

IMPACT OF CLIMATE CHANGE ON WATER STRESS AND WATER AVAILABILITY

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Türkiye is already considered a water stressed country. Over two-thirds of the country's 25 river basins face severe water scarcity, including those hosting the largest cities and economic hubs. With increased risk of drought and uncertain rainfall from climate change coupled with current water management practices, water security is an increasingly important issue, including for agricultural production and the rural incomes that depend on it. This article examines how climate change will impact water availability and the measures that can be taken to improve water supply, management and access.

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Türkiye, like other countries, is facing the harsh reality of climate change. In recent decades, floods, heatwaves, droughts, wildfires and landslides have affected the country with increasing frequency and intensity.

In 2021, Türkiye was particularly hit hard by climate changed induced extreme events:

- As a result of the drought in the second half of 2020 and early 2021, several reservoirs around major cities reached their lowest water storage levels in 15 years. For example, Istanbul's reservoir levels fell to less than 20 percent of their capacity, putting water supply services at high risk for the city's 16 million customers and other users, including industry.
- In June 2021, the outbreak of the Marmara Sea mucilage, believed to be the biggest in history, choked sea life, damaged the tourism and fishing industry, and threatened to impede the only shipping access to the Black Sea.
- In August 2021, the Black Sea region was hit by the worst floods in Türkiye's history. 97 people died and about 228 more were injured, more than 1,800 people were evacuated and at least 454 buildings sustained significant damage.

The Sixth Assessment Report of the United Nation Intergovernmental Panel on Climate Change highlights the Mediterranean Basin, where Türkiye is located, as one of the world's climate hotspots due to climate change. The report concludes that Türkiye will experience three accelerating trends at global warming of 2°C and above: (1) rising temperatures, (2) increase in droughts and aridity, and (3) rising sea water levels. Moreover, it predicts that 60 percent of the country's area could be subject to desertification if necessary measures are not taken.¹

These are big challenges for Türkiye, and improved water management strategies and significant climate financing will be needed over the coming years.

How Water-Secure is Türkiye?

Türkiye is already considered a water-stressed country. On the global scale, countries classified as water-rich have 8,000–10,000 cubic meters of water available per person per year whereas countries with less than 1,700 cubic meters – such as Türkiye, with about 1,600 cubic meters – of consumable water per person per year are classified as "stressed".² Over two-thirds of the country's 25 river basins already face severe water scarcity, including those hosting the largest cities and

1) Climate Change 2021: The Physical Science Basis. Official website: <https://www.ipcc.ch/report/ar6/wg1/>

2) The Falkenmark Water Scarcity Index ranks countries according to the amount of water available per capita.

economic hubs such as Istanbul, Ankara, Izmir, and Antalya, as well as important agricultural areas, such as the Konya plains.³ The current levels of water stress are likely to increase in the future, exacerbated by the effects of climate change, urbanization, and growth in economic activities such as tourism and agriculture. Turkish government experts believe that the available water could decline to as little as 1,200 cubic meters per capita annually by 2030.⁴

Despite increasing water scarcity, water use and withdrawals have steadily increased in recent decades. Between 2001 and 2020, total water withdrawal increased from 40.9 billion to 61.5 billion cubic meters per year. Agriculture remains the largest water consumer – 88 percent of water is used for irrigation, 10 percent by the municipal sector and 2 percent by the industry. In contrast, over the same period, most European countries were able to reduce their total annual water extraction rather than increase it, and even in southern Europe (where most irrigation undertaken by European countries occurs) agricultural water consumption was brought down by about 7 percent.

How Will Climate Change Impact Türkiye's Water Resources?

Climate change is primarily a water crisis. Its impacts will be mainly felt through the following channels: (i) water availability and stress; (ii) water quality and quantity; and (iii) intensification of extreme water-related events.

