircilik Bakanlığı, 2012).

Given the interconnected opportunities and difficulties in the agriculture sector, the goal of incorporating climate change adaptation into agriculture and food security policy in Türkiye is of utmost importance. The material given highlights several crucial details in reference to this goal (Çevre ve Şehircilik Bakanlığı, 2012):

1. Understanding the Interconnectedness: The book acknowledges that agriculture is both a contributor to and a sufferer of climate change. This knowledge emphasizes the necessity of addressing climate change's damaging effects on agriculture through a comprehensive strategy that considers not only agricultural productivity but also food security, environmental issues, biodiversity, and the sustainability of ecosystems.
2. Access to Sufficient, Safe, and Nutritious Food: One of the main goals is to make sure that everyone has access to food that satisfies their dietary requirements and food preferences. This is crucial for encouraging people to have active, healthy lives.
3. Primary Approach for Policies That Are Production-Oriented: The paper highlights that production-oriented policies in the agricultural sector should prioritize adaptation to climate change as a primary strategy. This means that while planning and creating policy for agriculture and food security, climate change adaptation should be a key component.
4. Action plans and national and regional development strategies should be amended and modified to include climate change-specific initiatives to effectively adapt to climate change. To guarantee that policies reflect the effects of shifting climatic conditions on agriculture, this is necessary.
5. Integration of Climate Change Issues: The essay emphasizes the necessity of integrating many aspects of climate change adaptation into current legal and policy frameworks. These aspects include food security, production, consumption, price, insurance systems, support for farmers, and market regulations. This guarantees that efforts to adapt to climate change are planned and consistent. Sustainable Use of Natural Resources: The main objective is to make sure that natural resources are used sustainably in agriculture while building a competitive and well-organized structure for responding to the effects of climate change. Aligning goals for climate change adaptation with policies, programs, and legal frameworks is part of this.
6. Enhancing Quality-Based Production: Many strategies targeted at raising production quality while maintaining sustainability and guaranteeing food security and safety are equally pertinent for coping with climate change. Good agricultural practices, organic farming, traceability, disease and pest management, irrigation, and public awareness campaigns are some of these techniques.

In conclusion, the goal of Türkiye's policies on agriculture and food security is to solve the complicated issues brought on by climate change in the agricultural sector. To do this, policies must be updated, climate change considerations must be incorporated into current frameworks, and sustainable farming methods that improve food security and safety while coping with the effects of climate change must be promoted. This all-encompassing strategy strives to protect agricultural output and guarantee that the public has access to wholesome food.

To adapt to climate change in the agriculture sector, it is critical to assess current policies, action plans, and legal frameworks in Türkiye, as stated in Objective 1.1. The following initiatives and critical points are highlighted in the text in relation to this goal (Çevre ve Şehircilik Bakanlığı, 2012):

- The Ministry of Food, Agriculture, and Livestock is accountable for: The Ministry of Food, Agriculture, and Livestock oversees tackling the effects of climate change on the agricultural industry in Türkiye. To solve these concerns, this ministry is instrumental in creating and implementing the laws and policies that will be used.
- Legislation and Legal Arrangements: Legal arrangements cover a wide range of topics, such as the quantity and quality of water resources, food safety and security, the preservation of agricultural biodiversity, irrigation infrastructure, fishing operations, management of drought and desertification, and risk management for natural disasters. These laws are essential for tackling the effects of climate change.
- Recent legal and institutional changes in the agriculture sector aim to strengthen administrative and institutional infrastructure, particularly in areas related to food safety, feed, food hygiene, veterinary services, and plant health. The goal of these continuing initiatives is to guarantee the security and safety of food.

- Linking Climate Change Adaptation to Agriculture Policies: There is a major focus on creating a seamless link between agricultural production policies and climate change adaptation policies. This fusion strives to make sure that agricultural policies are in line with objectives for adaptation to climate change.
- Environmental Protection and Rural Development: Sustainable rural development policies address problems including drought, forest fires, floods, biodiversity loss, and desertification brought on by inappropriate farming methods. For the sustainability of rural activities, these policies seek to redefine the link between agriculture and the environment.
- Development of integrated agricultural basin projects, expansion of organic farming and best agricultural practices, and promotion of environmentally friendly production techniques are all part of the strategy. These steps are taken as part of an endeavor to sustainably adjust to climate change without compromising agricultural production.
- Disaster Risk Management: Among rural development initiatives, disaster risk management—including precautions against earthquake, landslide, and flood threats—is prioritized. The objective is to improve safety in these locations while lowering hazards in vulnerable rural settlements.
- Impacts of Climate Change: The strategy attempts to include the effects of climate change in a few action plans, including the "Combating Agricultural Drought Strategy and Action Plan." Water resources, food safety, hazards from natural disasters, ecosystem services, and human health are all included in this integration.
- Support for Agricultural Producers: Considering the effects of climate change on their activities, such as agricultural basin production, the strategy provides support for agricultural producers. It also includes associated support measures.
- The General Directorate of Meteorology's strategic plan: A crucial organization for Türkiye's adaptation to climate change is the General Directorate of Meteorology. The plan focuses on strengthening atmosphere modeling and data simulation processes, providing early warnings for meteorological natural disasters, increasing the variety of goods and sectoral implementations, and tracking the effects of global warming and climate change on agriculture. These programs are meant to lessen the damaging effects of potential climate shifts.
- In conclusion, Objective 1.1 emphasizes the significance of coordinating Türkiye's policies, strategies, and legal framework with the aim of adjusting to the effects of climate change on the agriculture sector. These initiatives seek to safeguard food security and safety while also promoting environmentally friendly farming methods. Climate change issues are included into.

In conclusion, Objective 1.1 emphasizes the significance of coordinating Türkiye's policies, strategies, and legal framework with the aim of adjusting to the effects of climate change on the agriculture sector. These initiatives seek to safeguard food security and safety while also promoting environmentally friendly farming methods. To effectively address these issues, it is essential to include climate change considerations into current policies and programs.

To comprehend the effects of climate change on agriculture and to make it easier for adaptation to these changes, purpose 2 emphasizes the significance of creating and extending research and scientific studies. The following major themes are emphasized in the paper (Çevre ve Şehircilik Bakanlığı, 2012):

- Productivity has historically been a focus of agricultural research and development initiatives, which are frequently motivated by economic development objectives. As a result, the topic of adapting to climate change has received less attention.
- Change to Climate Change Adaptation: The goal highlights the necessity of changing research initiatives, particularly those pertaining to the preservation of soil and water resources, to climate change adaptation. To address the effects of climate change on agriculture nationwide, particularly in terms of drought, irrigation practices, adjustments to production patterns, enhanced crop diversity, and disaster management strategies must be developed.
- Drought-Resistant Products: Due to the severe drought issues encountered in some regions during Türkiye's efforts to adapt to climate change, research organizations like the General Directorate for Agricultural Research and Policies have started developing agricultural products that are resistant to drought. These goods are being used by farmers to lessen the effects of climate change on agriculture.
- Socio-Economic Research: Considering the effects of climate change, the plan aims to carry out socio-economic research and scientific studies on agriculture, food, the environment, and rural development at the national level. This research will help guarantee the livelihoods of populations, such as women farmers, and it will inspire the creation of ground-breaking policies that promote the growth of the nation's agricultural in accordance with climate change.
- Sustainable Food Security: The strategy places a strong emphasis on developing a system of food security that is based on facts discovered through research and development projects that take the effects of climate change into account. This system seeks to fulfill consumer expectations while adjusting to shifting environmental factors.
- Development of a Database and Information System: The goal emphasizes the significance of nationwide regional or basin-scale development of a secure database and information system. This approach, which can be periodically updated to consider shifting climate impacts, will assist assess and track the impact of climate change on agricultural fields.

In conclusion, Purpose 2 emphasizes the necessity of a research-driven strategy to modify agriculture to the problems brought on by climate change. It underlines the significance of adjusting research priorities to address issues like as drought resistance, socioeconomic research, climate change adaptation, and the implementation of a sustainable food security system based on scientific evidence. To inform future adaptation plans, it also underlines the significance of gathering and monitoring data on the effects of climate change at the regional and basin levels.

The creation and growth of research and development (R&D) initiatives aiming at efficient agricultural, soil, and water management in the context of climate change are the main topics of Objective 2.1. The following initiatives and critical points are highlighted in the text in relation to this goal (Çevre ve Şehircilik Bakanlığı, 2012):

- Vulnerability Analysis: To evaluate the potential effects of climate change on agricultural productivity, production, and local knowledge, the text emphasizes the significance of conducting vulnerability analyses in agricultural areas. To track changes and create the required policies to address climate-related issues in agriculture, these evaluations are crucial.
- Accounting for Moisture and Salinity Stress: A thorough understanding of elements like moisture and salinity stress on crops is necessary for effective management of agricultural products, land, and water. Sustainable agriculture techniques depend on identifying and resolving these pressures.
- R&D Development: To address the problems posed by climate change, the objective highlights the need to grow and extend R&D initiatives, particularly at the regional or basin level. For agriculture to adapt to shifting climatic circumstances and to ensure food security, this study is crucial.
- Enhancing Genetic variety: Research efforts are anticipated to be concentrated on figuring out the productivity and present genetic variety of local agricultural goods, taking adaptability to climate change into account. Biotechnology is seen as an important tool in these initiatives, providing fresh chances for study and development.
- Crop Pattern Modification: It is acknowledged that new crop patterns are required to adapt to the effects of climate change. The direction of these developments and their general adoption will be greatly aided by R&D studies and scientific endeavors.
- Irrigation Area Vulnerability Analysis: The essay emphasizes the significance of carrying out vulnerability evaluations specifically for agricultural irrigation areas. Understanding and tackling the unique problems brought by climate change in these locations will be made easier with the aid of this analysis.

In a nutshell Objective 2.1 highlights the value of research and development initiatives to increase agriculture's adaptability to climate change. It highlights the necessity of vulnerability assessments, dealing with moisture and salinity stress, and stepping up R&D initiatives, including the application of biotechnology. Additionally, it emphasizes the necessity of conducting vulnerability evaluations

specifically for irrigation areas and adapting agricultural patterns to changing climate conditions to ensure efficient crop, soil, and water management in the face of climate change.

