



WATER AND FOOD SECURITY IN TURKEY IN A CHANGING CLIMATE

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Executive Summary

Water and food security in a changing climate have become unprecedented challenges confronting Turkey and its future. Currently, the country is experiencing a period of drought, and climate projections indicate a fall in water potential. Turkey is a water-stressed country, and by the second half of the century it will reach the level of water poverty. The Global Food Security Index estimates that food security in Turkey is 49th out of 113 index countries and 8th in the MENA region. Thus, water and food security have become an important debate within the discussion on climate change.

To deal effectively with water and food security in a sustainable fashion, we recommend to:

- Increase investments in research and development as well as the efforts and commitments towards better management of water and food resources.
- Implement measures to reduce the rate of deforestation and develop mechanisms that can accelerate afforestation.
- Apply drip and sprinkler irrigation and smart irrigation systems to decrease the water consumption in the agriculture sector.
- Repair the water distribution networks to prevent leakages and losses in urban areas.
- Harvest rainwater and recover and recycle industrial wastewater.
- Raise public awareness for water resources conservation.
- Protect agricultural lands, decrease excessive use of mineral fertilizer, decrease the consumption of pesticides, and increase the organic content of soil through compost and digestate applications.
- Adapt crops to climate change and monitor crop yield.
- Reduce food waste by buying the necessary amount of food, storing it properly, and donating the rest of the fresh food instead of throwing it away.

By adopting these measures, Turkey can simultaneously contribute to the UN's Sustainable Development Goals to "ensure access to clean water and sanitation for all" and to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" by 2030. Working toward these global goals is the current solution for a sustainable world, ending all forms of poverty, fighting inequalities, and tackling climate change for all people.

Introduction

Our globalizing world is in a profound crisis. It has been confronted by unprecedented challenges giving rise to crisis-ridden risks and problems. What we face today can be described as not one but "multiple crises of globalization" constituted by the simultaneous existence of an enduring and severe economic crisis; increasing security risks involving wars, terror, and violence; unsolved social justice problems in the areas of poverty, inequality, and unemployment; climate change and global warming; the growing scarcity in our fundamental resources such as food, water, and land; and the lack of leadership and governance. As globalization is confronted by these unprecedented challenges, feelings of uncertainty, insecurity, and risk have begun to mark international, regional, and national politics. While uncertainty and ontological insecurity about our lives and living conditions have been increasing, trust is being replaced by risk, which has led German social theorist Ulrich Beck to coin the term "world risk society," an apt description of the present. We are living in a global risk society generating global challenges and shaped by uncertainty and insecurity.¹

These risks, factors such as globalization, climate change, urbanization, population increase, and social and economic development, are human-induced factors that may lead to environmental problems threatening water and food security. Thus, to describe this current geological epoch in which humans create the most prescient challenges, American biologist Eugene Stoermer and Dutch geochemist Paul Crutzen² have coined the term "Anthropocene," which is the combination of the words *anthropo*, meaning human, and *cene*,

meaning epoch. Indeed, many scientific studies have shown that humans are affecting major climatological, geophysical, and hydrological dynamics.³

Climate change affects multiple sectors, especially vulnerable sectors such as agriculture, forestry, energy, and tourism, which are highly dependent on environmental conditions such as temperatures and precipitation levels. Since climate change threatens water resources, causes drought, and leads to land cover change and decreased agricultural productivity, it affects water and food security. Along with climate change, population increase also threatens water and food security. Despite the decrease in water availability due to increasing temperatures and decrease in precipitation, water demand has increased due to rising populations and demands for better living standards. Food demand also increases as the population increases, in addition to changing climatic conditions that make growing food products more difficult.

No country is immune to the multiple crises of globalization, and Turkey is no exception. On the contrary, Turkey, which is directly affected by many of these challenges from climate change to terrorism, is an illustrative and illuminating case to critically analyze the impacts and manifestations of being a risk-laden society shaped by feelings of uncertainty and ontological insecurity. This study will focus on two of these challenges, namely those of water and food security in Turkey. In addition to being a water-stressed country, the Global Food Security Index estimates that food security in Turkey is 49th out of 113 index countries and 8th in the MENA region.⁴ In order to meet the targets of the UN's Sustainable Development Goals (SDGs), which aim to end hunger and prevent malnutrition by 2030 for all people, it is important to enhance and sustain water and food security in Turkey.

Current Situation in Turkey

Turkey is a developing country, with 80.8 million people in 2017 and an average population growth rate of 1.3 percent between 2010-2016.⁵ It is located in the east of the Mediterranean Basin, which is identified as one of the most vulnerable regions according to the Intergovernmental Panel on Climate Change (IPCC). This region and Turkey

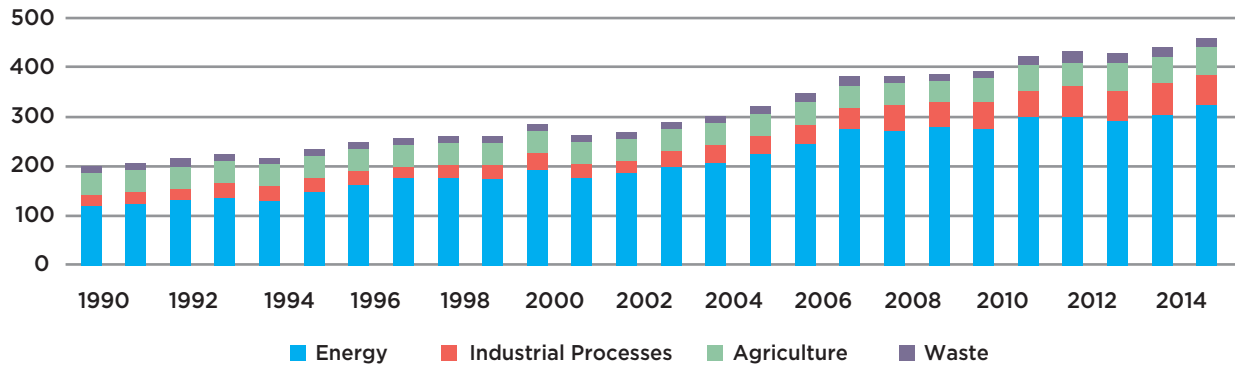
will have severe problems in agriculture due to climate change, as well as in many other sectors. Sen suggests that Turkey's agriculture sector will be strongly affected by temperature increase, drought, precipitation change, severe precipitation, and also by heat waves, floods, and wildfire.

While agriculture is the second largest sector in the Turkish economy, agricultural areas decreased from 26.3 million hectares in 2001 to 23.7 million hectares in 2016.⁶ Projected increases in population and decreasing agriculture area make food security—which is defined by the Food and Agriculture Organization of the United Nations (FAO) as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”⁷—a challenge.

Given the agriculture sector is a large consumer of water, it is equally important to improve a country's water security in order to sustain its food security. The Ministry of Forestry and Water indicates that 2017 was the driest year for Turkey in the past 44 years. According to the drought analysis of the Turkish State Meteorological Service, Eastern Anatolia—particularly the southeastern cities of Sanliurfa, Mardin, and Diyarbakir, and the eastern cities of Kars, Erzurum, and Agri—experienced a severe drought between January-December 2017.⁸ Climate projections show that available water in the Mediterranean Coast, Eastern Anatolia, and Southeastern Anatolia regions in 2041-2070 and 2071-2099 will decrease with respect to water potential in 2006. This decrease will threaten fruit growth in the west and grain production in the east.⁹ Along with climate change, urbanization, overuse of mineral fertilizer, pesticides, and unsustainable agricultural practices will also harm agricultural areas.

In order to fight climate change and the issues regarding environmental degradation, Turkey must increase measures for climate change mitigation and adaptation, water security, and food security. As an official candidate for European Union (EU) membership, environmental agreements should be at the core of Turkey's policy-making processes. Previously, Turkey indicated an intent to combat climate change in several international agreements.

Figure 1: Greenhouse Gas Emissions in Turkey (MtCO₂ eq.)