Disaster analysis for Türkiye's agricultural droughts is the emphasis of Objective 2.4. The following initiatives and critical points are highlighted in the text in relation to this goal (Çevre ve Şehircilik Bakanlığı, 2012):

- Climate-Related Disasters Occurring More Frequently: The objective recognizes that climate-related disasters such droughts, floods, forest fires, and storms are occurring more frequently and are influencing many nations' agricultural capacities, including Türkiye.
- Land and water management development at the national level is stressed as being essential to preventing climate change catastrophes from triggering the loss of agricultural areas in Türkiye. Disasters caused by climate change can be lessened in impact with proper land and water management.
- Definition of Agricultural Drought: According to the plan, compared to other industries, agriculture has a different definition of drought. In agriculture, annual areal precipitation is less important than the availability of water at plant roots during the growth season. A natural disaster known as "agricultural drought" is defined as when plants are unable to get the necessary water in the soil during the growing season.
- Support for Farmers impacted by Natural Disasters: The text refers to Law No. 2090, which aids farmers in the production of plants and animals for those who have been impacted by natural disasters. Since it went into effect in 1977, this law has addressed the losses incurred by farmers because of the agricultural drought.
- Legislative and Institutional Arrangements: To alleviate the losses brought on by agricultural drought and to improve the assurance regime, taking into consideration the effects of climate change, recent legislative and institutional arrangements have been made in Türkiye.
- The Ministry of Food, Agriculture, and Livestock oversees developing the "Combating Agricultural Drought Strategy and Action Plan." This strategy is intended to be used to put in place medium- and long-term preparations for upcoming droughts and their effects, even in years with normal rainfall. When putting it into practice, it takes climate change's effects into account.
- Food Security and Risk Mitigation: Given the increasing population, the drought's impact on agricultural productivity has a substantial impact on the ability to meet food needs and ensure food security. In this setting, evaluating agricultural drought relief operations is crucial.
- Adding Agricultural Drought in the Definition of Natural Disasters: Early warning systems and the accompanying analyses can be implemented by include agricultural drought in the definition of natural disasters.
- Institutional Modifications the Ministry of Food, Agriculture, and Livestock is being given permission to participate as a member and representative in an advisory commission by way of an amendment to the organizational statute of the Prime Ministry Disaster and Emergency Management Presidency. This institutional reform will make it easier to respond to the agricultural drought in a coordinated manner.
- The "Combating Agricultural Drought Strategy and Action Plan" calls for the creation of "Provincial Drought Action Plans" for each province to deal with drought locally. These plans have legal justifications and are subject to rules, and they are created in accordance with the dynamics and circumstances of each province.
- Building Up Crisis Centers in Drought-Affected Provinces: It is intended to enhance Drought Province Crisis Centers in terms of their administrative, financial, and legal capacities to successfully implement the action plans and crisis plans.

In a nutshell, Objective 2.4 of this document emphasizes the significance of treating agricultural drought as a climatic calamity and taking steps to lessen its effects. It emphasizes the necessity of early warning systems, provincial-level action plans, and legal and institutional mechanisms to prevent agricultural drought and guarantee food security in the face of changing climatic circumstances.

Identifying the socioeconomic effects of climate change on the agriculture industry is the goal of Objective 2.5, with a special emphasis on marginalized and vulnerable populations. The paragraph underlines the following crucial ideas and actions connected to this goal (Çevre ve Şehircilik Bakanlığı, 2012):

- Rights of Vulnerable Populations: The goal acknowledges that access to food, water, shelter, and health for the poor and vulnerable is particularly at risk due to climate change. Due to their poor and fragility, local communities, farmers, and women are the groups most impacted by the effects of climate change.
- Including the Voices of Vulnerable Groups: When designing plans for coping with climate change, the state is required to take the views and perspectives of the most vulnerable sectors of the agricultural industry into account. The purpose of this strategy is to guarantee that these groups' requirements are taken into consideration.
- Finding the Effects of Climate Change: In areas that would be most impacted by agricultural drought, it is crucial to swiftly find the causes of and the economic, social, and environmental effects of climate change. A major objective is to locate and assist poor farmers affected by climate change at the regional and basin levels.
- Gender-Responsive Measures: It is believed that it is crucial to take gender-specific actions to combat the effects of climate change. The fact that women are disproportionately impacted by climate change in terms of its direct and indirect effects on the economy, society, and health is stressed. However, there hasn't been much research done on this subject in Türkiye, and more research is strongly recommended.
- Agricultural Women's Contribution: The passage emphasizes the value of women in agriculture, especially in tiny family-run businesses where there is little external labor. Women perform a sizable amount of the agricultural labor in Türkiye, and this is especially common in rural areas. Depending on the activity and family finances, women play a variety of responsibilities in agriculture, but they are involved in all stages of production.
- Training and Capacity Building for Female Farmers: Ongoing training programs are established for female farmers with the goal of giving them the skills they need, introducing new technology, expanding their capabilities, and teaching them on sustainable agriculture-related themes. These training programs address a range of sustainable agriculture topics, such as implementing ecological farming methods, managing water resources, and diversifying the rural economy. For the development of their skills, information, techniques, and technologies for more effective resource management and agricultural production that is compliant with climate change, training and publication services are offered to female farmers.
- Socio-economic Impact Assessment: The passage stresses the importance of pinpointing the causes of and the economic, social, and environmental effects of climate change in areas that are particularly impacted by agricultural drought. The socioeconomic effects of climate change on agriculture will also be included in this assessment.

In conclusion, Objective 2.5 emphasizes the importance of evaluating the socioeconomic effects of climate change on the agriculture sector, especially for vulnerable groups like women and underrepresented communities. It urges an all-encompassing strategy that considers the views and requirements of various groups, places an emphasis on gender-responsive policies, and acknowledges the crucial part that women play in agriculture. To ensure that no one is left behind, it is important to design policies and support systems that address the specific opportunities and difficulties brought on by climate change in the agricultural sector.

The focus of Objective 3 is on planning for sustainable water usage in agriculture, especially in light of adaptation to climate change. The main ideas surrounding this goal are outlined in the following list:

- Importance of Water Management in Agriculture: Türkiye's agricultural industry depends heavily on its water supply. For agricultural production practices to successfully adjust to climate change, there must be effective management of water resources in a basin- and field-based framework.
- The development of agricultural support policies, the improvement of hard infrastructure services (such as flood channel excavation and alternative water collection methods), raising awareness of water harvesting in upper basins, and water-saving techniques are just a few of the strategies suggested to improve water management in the agricultural sector. Effective adaptation to climate change also depends on employing high-quality water for modern irrigation, cultivating resilient plant types and variations, and managing soil moisture.
- Long-term and immediate precautions: While some of these strategies can offer quick fixes, others are built for medium- and long-term success. Improving the institutional efficiency of important players in water management, such as the Ministry of Food, Agriculture, and Livestock, the General Directorate of State Hydraulic Works, and the General Directorate of Meteorology, is the main priority in the near term. The aim is to implement higher-level policies in the medium and long term, such as an efficient water code, integrated adaptation plans, and macroeconomic targets for the agricultural sector in terms of climate change.
- Agriculture Water Use: in 2012, irrigation accounts for over 75% of Türkiye's total annual water consumption of 46 billion m^3. About 28 million hectares are used for agriculture in Türkiye, of which 25.8 million hectares may be irrigated. By 2023, plans call for installing irrigation systems throughout 8.5 million hectares, with the main goal being to use more efficient irrigation methods to lower irrigation water use from 75% to 65%. Around 72 billion m^3 of water per year are expected to be used for agriculture.
- Water Sources: Dams and reservoirs provide most of the water used for irrigation in agriculture, with groundwater resources providing around 35% of the irrigation water. Certain projects, however, have had negative effects on the environment, leading to the loss of important habitats and issues including soil salinity, leakage, and the spread of agricultural chemicals because of over-irrigation.
- Planning a cross-domain production: An extensive production planning program was started in 2009 to reduce the amount of water used in agriculture. Based on temperature, soil, topography, and field quality, this program classified productive areas as "agricultural basins". This cross-domain production planning's key objectives are to safeguard agricultural biodiversity, conserve land and water resources, and use less water in agriculture.
- Irrigation Methods, Modern and Alternative: The application of modern and alternative irrigation methods is meant to encourage water conservation on a basin and agricultural land scale in the context of climate change adaptation.
- Groundwater Use: In Türkiye, irrigation activities heavily rely on groundwater. In order to use groundwater for irrigation of agricultural land, control measures need to be strengthened, especially in the case of illegal wells.

In conclusion, Goal 3 emphasizes the significance of sustainable water management in agriculture and the necessity for effective water use to mitigate climate change. To reduce water consumption in the agricultural sector, it highlights the necessity of contemporary irrigation methods, prudent water resource management, and cross-domain production planning within agricultural basins. The goal is to make sure that water resources are utilized effectively while protecting agricultural production and tackling climate change issues.

Increasing the efficacy of water management in agriculture is outlined in Objective 3.1, with a focus on climate change adaptation. The key points are as follows:

- Technical and technological advancements will be encouraged in order to make sure that the agricultural production system and companies reliant on agriculture are receptive to the environment and climate.
- Creating Drought-Resistant Varieties: To adjust to climate change, crop varieties that are drought- and salination-resistant must be created. The seed industry in Türkiye mostly sells imported hybrid seeds, which need a lot of water to be productive. Public initiatives will be in charge of leading the development and promotion of drought-resistant crop types within agricultural basins.
- In regions where the temperature, soil, and topography are adequate, the use of water-efficient irrigation techniques, such as sprinkler or drip irrigation, will be encouraged. These techniques are meant to increase agricultural water efficiency. It is anticipated that saving water in arid regions will significantly enhance overall production and profitability.
- Monitoring Water Quality: In contemporary irrigation techniques, the quality of the irrigation water is just as crucial as the amount of water used, the timing of the irrigation, and the method used. Poor water quality can result in lower crop yields, soil salinity, and desertification even on well-irrigated and productive soil. Therefore, it is essential to do a water analysis before utilizing irrigation water to check for specific elements (such as boron, copper, and zinc) that can contaminate the soil and produce salinization. With this strategy, every drop of water is effectively used, and water management systems are created with local conditions in mind to reduce agricultural water losses.
- Irrigation Techniques Adapted to Plant Types: The technique of irrigation used can have a big impact on water conservation efforts and relies on the type of plant. This includes technologies like drip irrigation based on products, sprinkler irrigation, row irrigation, and ponding, which will be chosen while taking the effects of climate change into account. Irrigation intervals and frequency will be tailored to the plant type in areas with limited water resources.
- Investments in modern irrigation will be promoted in order to move away from outdated irrigation practices (like flooding) that result in soil desertification and excessive water use. For effective water utilization, the emphasis is on using contemporary irrigation techniques like sprinkler and drip irrigation with closed systems.
- Regional Production Patterns: A top priority will be establishing the most suitable regional production patterns based on available water resources. Recognizing the greater water usage correlated with the production of animal products, water-saving strategies will be applied to both vegetative and animal production.

In conclusion, the goal seeks to improve water management in agriculture by promoting contemporary irrigation practices, creating crop types that are drought-resistant, and improving irrigation techniques while taking into consideration the unique characteristics of each location. This strategy is essential for Türkiye's agricultural activities to effectively use water resources and adapt to climate change.

Protecting soil and agricultural biodiversity from the effects of climate change is the focus of purpose 4. These are the main ideas:

- Understanding the relevance of biodiversity as a crucial element of the agricultural ecosystem is crucial. The objective is to manage agricultural systems in a way that minimizes the use of external inputs, boosts output, and encourages the sustainability of ecosystems.
- Degradation of Soil and Agricultural Biodiversity: Due to variables such as droughts, desertification, and erosion, agriculture and livestock face difficulties, which reduces plant productivity. Hydrological systems can be harmed by the effects and demands on drinking water ecosystems, which could have an influence on agricultural production and food security.
- Türkiye's Rich Biodiversity: In terms of agricultural resources and biodiversity, Türkiye is among the top nations in the world. In addition to staple crops like wheat, barley, oats, peas, and lentils, it also boasts a vast array of fruits and bulbous plants, including tulips and plants utilized in Mediterranean agricultural systems. Türkiye is a "micro gene center" for many kinds and is home to many agricultural goods' wild cousins. The abandonment of rural areas and the preference for high-productivity types, particularly in more remote and mountainous locations, pose a risk of genetic loss.
- Protection Measures: Since the 1960s, Türkiye has started several initiatives aimed at conserving and utilizing agricultural genetic resources, such as the National Plant Genetic Sources Program. These projects highlight globally significant herbaceous and woody species that are crucial for maintaining biodiversity worldwide and include in-situ protection programs.

- Biodiversity challenges: The absence of thorough study makes it difficult to preserve animal genetic diversity in Türkiye. There is a lack of information about native breeds, and some studies have noted the eradication of specific cattle, sheep, and goat varieties.
- Impacts on Biodiversity and Ecosystems: Türkiye has struggled to conserve its ecosystems and biodiversity, particularly in wetlands and grazing areas. These difficulties include clearing pasture lands and semi-natural habitats, overgrazing, converting wetlands to agriculture, diverting water streams to dam and irrigation projects, overusing underground water for irrigation, flooding vulnerable habitats because of the construction of irrigation dams, and agricultural runoff containing nutrients and pesticides.

For defending soil and agricultural biodiversity against the effects of climate change, it is essential to address these problems and challenges. It involves taking a comprehensive strategy to minimizing the negative effects of habitat loss and land degradation while preserving the diversity of crops, plants, and animals in Türkiye's agricultural ecosystem.

In Objective 4.1, a comprehensive strategy is laid out for defending and enhancing soil's physical, chemical, and biological effectiveness against the effects of climate change on agriculture. The main ideas and activities specified in this objective are broken down as follows:

- Conserving Soil Moisture: In light of the growing negative effects of climate change, it is crucial to put these practices into practice. For agriculture to remain viable in the face of shifting climatic circumstances, this is essential.
- Commercial fertilizers should be substituted with more environmentally friendly options because they might damage the soil's structure and ability to retain moisture. The usage of animal manure and green fertilizer are suggested as viable substitutes to improve soil health.
- Research and development: To conduct research and carry out projects relating to soil and moisture conservation strategies, national research institutes like the Soil and Water Resources Research Institutes will be extremely important. This includes researching water-plant-soil relationships, water-saving techniques, and irrigation methods to prepare for the effects of climate change.
- Land Quality Categories: It's crucial to create categorization guidelines for soil and lands. In order to conserve, enhance, and increase soil productivity, it is crucial to categorize land quality and make sure that applications for these purposes comply with these categories. This division facilitates effective land management.
- Fertilizer Use Based on Soil Analysis: It is essential to base fertilizer use on laboratory assessments of soil composition. This method maximizes fertilizer application while minimizing the detrimental effects on soil health. To improve soil's ability to absorb carbon, these studies should be expanded.
- Promoting Technological Advancements: Emphasis is placed on the widespread adoption of appropriate methods and tools for soil cultivation, as well as cutting-edge irrigation and water management systems. This encourages sustainable agriculture and the effective use of resources.
- Advanced Harvest Systems: To adapt to the effects of climate change on agriculture, advanced harvest systems and agricultural forestry techniques should be used. The following programs can assist in managing the effects of climate change.

This goal's overall message emphasizes the necessity of an integrated, sustainable approach to agriculture that takes the effects of climate change into consideration. In order to safeguard and improve soil quality and productivity in the face of a changing climate, it places a strong emphasis on research, appropriate fertilizer use, and the implementation of contemporary agricultural techniques.

In order to safeguard agricultural biodiversity and resources and prepare for the effects of climate change on agriculture, Objectives 4.2 and 4.3 highlight crucial methods and actions. The breakdown of each goal is as follows:

- Protecting Agricultural Biodiversity and Resources for Climate Change Adaptation:
- Novel Agricultural Techniques: The focus of this aim is on the creation of novel and useful agricultural methods that support the sustainable use of natural resources and aid in agriculture's ability to adapt to climate change.
- Understanding how climate change affects agricultural biodiversity and resources requires research on the effects of the changing climate on agricultural goods coming from Türkiye.
- Product Pattern Research: Analyzing agricultural product patterns is essential for preserving biodiversity and adjusting to changing climatic conditions.

The ultimate purpose of this strategy is to maintain agricultural resources and biodiversity in order to improve climate change adaptation.

- Finishing Land Consolidation Activities to Improve Agricultural Efficiency and Prepare for Climate Change:
- Land Consolidation for Agricultural Efficiency: It is well known that land consolidation can boost agricultural productivity while preserving soil quality. It is crucial for attaining sustainable development and cutting down on agriculture's excessive use of energy and water.
- Land consolidation has developed from a straightforward land organization procedure into a multidimensional development tool utilized in integrated rural planning.
- Protecting vulnerable lake basins, water reservoirs, and flood-risk areas are just a few examples of the environmental issues that can be resolved by using land consolidation. By rearranging land parcels, one can directly mitigate the effects of climate change by creating conservation belts around lakes.
- Energy Efficiency: Land consolidation may result in less agricultural energy being used, which will help the effort to minimize greenhouse gas emissions. It lowers the amount of energy required to move between Türkiye's small, dispersed land parcels.
- Water management is mandated by the General Directorate of State Hydraulic Works (SHW), which also regulates water distribution, increases irrigation efficiency, lowers the cost of building irrigation networks, and eliminates expropriation costs by combining land in irrigation projects.
- Regulations and Amendments: Land consolidation project principles and applications are subject to legal restrictions. In order to adjust to the effects of climate change, it is also emphasized that the bylaw governing land usage and protection, as well as land consolidation, will need to be updated.
- Simultaneous Development: In order to provide sustainable water management in agriculture, in-field development and land consolidation projects will be built simultaneously with irrigation systems, increasing overall effectiveness and climatically resilient construction.

In summary, while Objective 4.3 emphasizes the significance of land consolidation as a multifaceted tool for improving agricultural efficiency and resilience to climate change impacts, Objective 4.2 concentrates on the development of agricultural techniques and research to protect biodiversity and resources in the face of climate change.

In order to address climate change-related adaptation options in agriculture, purpose 5 concentrates on enhancing institutional capacity and interagency cooperation in Turkey. The following are the main ideas and steps outlined in this purpose:

- Numerous Ministries and Agencies Responsible: The impact of climate change on agriculture is being addressed by Turkey's almost 40 Ministries and Agencies. The Prime Ministry Disaster and

Emergency Management Presidency, the General Directorate of State Hydraulic Works, the General Directorate of Meteorology, the General Directorate of Forestry, the Ministry of Food, Agriculture and Livestock, and the Ministry of Environment and Urbanization are just a few of the well-known institutions.

- Meteorological Early Warning System (MEUS): To identify areas at risk for forest fires, the General Directorate of Meteorology created the Meteorological Early Warning System (MEUS). To aid in the prevention of forest fires, data from this system is shared with the General Directorate of Forestry, a division of the Ministry of Forestry and Water Works.
- Initiatives from the ministry of food, agriculture, and livestock: This ministry is working hard to prepare for the effects of climate change. They are concentrating on tasks like creating drought-resistant species, assessing soil moisture, and more efficiently exploiting agricultural areas as they prepare legislation for the EU harmonization effort. The Turkey Agricultural Drought Action Plan is now being implemented at the provincial level and is intended to monitor agricultural drought, analyze risks, and reduce its adverse effects.
- Collaboration Between Agencies: There is a need for increased coordination and cooperation among all pertinent institutions across all sectors in order to handle the effects of climate change in an effective manner. The creation of a thorough information and data base, as well as a greater comprehension of the various consequences, uncertainties, and vulnerabilities, are all part of this.
- Dedicated Agricultural Projects: Turkey has also launched projects like the "Agricultural Crop Monitoring and Tracking Systems" and the "Drought Test Centre" at the Konya Bahri Dadaş International Research Institute. To increase agriculture's resistance to climate change, initiatives like "Advanced Cultivation Methods in Arid Conditions" have been put in place.

In conclusion, the goal underlines the value of cooperation and coordination among many ministries and agencies in order to successfully manage the issues brought on by climate change in the agriculture sector. It also emphasizes specific projects and strategies, such drought monitoring, early warning systems, and agricultural research programs, to increase agricultural resilience and adapt to changing climatic circumstances.