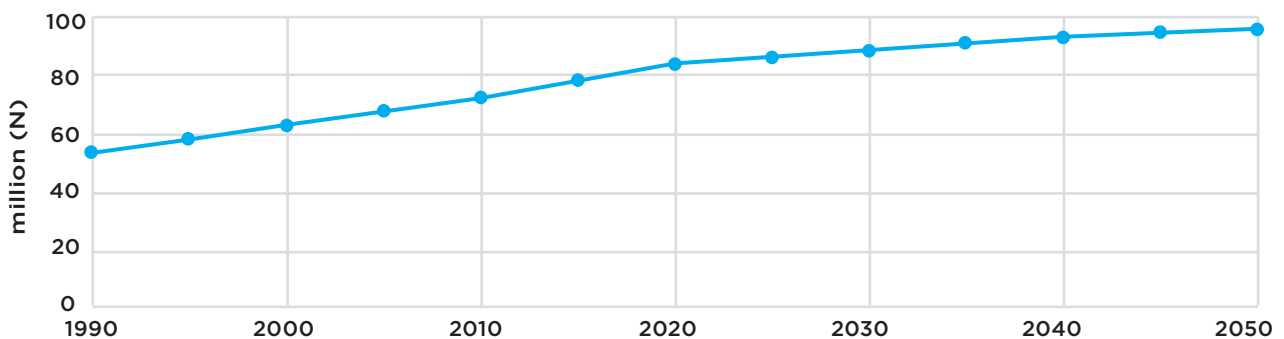
Source: Data from UNFCCC, April 15, 2017.¹⁰

The country became a party to the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratified the Kyoto Protocol in 2009. Likewise, Turkey also signed the Paris Agreement in April 2016 but has still not ratified it.

Despite this intent, greenhouse gas emissions from Turkey have doubled since the 1990s, which can be seen in Figure 1. According to the emission inventory of Turkstat (Turkish Statistical Institute), the sector most responsible for emissions is the energy sector.¹⁰ The industry, agriculture, and waste sectors follow. There should be greenhouse gas emission mitigation efforts in every sector to attenuate climate change as well as adaptation efforts to sustain good environmental conditions, particularly in the agriculture sector to sustain food security.

Figure 2 shows the population forecast for Turkey. Data was provided by the United Nations and analyzed by worldometers. According to the medium-fertility variant, rapid population increase will continue until 2020. In addition, immigration to Turkey is forecasted to be around 300,000 per year by 2020, similar to the 2015-2018 period. After 2020, migration from Turkey is forecasted to increase. The population of Turkey is expected to reach 88.4 million people by 2030 and 95.6 million people by 2050.¹¹ This projected increase in population will result in higher demand for food and water resources.

Figure 2. Population Forecast



Source: Data from Worldometers, 2018.¹¹

Water Resources in Turkey

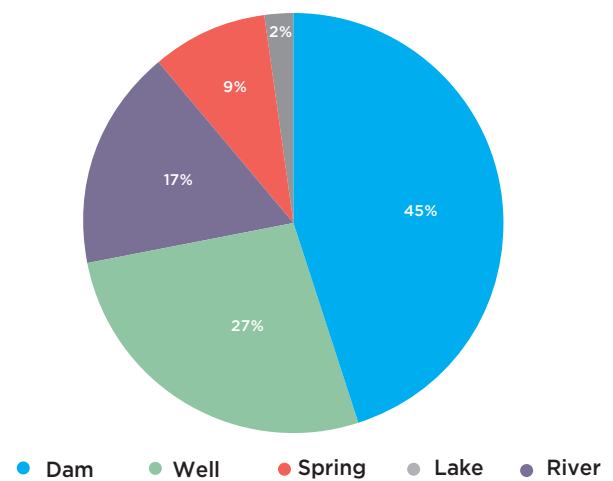
The world’s first regional “water war” took place 4,500 years ago in modern day Iraq, where the Tigris meets the Euphrates. Although resource wars are not currently a common phenomenon, there is growing potential for domestic conflicts triggered by water insecurity. Precipitation decreases can be a push factor for rural to urban migration.¹² The World Resource Institute (WRI) shows that Turkey has high water stress, with 3.02 baseline water stress measured through total annual water withdrawals expressed as a percentage of the total annual available fresh water.¹³ The projected change in water stress will increase to around 1.4 times baseline levels by 2020, around 2 times baseline levels by 2030, and around 2.8 times baseline levels by 2040.¹⁴