In order to combat climate change and prepare for its effects on the agricultural sector, Objective 5.1 focuses on enhancing interagency cooperation and increasing the capacity of pertinent institutions within the Ministry of Food, Agriculture, and Livestock (MFAL). The goal of Objective 5.2 is to raise awareness among civil society members of the impacts of climate change on agriculture and the necessary adaptation measures. The major ideas and steps associated with each of these goals are listed below:

Strengthening interagency cooperation and capacity building is goal 5.1.

- Increasing Capacity for Drought Management: The goal emphasizes the significance of enhancing the capability of the committees and agencies in charge of managing the agricultural drought. Programs for research and training to address the impacts of regional and local climate change are included.
- The Ministry of Food, Agriculture and Livestock and its allied institutions are urged to create a separate division within their respective provincial organizations that will be responsible for handling climate change-related concerns.
- Collaboration with International Organizations: All MFAL institutions engaged in agricultural sector adaptation to climate change should improve their capacity for working with international organizations. This involves improving drought and flood early warning systems.

Increasing Civil Society Awareness of Climate Change Effects and Adaptation is Objective 5.2:

- Governance and the National Climate Change Strategy: The National Climate Change Strategy highlights the need to build a coordination system that is open to all parties and is founded on scientific-analytical research. With the help of this system, sound information management and decision-making procedures will be provided.
- The General Directorate of Meteorology's Meteorological Early Warning System (MEUS) is used to pinpoint areas at danger for forest fires. It encourages the General Directorate of Forestry and the General Directorate of Meteorology to work together to prevent forest fires.
- Programs to Raise Awareness: To inform farmers of the effects of climate change on agriculture and livelihoods, the Ministry of Food, Agriculture, and Livestock conducts education and awareness-raising programs. These actions are taken in accordance with the Good Agricultural Practices Regulation.
- Promotion of contemporary Irrigation Methods: To ensure the effective use of water resources, farmers are instructed in contemporary irrigation methods and plant irrigation techniques. They are also urged to become members of cooperatives to advance their education.
- Role of non-governmental organizations (NGOs): While NGOs in Turkey have boosted their awareness-raising initiatives, many of these groups still concentrate on mitigation strategies, and there is space for development in terms of adaptation. The significance of educating NGOs on climate change adaptation is emphasized.
- Preventing Salinization: In the mid- to long-term, projects should be established to stop the salinization of irrigated areas brought on by rising temperatures and evaporation. These procedures need to be explained to farmers.
- Participatory Consultation with Stakeholders: Effective consultation with stakeholders, including NGOs active in the agricultural sector, was conducted during the development of the National Climate Change Adaptation Strategy.
- Continuous Education: It is advised that NGOs that are members of numerous commissions and associations involved in crisis management, drought damage assessment, and climate change adaptation, continue their education. The effects of climate change and strategies for adaptation should be covered in this education.

In conclusion, these goals emphasize the need for improved agency and organization coordination, raised public awareness, and educational initiatives to improve Turkey's agriculture sector's capacity to combat and adapt to climate change.

Environmental Outlook for Turkish Agriculture with Agricultural Statistics

The Turkish agricultural sector is an important contributor to the country's economy, accounting for about 7% of GDP and 20% of employment. The sector is also a major source of food for Turkey's population of over 80 million people. However, the Turkish agricultural sector is facing several environmental challenges, including:

- Climate change: Climate change is already having a significant impact on Turkish agriculture, with more extreme weather events, such as droughts, floods, and heat waves. These events are damaging crops and livestock and reducing yields.
- Water scarcity: Turkey is a water-stressed country, and agriculture is the largest user of water. Water scarcity is becoming a major challenge for Turkish agriculture, especially in the context of climate change.
- Land degradation: Land degradation is a serious problem in Turkey, and it is affecting agricultural productivity. Land degradation is caused by a few factors, including soil erosion, salinization, and deforestation.
- Pollution: Pollution from agricultural activities, such as the use of fertilizers and pesticides, is also a major environmental challenge. Pollution can contaminate soil and water resources, and it can

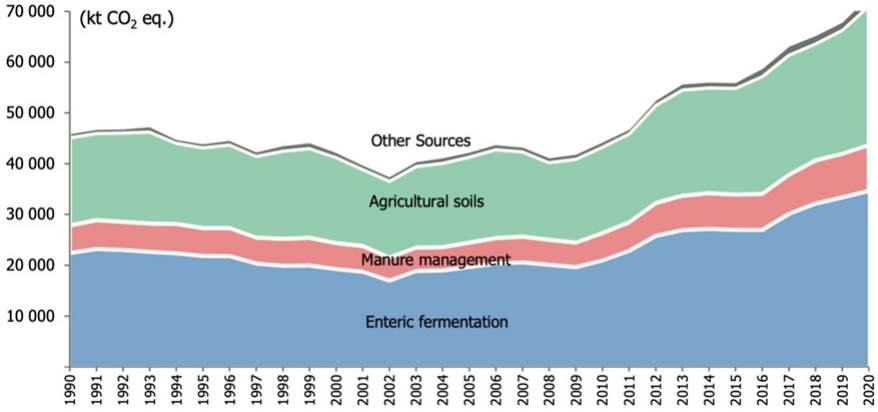
also have a negative impact on human health and biodiversity.

These environmental challenges are having a significant impact on the sustainability of the Turkish agricultural sector. To address these challenges, the Turkish government and the agricultural sector need to adopt more sustainable agricultural practices. This includes reducing the use of fertilizers and pesticides, improving water management, and restoring degraded land.

The Turkish government has developed a few policies and programs to support sustainable agriculture. However, more needs to be done to implement these policies and programs effectively. The agricultural sector also needs to invest in research and development to develop new sustainable agricultural technologies.

The future of the Turkish agricultural sector will depend on how it addresses the environmental challenges it faces. By adopting more sustainable agricultural practices, the Turkish agricultural sector can become more resilient to climate change, water scarcity, and land degradation. This will help to ensure the long-term sustainability of the sector and the food security of the Turkish population.

Figure 5.1 Cumulative emissions of agricultural categories, 1990–2020



The graph illustrates the cumulative emissions of various agricultural categories from 1990 to 2020, measured in gigatons of carbon dioxide equivalent (GtCO2-eq). The data gleaned from the graph reveals the following key insights:

Enteric fermentation emerges as the largest contributor to agricultural emissions, constituting approximately 40% of the total emissions in 2020. Enteric fermentation is the digestive process in ruminant animals like cows, sheep, and goats, resulting in the production of methane, a potent greenhouse gas.

Following closely, manure management ranks as the second most significant source of agricultural emissions, contributing to around 15% of the total emissions in 2020. Manure management encompasses the storage, handling, and application of animal waste, which can emit methane and nitrous oxide, both potent greenhouse gases.

Agricultural soils represent the third most substantial source of emissions, accounting for about 10% of the total emissions in 2020. Nitrous oxide emissions from agricultural soils are attributed to the use of nitrogen fertilizers and the cultivation of organic matter within the soil.

The graph also highlights additional agricultural emission sources, including rice cultivation, liming, and field burning. Furthermore, the data clearly depicts a consistent upward trajectory in cumulative agricultural emissions over the specified period. Several factors contribute to this increase, including:

- Escalating agricultural production: Global agricultural output has witnessed significant growth over the past few decades, driven by factors such as population expansion, rising incomes, and shifts in dietary preferences.
- Augmented use of fertilizers: The agricultural sector has increased fertilizer application to boost crop yields, yet this also leads to higher nitrous oxide emissions.
- Expansion of agricultural land: Agricultural expansion into new territories, including forests and grasslands, leads to the release of carbon dioxide into the atmosphere due to land-use changes.

The rising trend in agricultural emissions underscores a critical concern, as agriculture plays a pivotal role in climate change. It is imperative to curtail greenhouse gas emissions from the agricultural sector to mitigate the far-reaching effects of climate change. This can be achieved through the adoption of more sustainable agricultural practices, encompassing reduced fertilizer usage, enhanced manure management, and limitations on land conversion for agricultural purposes. It's worth noting that the graph does not encompass all sources of agricultural emissions, excluding factors such as emissions from agricultural transportation and the processing and distribution of agricultural products.

Table 5.3 Overview of the agriculture sector emissions, 1990–2020

Year	A. Enteric fermentation		B. Manure management		C. Rice cultivation		Agriculture total	
	(kt CO_2 eq.)	(%)	(kt CO_2 eq.)	(%)	(kt CO_2 eq.)	(%)	(kt CO_2 eq.)	(%)
1990	22 397	48.6	5 436	11.8	100	0.2	46 054	100
1991	23 221	49.5	5 657	12.1	100	0.2	46 928	100
1992	23 025	49.0	5 533	11.8	94	0.2	46 979	100
1993	22 636	47.7	5 597	11.8	101	0.2	47 407	100
1994	22 339	49.7	5 793	12.9	90	0.2	44 926	100
1995	21 815	49.5	5 523	12.5	113	0.3	44 080	100
1996	21 792	48.7	5 570	12.4	126	0.3	44 757	100
1997	20 313	47.8	5 166	12.2	124	0.3	42 505	100
1998	19 890	45.5	5 348	12.2	135	0.3	43 720	100
1999	19 963	45.1	5 448	12.3	147	0.3	44 276	100
2000	19 234	45.4	5 142	12.1	128	0.3	42 332	100
2001	18 714	46.9	5 096	12.8	132	0.3	39 894	100
2002	16 975	45.1	4 540	12.1	135	0.4	37 608	100
2003	18 874	46.5	4 596	11.3	143	0.4	40 558	100
2004	18 969	45.9	4 590	11.1	156	0.4	41 298	100
2005	19 680	46.4	4 781	11.3	183	0.4	42 439	100
2006	20 352	46.4	5 027	11.5	212	0.5	43 900	100
2007	20 575	47.4	5 081	11.7	203	0.5	43 421	100
2008	20 084	48.6	4 929	11.9	216	0.5	41 302	100
2009	19 606	46.6	4 863	11.6	208	0.5	42 032	100
2010	20 946	47.2	5 391	12.1	202	0.5	44 409	100
2011	22 847	48.7	5 639	12.0	204	0.4	46 901	100
2012	25 790	49.0	6 425	12.2	249	0.5	52 662	100
2013	26 906	48.2	6 769	12.1	231	0.4	55 858	100
2014	27 154	48.3	7 068	12.6	229	0.4	56 219	100
2015	26 947	48.0	6 956	12.4	240	0.4	56 133	100
2016	26 984	45.8	7 060	12.0	243	0.4	58 894	100
2017	30 110	47.6	7 697	12.2	234	0.4	63 262	100
2018	32 136	49.2	8 508	13.0	252	0.4	65 338	100
2019	33 368	49.1	8 597	12.6	263	0.4	68 023	100
2020	34 615	47.3	9 060	12.4	262	0.4	73 155	100

Figures in the table may not add up to the totals due to rounding.

Table 5.3 Overview of the agriculture sector emissions, 1990–2020 (continued)

Year	D. Managed soils		F. Field burning		H. Urea application		Agriculture total	
	(kt CO_2 eq.)	(%)	(kt CO_2 eq.)	(%)	(kt CO_2 eq.)	(%)	(kt CO_2 eq.)	(%)
1990	17 314	37.6	347	0.8	460	1.0	46 054	100
1991	17 155	36.6	359	0.8	436	0.9	46 928	100
1992	17 527	37.3	341	0.7	459	1.0	46 979	100
1993	18 078	38.1	367	0.8	627	1.3	47 407	100
1994	15 931	35.5	321	0.7	453	1.0	44 926	100
1995	15 871	36.0	332	0.8	426	1.0	44 080	100
1996	16 391	36.6	344	0.8	534	1.2	44 757	100
1997	16 023	37.7	347	0.8	532	1.3	42 505	100
1998	17 306	39.6	382	0.9	658	1.5	43 720	100
1999	17 643	39.8	342	0.8	733	1.7	44 276	100
2000	16 870	39.9	340	0.8	617	1.5	42 332	100
2001	15 107	37.9	318	0.8	527	1.3	39 894	100
2002	15 103	40.2	328	0.9	527	1.4	37 608	100
2003	16 054	39.6	325	0.8	565	1.4	40 558	100
2004	16 591	40.2	359	0.9	632	1.5	41 298	100
2005	16 880	39.8	302	0.7	613	1.4	42 439	100
2006	17 422	39.7	294	0.7	592	1.3	43 900	100
2007	16 740	38.6	256	0.6	566	1.3	43 421	100
2008	15 250	36.9	259	0.6	565	1.4	41 302	100
2009	16 474	39.2	288	0.7	593	1.4	42 032	100
2010	17 006	38.3	219	0.5	645	1.5	44 409	100
2011	17 421	37.1	233	0.5	558	1.2	46 901	100
2012	19 334	36.7	224	0.4	640	1.2	52 662	100
2013	20 905	37.4	240	0.4	807	1.4	55 858	100
2014	20 764	36.9	215	0.4	788	1.4	56 219	100
2015	21 006	37.4	174	0.3	811	1.4	56 133	100
2016	23 147	39.3	164	0.3	1 295	2.2	58 894	100
2017	23 607	37.3	165	0.3	1 450	2.3	63 262	100
2018	23 022	35.2	163	0.2	1 257	1.9	65 338	100
2019	24 342	35.8	165	0.2	1 288	1.9	68 023	100
2020	27 389	37.4	173	0.2	1 657	2.3	73 155	100

Figures in the table may not add up to the totals due to rounding.

This table provides an overview of greenhouse gas emissions stemming from Turkish agriculture in the year 2020. The data in this table underscores the following key findings:

1. Enteric fermentation stands out as the primary source of greenhouse gas emissions within Turkish agriculture, constituting roughly 40% of the total emissions. Enteric fermentation, occurring during the digestion process of ruminant animals like cows, sheep, and goats, leads to the release of methane, a potent greenhouse gas.
2. Following closely, the management of manure emerges as the second-largest contributor to greenhouse gas emissions from Turkish agriculture, accounting for approximately 25% of the total emissions. Manure management encompasses the storage, handling, and application of animal waste, which can emit methane and nitrous oxide, both potent greenhouse gases.
3. Agricultural soils rank as the third major source of greenhouse gas emissions within Turkish agriculture, making up about 15% of the total emissions. These emissions occur as agricultural soils release nitrous oxide due to the use of nitrogen fertilizers and the cultivation of organic matter in the soil.
4. Additional contributors to agricultural emissions include rice cultivation, liming, and field burning.

Furthermore, the table underscores the significant role of the agricultural sector in Turkey's greenhouse gas emissions profile, contributing to around 20% of the total emissions. Several key inferences can be drawn from the table:

- Emission Reduction Imperative: The data underscores the urgent need for the Turkish agricultural sector to curtail its greenhouse gas emissions. This action is vital to align with Turkey's climate change mitigation objectives and reduce its overall carbon footprint.
- Emission Reduction Strategies: There exist various effective strategies for the Turkish agricultural sector to reduce its greenhouse gas emissions. These measures encompass enhancing manure management practices, minimizing the utilization of nitrogen fertilizers, and adopting sustainable agricultural techniques that are less emissions intensive.
- Government Support Requirement: To enable the agricultural sector in effectively lowering its greenhouse gas emissions, it is imperative for the Turkish government to play a supportive role. This may include providing financial assistance, incentives, and investing in research and development efforts aimed at developing and promoting sustainable agricultural practices.
- Policy Development: The data presented in the table serves as a crucial resource for policymakers and environmental authorities. It provides the necessary insights to formulate policies and programs geared towards emission reduction and mitigating the adverse impacts of climate change. These policies can facilitate a transition to a more sustainable and environmentally friendly agricultural sector in Turkey.

The provided table serves as a continuation of the agricultural emissions dataset, offering insights into emissions spanning the years 1990 to 2020 across specific categories:

- D. Managed soils
- F. Field burning

- H. Urea application
- Agriculture total

Emissions from managed soils encompass those originating from the cultivation and management of agricultural lands, encompassing emissions arising from the application of fertilizers, the management of manure, and other agricultural inputs.

Field burning emissions are linked to the incineration of agricultural residues, including crop stubble and straw.

Emissions from urea application stem from the utilization of urea fertilizer in crop cultivation. Urea, a nitrogen-based fertilizer, has the capacity to emit nitrous oxide, a potent greenhouse gas.

Agriculture total emissions represent the cumulative emissions from all agricultural sources, including but not limited to enteric fermentation, manure management, agricultural soils, field burning, urea application, and various other contributing factors.

The data conclusively indicates that emissions in all four categories have exhibited an upward trajectory over the years. The most pronounced increase has been recorded in emissions from managed soils, a trend likely attributed to the heightened use of fertilizers and manure to enhance crop yields.

Furthermore, the data underscores the pivotal role of agriculture in contributing to Turkey's overall greenhouse gas emissions profile. In the year 2020, the agricultural sector accounted for approximately 20% of the nation's total emissions.

Explanation of Agricultural Emission Trends:

Several key factors have driven the observed trends in agricultural emissions within Turkey. These include:

1. Escalating Agricultural Production: Turkey has experienced a substantial surge in agricultural output over recent decades, driven by various factors, including population growth, rising incomes, and shifting dietary preferences.
2. Increased Utilization of Fertilizers and Pesticides: Farmers have intensified their application of fertilizers and pesticides to bolster crop yields. However, these agricultural inputs also serve as sources of greenhouse gas emissions.
3. Expansion of Agricultural Land: Agricultural activities have extended into new territories, encompassing areas previously occupied by forests and grasslands. This land-use conversion to agriculture results in the release of carbon dioxide into the atmosphere.
4. Climate Change Impact: The influence of climate change is notably evident in Turkish agriculture, marked by more frequent and severe weather events such as droughts, floods, and heatwaves. These events inflict damage on crops and livestock, ultimately leading to diminished yields.

Implications for Climate Change Mitigation:

The trends in agricultural emissions within Turkey underscore the imperative of addressing climate change mitigation in this sector. Given that agriculture represents a significant contributor to Turkey's greenhouse gas emissions and emissions from this sector are on the rise, proactive measures are imperative.

Efforts aimed at reducing greenhouse gas emissions from agriculture in Turkey can encompass:

1. Enhanced Manure Management: The refinement of manure management practices holds the potential to reduce emissions of methane and nitrous oxide.
2. Reduced Fertilizer Utilization: The adoption of sustainable agricultural practices, such as crop rotation and integrated pest management, can lead to a reduction in fertilizer usage.
3. Land Restoration: The restoration of degraded land can enhance soil health and mitigate carbon dioxide emissions.
4. Sustainable Agricultural Practices: The adoption of sustainable agricultural practices like cover cropping and conservation tillage can further contribute to reduced greenhouse gas emissions.

While the Turkish government has initiated policies and programs to support sustainable agriculture, comprehensive and effective implementation remains paramount. Additionally, investment in research and development is essential to drive the development of new sustainable agricultural technologies. Through the embrace of more sustainable agricultural practices, the Turkish agricultural sector can bolster its resilience to climate change, curtail greenhouse gas emissions, and align with Turkey's climate change mitigation goals, thus ensuring the enduring sustainability of the sector.