Turkey has an average precipitation of around 643 mm/yr and 501 billion m³/yr precipitation in total. There is currently around 112 billion m³ of available water, around 1,387 m³/capita-yr, which means Turkey is a water-stressed country.¹⁵ According to population projections Turkey’s population will be 88.4 million in 2030,¹⁶ which means available water will be around 1,267 m³/capita-yr assuming that the current water resources are conserved.¹⁷ Water extraction (abstraction) methods for municipal water supply are given in Figure 3. According to TUIK’s data,¹⁸ the largest water source is from dams (45%), while wells (27%), springs (17%), rivers (9%), and lakes (2%) are the other sources of water ex-

traction. The shift of water extraction from natural sources such as wells and springs to dams can be seen in Figure 4.

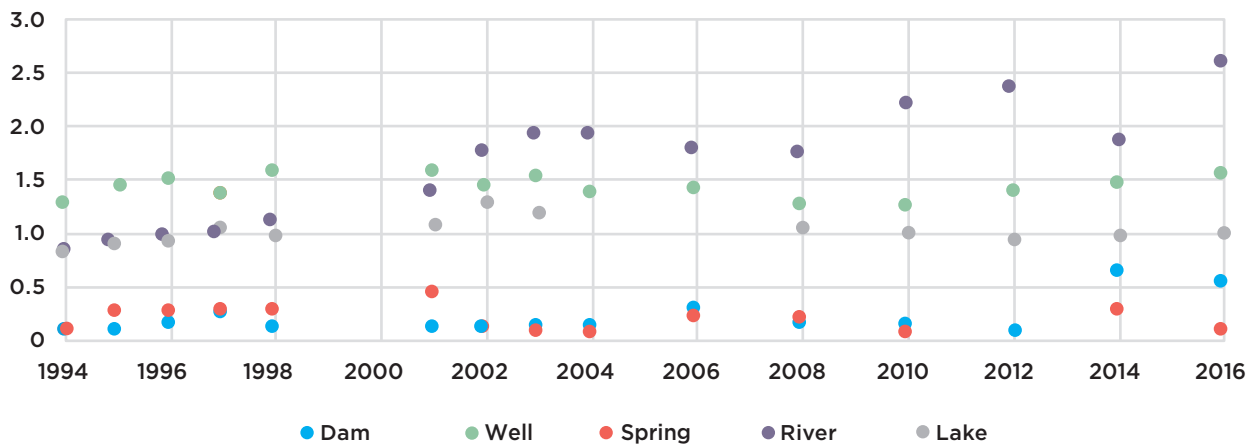
Previous periods of drought have reduced both water extraction and water consumption. Data provided by Turkstat shows a decrease in 2006 in all the extraction methods as a result of the drought in 2006.¹⁹ There is no available data for water extraction in 2007, but the drought period lasted from 2006-2007. The drought from 2006-2007 was an important cause in the decrease of water consumption after this time period. Figure 5 shows water consumption per person between 2001-2016.²⁰

Figure 3: Water Extraction for Municipal Water (2016)

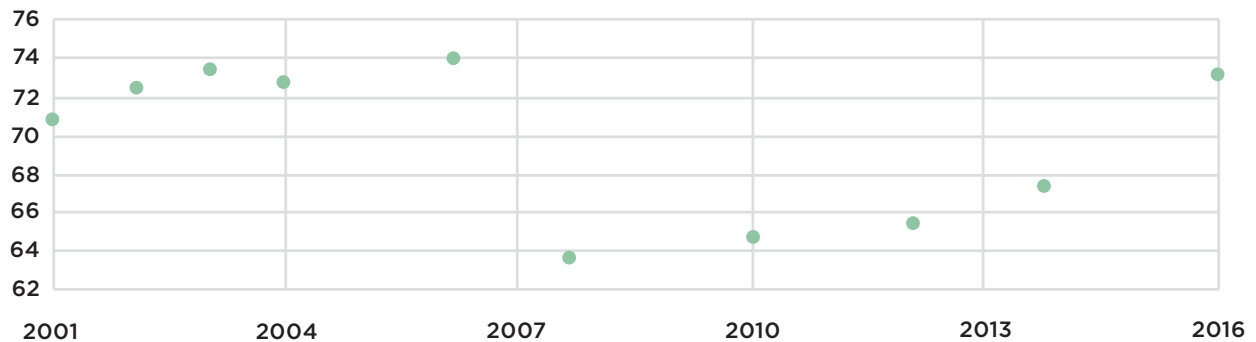


Source: Data from Turkstat, 2017.¹⁸

Figure 4: Water Extraction for Municipal Water Supply Network, 1994-2016 (billion m³)