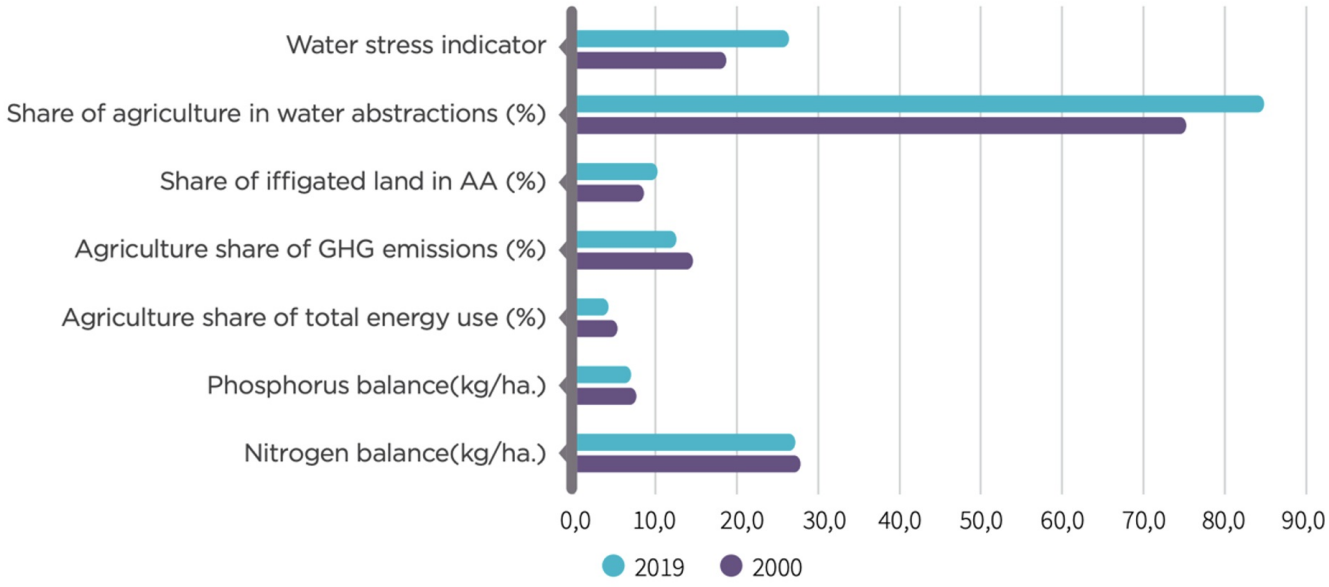


Figure 14. Environmental Indicators in Turkey
Source: OECD, 2021c

The share of agriculture in water abstractions in Turkey has been increasing over time, from around 70% in 2000 to around 75% in 2019. This suggests that agriculture is becoming increasingly water-intensive in Turkey. The share of irrigated land in Turkey has also been increasing over time, from around 20% in 2000 to around 25% in 2019. This suggests that farmers are increasingly relying on irrigation to grow crops in Turkey. The share of agriculture in greenhouse gas emissions in Turkey has been relatively stable over time, at around 20%. This suggests that agriculture is not a major contributor to greenhouse gas emissions in Turkey. The share of agriculture in total energy use in Turkey has been decreasing over time, from around 10% in 2000 to around 8% in 2019. This suggests that agriculture is becoming more energy-efficient in Turkey. The phosphorus balance in Turkey has been negative since 2000, meaning that more phosphorus is being removed from the soil than is being added. This suggests that Turkey's soils are becoming depleted of phosphorus. The nitrogen balance in Turkey has also been negative since 2000, meaning that more nitrogen is being removed from the soil than is being added. This suggests that Turkey's soils are becoming depleted of nitrogen. These inferences suggest that agriculture in Turkey is facing a number of challenges, including water scarcity, soil degradation, and climate change. The Turkish government needs to take steps to address these challenges in order to ensure the sustainability of Turkish agriculture.

Here are some specific policy recommendations:

The government should invest in water-saving technologies and irrigation infrastructure to help farmers reduce their water use. The government should promote sustainable agricultural practices, such as crop rotation and cover cropping, to help improve soil health and reduce soil erosion. The government should support research and development on climate-smart agriculture to help farmers adapt to the impacts of climate change. The government should provide financial assistance to farmers to help them implement sustainable agricultural practices.

The data in the image I added here is too old because it is from 2019. The world has changed a lot since then, and the agricultural sector is no exception.

- For example, the COVID-19 pandemic has disrupted agricultural supply chains and led to food shortages in some parts of the world. The war in Ukraine has also had a significant impact on the global agricultural market, causing food prices to rise.
- In addition, climate change is becoming a major threat to agriculture. Extreme weather events such as droughts, floods, and heat waves are becoming more common and more severe. This is making it more difficult for farmers to grow crops and raise livestock.

As a result of these changes, the data in the image cannot be longer accurate for scientific inference. It is important to have up-to-date data on agriculture in order to make informed decisions about agricultural policy and practice. The Turkish government should invest in collecting and publishing more up-to-date data on agriculture. This data should be made available to researchers and policymakers so that they can develop effective strategies for addressing the challenges facing Turkish agriculture.

Wheat is a staple food crop for billions of people around the world, and Turkey is one of the world's leading wheat producers. In recent years, Turkey has seen a significant increase in wheat yields, which is a positive development for the country and for global food security.

According to data from the Turkish Statistical Institute, wheat yields in Turkey have increased by an average of 1.5% per year over the past 10 years. This increase is likely due to a combination of factors, including improvements in agricultural technology, changes in farming practices, and favorable weather conditions.

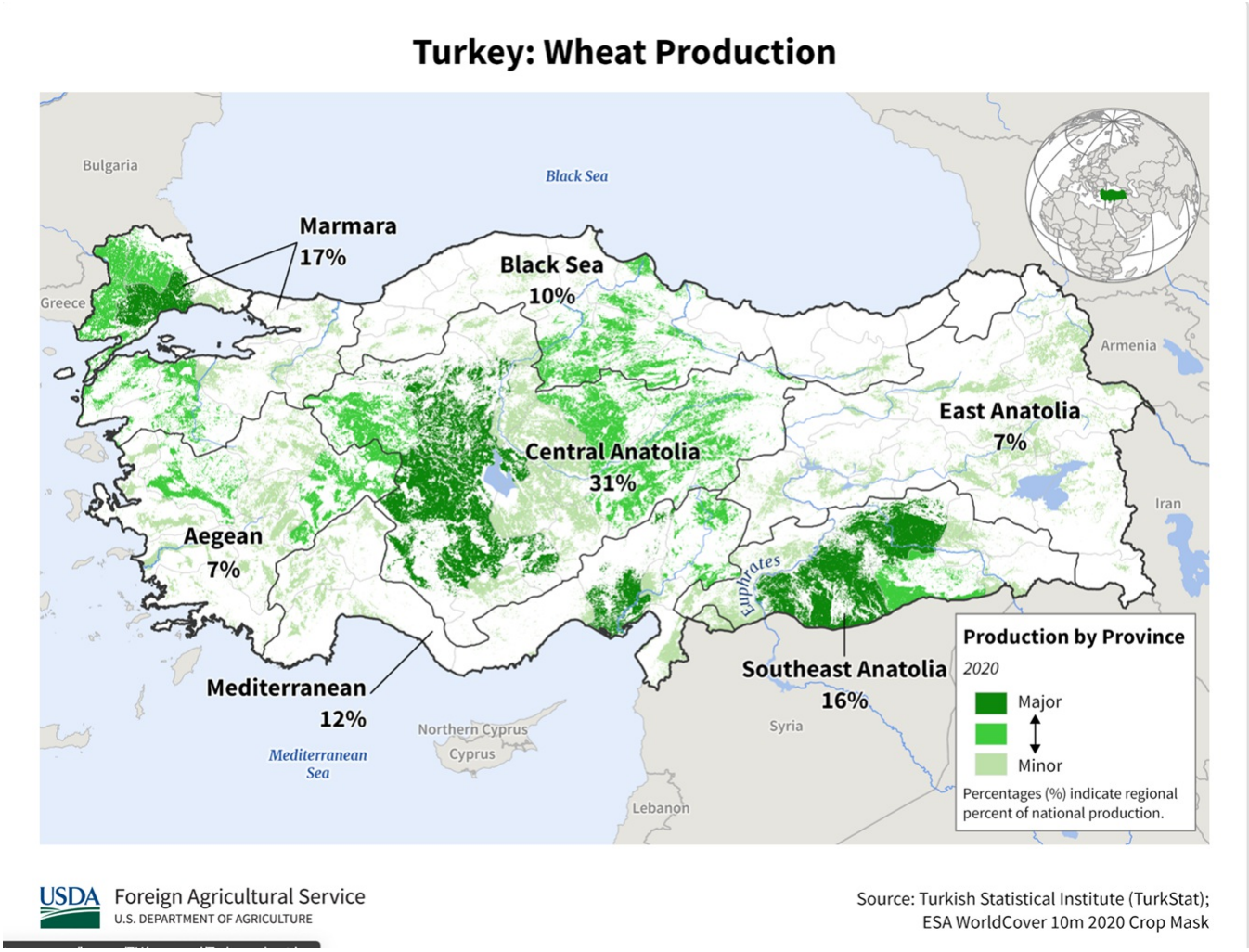
One of the key drivers of the increase in wheat yields has been the adoption of improved seeds and fertilizers. Turkish farmers are increasingly using high-yielding varieties of wheat that are resistant to pests and diseases. They are also using more fertilizers to improve the fertility of the soil.

Another important factor contributing to the increase in wheat yields has been the adoption of more sustainable farming methods. Turkish farmers are increasingly using irrigation and other water-saving techniques, and they are also practicing crop rotation and other methods to improve soil health.

Finally, favorable weather conditions have also played a role in the increase in wheat yields in Turkey. In recent years, Turkey has experienced relatively mild winters and abundant rainfall during the growing season. This has created ideal conditions for wheat production.

The increasing trend in wheat yields in Turkey is a positive development for the country and for global food security. As Turkey becomes more self-sufficient in wheat production, it will be less reliant on imports. This is especially important in the context of the current global food crisis, which has been caused by a number of factors, including the war in Ukraine and the COVID-19 pandemic.

The Turkish government should continue to support farmers in their efforts to improve wheat yields. This can be done by providing financial assistance for the purchase of improved seeds and fertilizers, and by promoting sustainable farming practices. The government should also invest in research and development to further improve wheat yields and make Turkish agriculture more resilient to climate change.



The chart and table in the image show the trend of wheat yields in Turkey over the past 10 years. The chart shows that wheat yields have been increasing steadily, from 2.4 tons per hectare in 2013/14 to 2.5 tons per hectare in 2022/23. The forecast for 2023/24 is for a further increase in wheat yield to 2.7 tons per hectare.

The table shows that wheat area in Turkey has been relatively stable over the past 10 years, ranging from 7.000 million hectares in 2019/20 to 7.860 million hectares in 2015/16. Wheat production has been more volatile, ranging from 15.250 million tons in 2014/15 to 21.000 million tons in 2017/18. The forecast for 2023/24 is for wheat production to increase to 19.500 million tons.

The increase in wheat yields in Turkey is likely due to a combination of factors, including:

- Improvements in agricultural technology, such as the use of improved seeds and fertilizers
- Changes in farming practices, such as increased irrigation and the adoption of more sustainable farming methods
- Favorable weather conditions

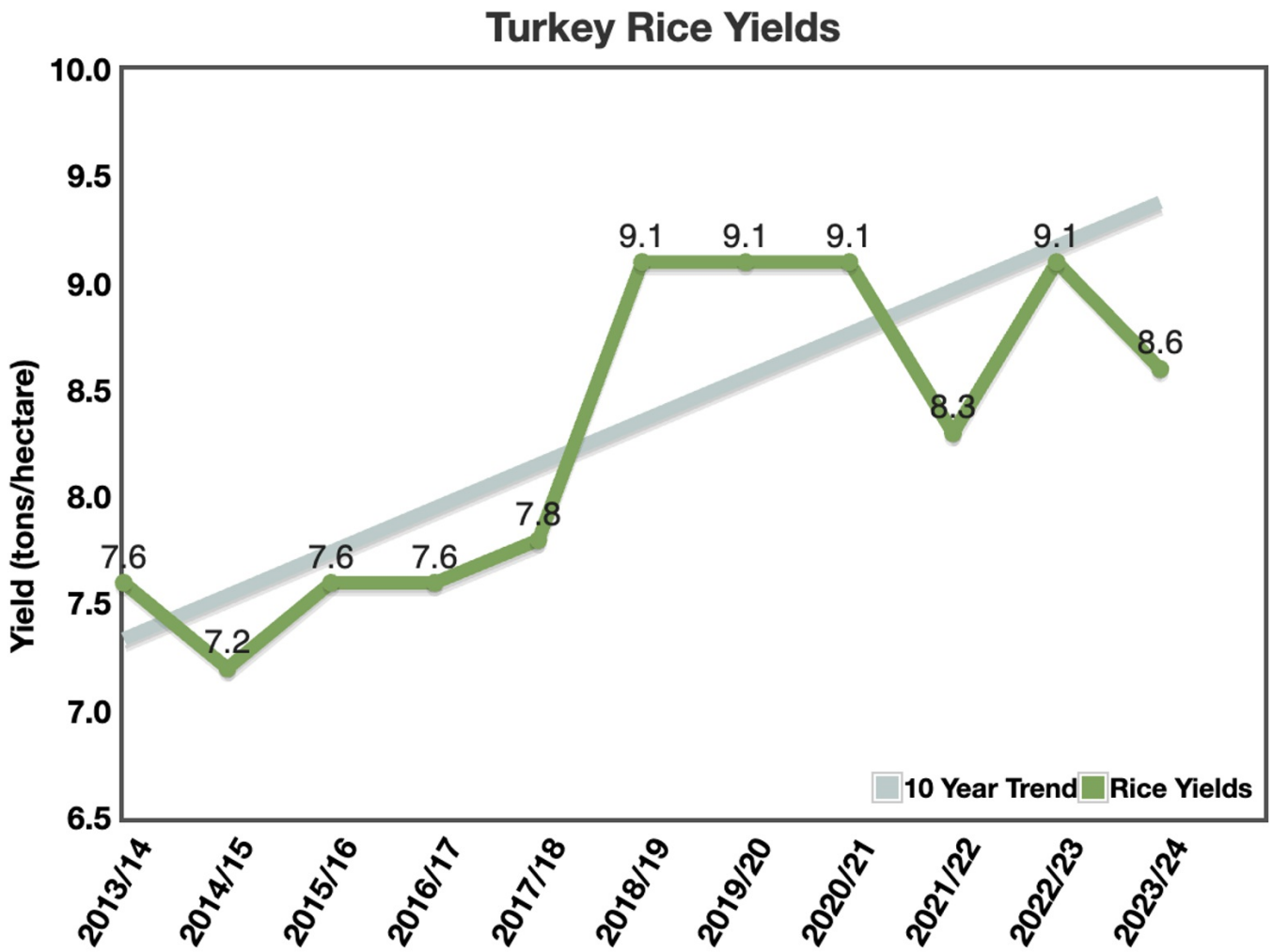
The increasing trend in wheat yields in Turkey is a positive development, as it suggests that the country is becoming more self-sufficient in wheat production and is less reliant on imports. This is important in the context of global food security, as wheat is a staple food crop for billions of people around the world.

Table 5.20 Irrigated area and estimated emissions for rice cultivation, 1990–2020

	Total		Continuously Flooded		Intermittently Flooded			
					Single Aeration		Multiple Aeration	
Year	(kt CO_2 eq.)	Area (ha)	(kt CO_2 eq.)	Area (ha)	(kt CO_2 eq.)	Area (ha)	(kt CO_2 eq.)	Area (ha)
1990	100.08	46 348	51.84	17 276	16.08	8 693	32.16	20 379
1991	99.78	40 400	59.98	16 800	14.42	7 764	25.38	15 836
1992	94.01	42 978	48.68	16 351	15.79	8 090	29.54	18 537
1993	101.29	44 842	56.31	18 751	17.01	8 553	27.98	17 538
1994	89.63	39 562	48.48	15 950	16.58	8 294	24.57	15 318
1995	112.51	49 955	62.85	21 203	16.71	8 434	32.95	20 318
1996	125.63	54 779	75.58	25 859	16.59	8 378	33.46	20 542
1997	124.17	54 995	73.35	25 447	17.22	8 878	33.60	20 670
1998	135.06	59 885	79.51	27 566	19.08	9 892	36.47	22 427
1999	146.59	64 983	87.09	30 133	20.95	10 975	38.55	23 875
2000	127.96	57 859	71.20	24 800	20.42	10 694	36.35	22 365
2001	131.92	59 000	75.04	26 085	25.70	13 763	31.18	19 152
2002	134.78	59 809	78.18	27 055	24.65	13 138	31.95	19 616
2003	142.82	65 000	77.70	26 697	27.40	14 731	37.72	23 572
2004	156.08	69 990	88.66	30 326	28.48	15 385	38.93	24 279
2005	182.98	84 909	96.05	32 926	35.04	18 949	51.89	33 034
2006	211.87	99 043	108.95	37 559	41.28	22 506	61.64	38 978
2007	202.71	93 799	110.05	37 841	35.84	20 419	56.81	35 539
2008	215.63	99 493	116.96	40 325	40.44	22 762	58.22	36 407
2009	208.47	96 444	110.30	38 116	40.65	22 539	57.52	35 789
2010	201.88	98 966	86.23	29 856	39.80	21 900	75.86	47 210
2011	204.08	99 383	93.73	32 456	38.95	21 449	71.40	45 479
2012	248.91	119 664	120.32	41 613	44.29	24 647	84.30	53 405
2013	230.53	110 592	111.64	38 670	41.45	23 018	77.44	48 905
2014	229.37	108 649	114.59	39 628	45.20	25 395	69.59	43 626
2015	239.85	115 856	115.71	40 057	41.58	23 355	82.56	52 444
2016	242.83	116 056	120.66	41 763	42.80	23 912	79.38	50 381
2017	233.65	109 505	121.81	42 153	42.60	23 778	69.24	43 575
2018	252.22	120 137	125.12	43 178	45.84	25 606	81.26	51 353
2019	262.86	126 419	127.74	44 053	45.94	25 817	89.17	56 549
2020	261.53	125 398	127.58	43 942	47.08	26 551	86.87	54 905

Figures in the table may not add up to the totals due to rounding.

Rice cultivation is a major source of greenhouse gas emissions. The table shows that rice cultivation emitted an estimated 261.53 million tons of CO_2 equivalent in 2020. This represents about 1.4% of global greenhouse gas emissions. Continuously flooded rice cultivation emits more greenhouse gases than intermittently flooded rice cultivation. This is because continuously flooded rice paddies create anaerobic conditions, which promote the production of methane, a potent greenhouse gas. Rice cultivation emissions have been increasing over time. The table shows that rice cultivation emissions have increased by about 50% since 1990. This is due to several factors, including increased rice production, increased use of fertilizers, and the expansion of rice cultivation into new areas, such as wetlands. The irrigated area for rice cultivation has increased steadily over time, from 37.9 million hectares in 1990 to 125.4 million hectares in 2020. The estimated emissions for rice cultivation have also increased steadily over time, from 100.08 million tons of CO_2 equivalent in 1990 to 261.53 million tons of CO_2 equivalent in 2020.



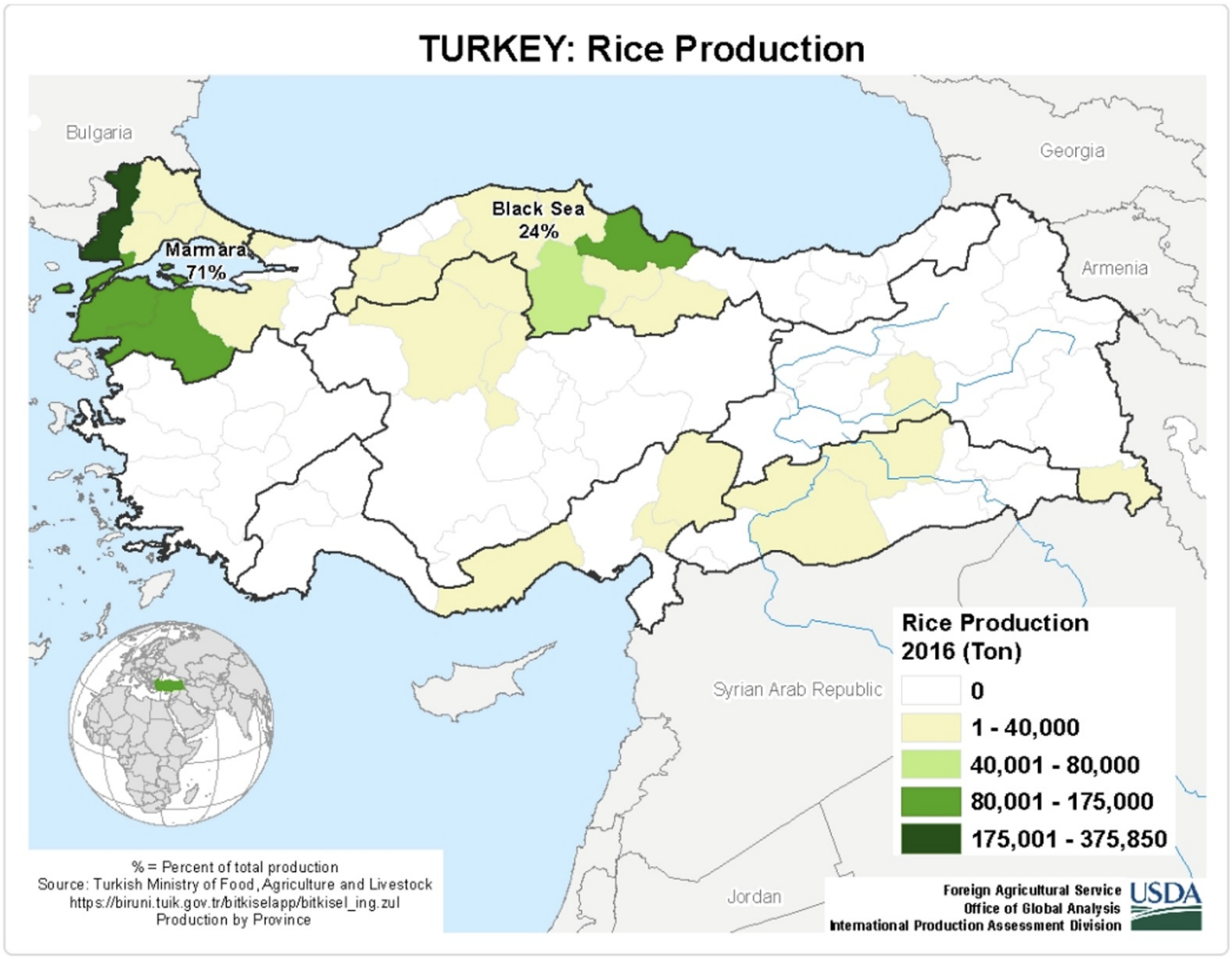
Rice holds a significant position as a major agricultural crop and a dietary cornerstone for a substantial portion of the country's population. There is a distinct upward trend in Turkish rice yields over the past decade, surging from 7.6 tons per hectare in 2013/14 to a commendable 8.3 tons per hectare in 2023/24.