Source: Data from Turkstat, 2017.¹⁹

Figure 5: Water Consumption Per Person (m³/capita-yr)

Source: Data from Turkstat, 2017.²⁰

Climate scientists recognize that the Mediterranean basin is one of the most vulnerable regions to the effects of climate change. As a country located in the eastern Mediterranean basin, Turkey also experiences several problems related to climate change like heat waves, droughts, storms, severe precipitation, and floods. Sen suggests that precipitation in Turkey will decrease according to the climate projections, and this leads to a decrease in the amount of usable water.²¹

Deforestation also threatens water security. Conversion of watersheds to urban regions changes the land use, preventing water drainage into the ground. This causes flooding and loss of water. All these problems lead to a decrease in the amount of water per capita, which is estimated to be less than 1,000 m³/yr by 2070. This is within the water scarcity level. Sen's projections show that water potential in the southern basins will decrease substantially, whereas the northern basins show small change or no change.²²

Agriculture is the most important consumer of water, and around 70% of the water used for agricultural purposes is consumed by irrigation. In Turkey, Euphrates and Tigris basins in the Southeastern Anatolia Region have the highest annual flow and water potential. These two basins have an important role in both energy production and agricultural irrigation. Projections show temperature increases over the entire basin,²³ which may decrease the water potential. As a result of the Southeastern Anatolia Project (GAP in Turkish) irrigation projects, irrigated agricultural area in the upper plains of Mesopotamia was enlarged after the 1990s. Due to higher temperatures and larger

irrigated areas, increased evaporation will cause greater water loss. According to the projections, the basin's water potential may decrease around 9-10% by 2041-2070 and 25-30% by 2071-2099.²⁴