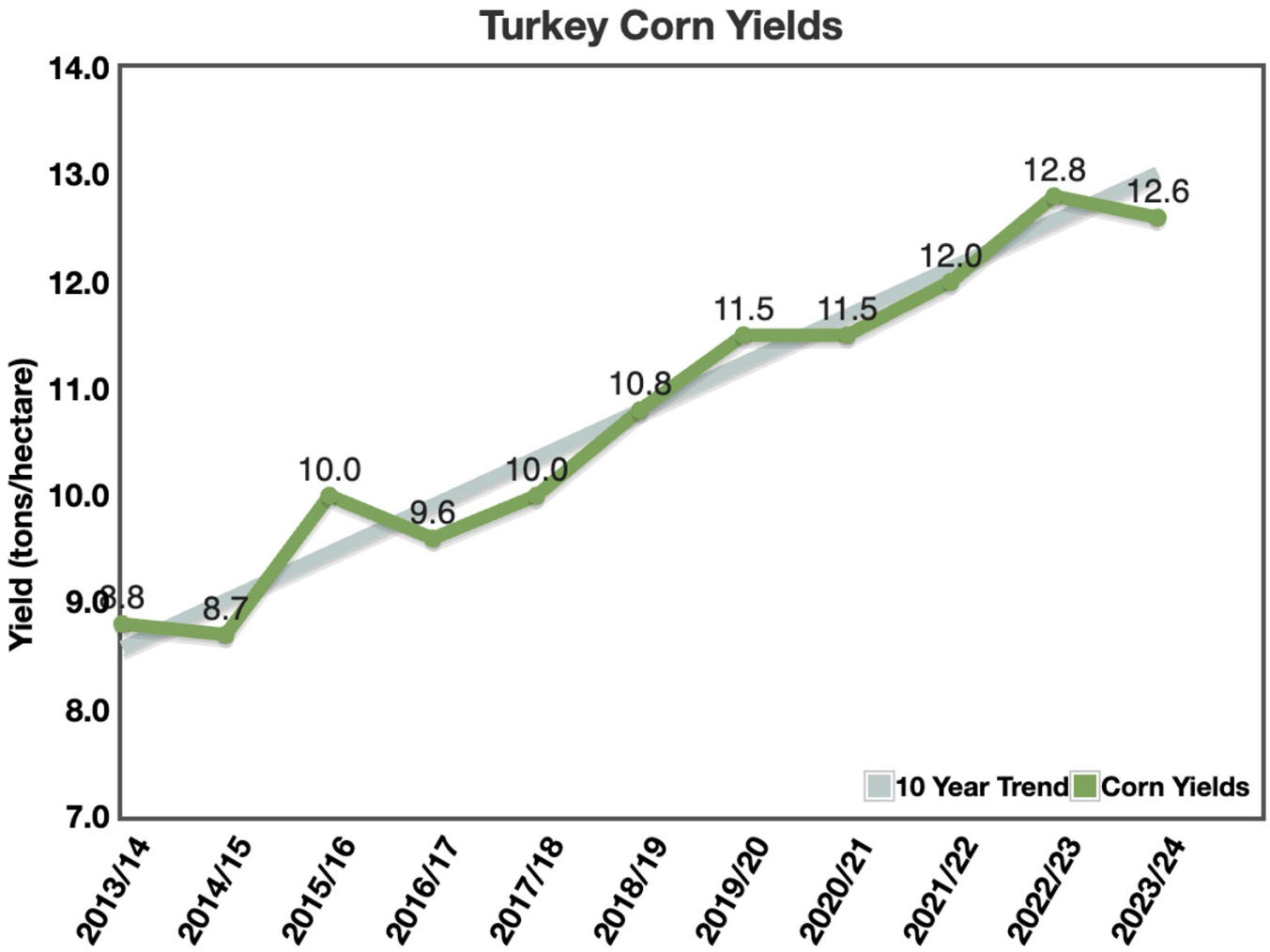
This noteworthy growth can be attributed to a trifecta of influential factors:

1. Technological Advancements: Turkish farmers have wholeheartedly embraced state-of-the-art agricultural technologies, incorporating advanced seed varieties, precision agriculture techniques, and the principles of integrated pest management. These technological strides have undeniably served as the bedrock of the amplified rice yields.
2. Governmental Support: The Turkish government, in a commendable role, has emerged as a steadfast supporter of rice cultivation, providing indispensable support through subsidies, loans, and outreach services. This strategic backing has unquestionably led to a significant enhancement in the efficiency and overall productivity of rice farming within the nation.
3. Favorable Climatic Provisions: Turkey has been the beneficiary of propitious climatic conditions, ideally suited for rice production in recent years. These favorable environmental dynamics have established an enabling backdrop for the augmentation of rice yields.

The burgeoning rice yields in Turkey symbolize a salient and propitious development for the agricultural landscape and the broader national economy. Elevated yields empower farmers to extract greater rice output from their land holdings, thereby fortifying their financial prospects. Furthermore, a surge in yields translates into a substantial reduction in the overheads associated with rice production, bestowing upon Turkish rice a more competitive stance on the global stage.

The evolving trend of increased rice yields in Turkey is commendable. The nation's rice cultivators are currently navigating a commendable transformation, typified by amplified efficiency and productivity, all while harnessing the fortuitous climatic advantages. Nevertheless, it is imperative to recognize that the trajectory of mounting rice yields may not indefinitely remain sustainable. The looming specter of climate change casts an imposing shadow across agricultural production on a global scale, with Turkey being no exception. To successfully navigate this formidable challenge, our farming community may be compelled to adapt to evolving climatic exigencies and explore innovative agricultural technologies as safeguards, aimed at preserving and potentially elevating rice yields in the foreseeable future.


TURKEY: Rice Production
Bulgaria
Georgia
Armenia
Black Sea
24%
Marmara
71%
Syrian Arab Republic
Jordan
Rice Production
2016 (Ton)
0
1 - 40,000
40,001 - 80,000
80,001 - 175,000
175,001 - 375,850
% = Percent of total production
Source: Turkish Ministry of Food, Agriculture and Livestock
https://biruni.tuik.gov.tr/bitkiselapp/bitkisel_ing.zul
Production by Province
Foreign Agricultural Service
Office of Global Analysis
International Production Assessment Division
USDA



This line graph shows Turkey's corn yields from 2014 to 2023. The trend line shows that corn yields have increased slightly in recent years.

However, it is important to note that this trend is not expected to continue in the long term. Climate change is causing a number of changes in Turkey's climate, including rising temperatures, declining rainfall, and more extreme weather events. These changes are expected to have a negative impact on corn production in Turkey in the coming years.

Therefore, while corn yields have increased slightly in recent years, it is important to be aware of the potential risks posed by climate change. Turkey needs to develop adaptation strategies to protect its corn crops and ensure a stable food supply in the future.

Here are some specific examples of adaptation strategies that Turkey could implement:

- Develop new crop varieties that are more tolerant of heat, drought, and other climate stresses.
- Improve irrigation systems to make better use of water resources.
- Plant crops at different times of year to avoid the hottest and driest periods.
- Use crop insurance to protect farmers from financial losses caused by climate change.

By taking these steps, Turkey can reduce the vulnerability of its corn production to climate change and ensure a stable food supply in the future.

References

- Çevre ve Şehircilik Bakanlığı. (2012). *Turkey's National Climate Change Adaptation Strategy and Action Plan 2011–2023*
- *Climate Change Data | Climate Watch* (n.d.). Retrieved October 18, 2023, from https://www.climatewatchdata.org/sectors/agriculture?contextBy=country&country=TUR&countryYear=2010&currentLocation=244&emissionsCountry=TUR&indicator=&model=22&scenario=175%2C170%2C178%2C173%2C177%2C171%2C176%2C1
- *Country summary: Türkiye*. (n.d.). Retrieved October 18, 2023, from https://climateactiontracker.org/countries/turkey/
- European Union. (2023, July 5). *Climate change*. https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/climate-change_en
- *Global Crop Monitoring*. (n.d.). Retrieved October 18, 2023, from https://stories.ecmwf.int/global-crop-monitoring/index.html#group-section-Sustainable-crop-production-HfKLwHBi7t
- Hoshide, A. K., Sarkar, R., Larkin, R., & Abreu, D. C. D. (2023). Editorial:Ecological intensification and sustainable intensification: Increasing benefits to and reducing impacts on the environment to improve future agricultural and food systems. *Frontiers in Environmental Science*, *11*, 1301995. https://doi.org/10.3389/fenvs.2023.1301995

- *Turkey. 2022 National Inventory Report (NIR) | UNFCCC*. (n.d.). Retrieved October 18, 2023, fromhttps://unfccc.int/documents/461926