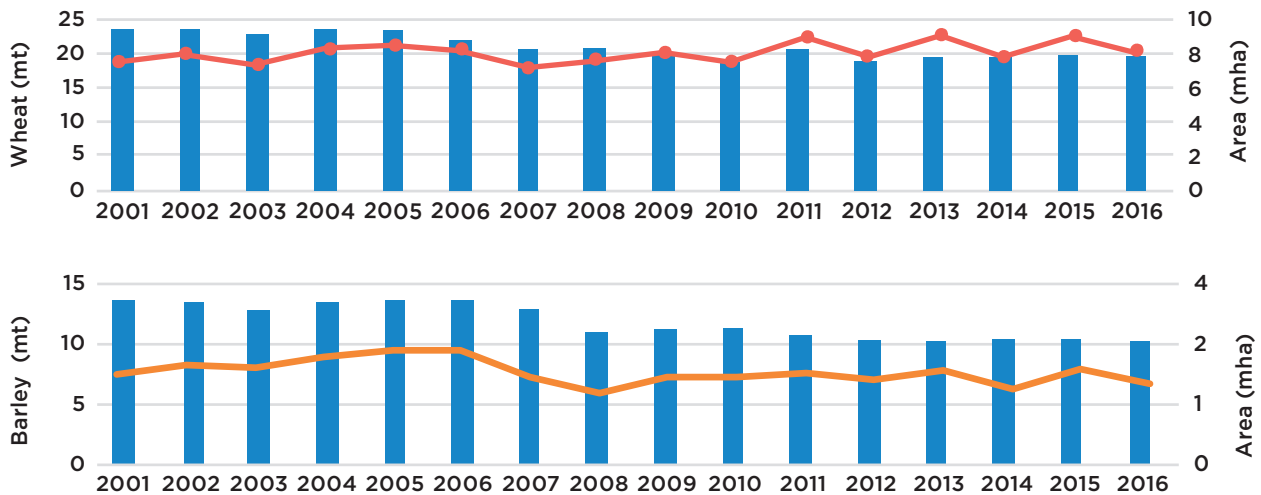
Agriculture in Turkey

Turkey has suitable conditions for agriculture, since it features a diverse climate. Several crops, fruits, and vegetables can be grown within Turkey's diverse climates. Its central plains are suitable to grow wheat, barley, and rye, and its coastal regions are suitable for fruit and vegetable production.²⁵ However, the soil carbon content is low in Turkey, which can limit total agricultural productivity, in addition to decreases in precipitation and extreme weather events.

Agriculture is important for the Turkish economy, despite a recent loss in agricultural production. Agriculture, forestry, and fishing's share in GDP was 6.2% in 2016.²⁶ According to the World Trade Organization's (WTO) research, agricultural exports increased from 10.9% in 2010 to 11.7% in 2014, and imports increased from 6.9% to 7.5%, respectively. The agricultural sector was the second largest economic sector in terms of total exports after transport equipment (13.7%). The total number of people employed in the agricultural sector was 5.47 million in 2014, 5.48 million in 2015 and 5.30 in 2016; but, the ratio of employment decreased from 21.1% to 20.6%, and to 19.5%, respectively.²⁷

In addition to climate change, urbanization and massive usage of pesticides and mineral fertilizer also decrease Turkey's usable agricultural

Figure 6. Wheat and Barley Production



Source: Data from Turkstat, 2017.²⁸

area. Total agricultural land decreased from 40.9 mha in 2001 to 38.5 mha in 2015. Cultivated area decreased from 17.9 mha to 15.7 mha, respectively, or a decrease of around 2.2 mha in 14 years.²⁸ Figure 6 shows the decrease of wheat and barley production areas. Wheat lands decreased from 9.4 mha to 7.7 mha, and barley lands also decreased from 3.6 mha to 2.7 mha between 2001-2016. Despite a 20% increase in population from 65.6 million to 78.7 million people,²⁹ wheat production increased only by 8% from 19.0 mt to 20.6 mt, and barley production decreased from 7.5 mt to 6.7 mt.

Climate change is projected to decrease yields for many agricultural products across many regions. For example, the Southeastern Anatolia Project brought water from the Euphrates River to arable lands in the region and created better conditions to grow cotton and corn. However, agricultural gains are projected to be short-lived in the Harran plain, for example, due to climate change. Additionally, the Aegean Region, one of the most important regions for fruit production, will be also adversely affected as a result of temperature increase. Antalya, which is a very important region for vegetable production, will be also affected due to the increase in temperatures and decrease in precipitation. The leading region in wheat production, Konya, will be affected by temperature increase and precipitation decrease, which cause decreases in water potential

in the basin. This may result in a decrease in the agricultural yield.³⁰ Research conducted by WRI based on IPCC scenario A1B reveals that water stress will increase in many agricultural areas. Turkey was one region that will be adversely affected. Furthermore, crop yields are predicted to decrease in equatorial zones and southern extratropical regions by 2050.³¹

Food Security

Sustaining food security is also an important challenge in the context of the growing world population and the growing population in Turkey. According to the FAO, around 795 million people (10.9 percent of the world population) were undernourished in 2014-2016.³² Meanwhile, the global population is expected to rise to 9.6 billion people by 2050; and accordingly, it will be necessary to increase available food calories by 60 percent by 2050 with respect to 2006 levels.³³ Providing enough nutritious food for all people is, therefore, becoming a critical issue.

Data from the Global Hunger Index suggests that Turkey has improved its situation with regards to food security. For example, Turkey showed a decrease in hunger levels from 14 percent in 1992 to less than 5 percent in 2017.³⁴ As mentioned above, the Global Food Security Index estimates that Tur-

key is 49th out of 113 index countries and 8th in the MENA region when taking into account indicators such as affordability, availability, quality, and safety of food in determining food security. There is also an additional adjustment factor related to natural resources and resilience. This factor adjusts the results in terms of a country's climate change vulnerability, natural resources, and adaptation efforts. Turkey's strengths in terms of food security are its nutritional standards, food safety, the proportion of the population under the global poverty line, volatility of agricultural production, presence of food safety net programs, and access to financing for farmers. Its primary challenges related to food security are public expenditure on agricultural research and development, gross domestic product per capita, and political stability risk.³⁵

Sustainable Development Goals

Alongside 193 countries, Turkey ratified the UN's Sustainable Development Goals (SDGs), which was a follow-up to the Millennium Development Goals (MDGs). SDGs have a wider scope than the MDGs, and they are more inclusive as SDGs take into account the situations of all people. SDGs are a set of seventeen "Global Goals" aiming to end all forms of poverty, fight inequalities, and tackle climate change for all people. SDGs entered into force on January 1, 2016.

The SDGs explicitly aim to promote food and water security around the globe. The second goal of the SDGs aims to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture" by 2030. One target of the goal is to "ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality."³⁶ The sixth goal of the SDGs aims to "ensure access to clean water and sanitation for all," within targets aiming to "substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the num-

ber of people suffering from water scarcity."³⁷ The thirteenth goal sets out to "take urgent action to combat climate change and its impacts" and aims to "integrate climate change measures into national policies, strategies and planning."

The SDGs are located within the scope of Turkey's policies and measures geared towards environmental awareness. Turkey was a volunteer country presenting its national reviews at the High Level Political Forum on Sustainable Development in 2016. The new 2030 agenda for the SDGs is an initial step for the country to integrate its goals into its National Development Plan (NDP). Turkey's tenth National Development Plan aims to combat climate change and its effect on water resources. It also aims to support sustainable agriculture and food security. During the preparation of the eleventh NDP, the SDGs were taken into consideration. However, it is more critical that these SDGs transform into action. In order to tackle water and food insecurity, it is important to meet these targets along with the others.³⁸

Results and Conclusion

Climate change threatens water resources, causes drought, and leads to land cover change. Along with climate change, population increase also threatens water and food security. Despite the decrease in water availability due to the increasing temperatures and decreasing precipitation, water demand rises with increasing populations and living standards. Food demand also rises with population growth, and changing climatic conditions make growing food products more difficult.

Currently, Turkey is experiencing a period of severe drought, and climate projections indicate a fall in water potential. Together with the population increase, the amount of water per capita is estimated to be less than 1,000 m³/yr by 2070, which implies water scarcity. Wheat and barley production decreased between 2001-2016, and climate change projections show a further decrease in yields for many other agricultural products across many regions. Despite the current decrease in yields, food security is not a big challenge today. More likely, water security has first become an important debate within the discussion on climate change.

In order to sustain water and food security in Turkey, investments in research and development should be increased as well as the efforts and commitments towards better management of water and food resources. With respect to water security, it is vital to protect forests. Integrated water management is the most important approach to conserve and manage water resources efficiently.

For instance, drip and sprinkler irrigation and smart irrigation systems can be applied to decrease the water consumption in the agriculture sector, as this sector is the largest water consumer. Water distribution networks should be repaired to prevent leakages and losses. Rainwater harvesting and recovery and recycling of industrial wastewater can also save fresh potable water. Raising public awareness for water resources conservation campaigns is also an important tool towards establishing water security.

As sustaining food security strongly depends on water security, similar solutions, such as drip and sprinkler irrigation and smart irrigation systems, can also be recommended to improve food security. Protecting agricultural lands, decreasing the excessive use of mineral fertilizers and using them more efficiently, decreasing the consumption of pesticides, and increasing the organic content of soil through compost and digestate applications can help in increasing productivity and crop yield. In addition to crop adaptation, crop yield monitoring and forecasting can be helpful.

Reducing food waste is also an important strategy in securing food for more people. These efforts can increase affordability, availability, quality, and safety of food. Raising public awareness is very crucial for food security, as well. It is important to buy the necessary amount of food, store it properly, and donate the rest of the fresh food instead of throwing it away.

By adopting these measures, Turkey can simultaneously contribute to the UN's Sustainable Development Goals in terms of "clean water and sanitation" and to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" by 2030. Working toward these global goals is the current solution for a sustainable world, ending all forms of poverty, fighting inequalities, and tackling climate change for all people.

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