Climate change is expected to affect water availability and increase stress on surface and groundwater. According to a 2016 Climate Change assessment by the Ministry of Forestry and Water Affairs,⁵ exploitable water resources could decrease from 112.1 billion m³ to about 86 billion m³ by the 2050s – in an optimistic scenario. However, in a worst-case scenario, water demand may exceed Türkiye's exploitable water level as early as the 2030s. Irrigated agriculture, which consumes most the country's overall exploitable water, would be the hardest hit.

The combined impacts of climate change and excessive groundwater pumping due to increasing water demand have already caused a significant decline in groundwater levels. For example, in the Konya basin, groundwater levels have dropped by more than two meters, threatening the long-term sustainability of agriculture and contributing to the occurrence of massive sinkholes.⁶ While some sinkholes

3) Turkey Water Sector Engagement Note, 2020: 62.

4) Republic of Turkey, General Directorate of Water Management, Climate Change and Adaptation. Book, accessible online at <https://www.tarimorman.gov.tr/SYGM/Belgeler/iklim%20de%C4%9Fi%C5%9Fikli%C4%9Finin%20su%20kaynaklar%C4%B1na%20etkisi/iklimkitap2020.pdf>

5) Former Ministry of Agriculture and Forestry.

6) Sinkholes open up when underground caverns created by drought can no longer contain the weight of the soil layer above.

are relatively shallow, others can be as deep as 150 meters. Simulation of aquifer behavior until 2050 predict reductions in recharge of aquifers and groundwater availability, particularly in the coastal plains along the Mediterranean Sea where groundwater is the main source of irrigation water.⁷

Climate change is expected to exacerbate negative impacts of pollution on water quality. In many areas, increased water temperatures can cause eutrophication and greater outbreaks of harmful algal blooms. This in turn will impact the water quality of lakes and reservoirs as well as wetlands and ecosystems, with negative impacts on livelihoods of those depending on fishery and aquaculture.

A recent example is the climate change-induced warming of the Marmara Sea which – combined with widespread pollution from the discharge of untreated industrial and domestic wastewater and agricultural uses of fertilizers and pesticides – contributed to the Mucilage Crisis in June 2021.

Climate change is expected to increase the frequency and intensity and the costs of extreme water related events. Climate change has not been proven to directly cause individual extreme environmental events, but it has been shown to make these events more destructive, and likely happen more frequently than they normally would be.

In 2007-08, Türkiye experienced a severe drought that affected more than 435,000 farmers and resulted in economic losses of US\$ 1.4–2.2 billion.⁸ Likewise, devastating floods in 2006 and 2009, totaled almost 1 trillion US\$ in damage. It is estimated that in the event of a 100-year flood, more than 3 percent of GDP (US\$20 billion) and 3 million people (3 percent of the population) could be affected.⁹

7) Avci et al. 2021. Assessing the effect of climate change on groundwater use in Demre coastal aquifer (Antalya, Turkey), coupled use of climate scenarios and numerical flow modeling.

8) M. Bagherzadeh and M. Shigemitsu, “Building the resilience of Türkiye’s agricultural sector to droughts. OECD Food, Agriculture and Fisheries,” Papers 167, OECD Publishing (2021). Available at: <https://ideas.repec.org/p/oec/agraaa/167-en.html>

9) GFDRR, (2019).

The Impacts of Water Security and Climate Change for the Economy, Environment and Society

Water is a connector across sectors – such as agriculture, energy, and industry. It also plays an essential role in human capital accumulation and health. Water dependent sectors are also supporting economic recovery and contributing to job creation and employment. The 2015 World Water Development Report noted that three out of four jobs constituting the global workforce are dependent on water.¹⁰

Water and the Economy

Water is critical for food security and rural development. Since the 1980s, policies have supported lucrative cash crops, transforming Türkiye into the world's top ten agricultural producer. The sector is also a workhorse for the economy: as Türkiye's largest employer, it supplies jobs to nearly a fifth of the workforce and accounts for 6 percent of the country's economic activity. On the flip side, almost all export oriented and import substitution crops are heavily dependent on irrigation which accounts for almost 75 percent of the country's freshwater use — a figure that is not sustainable. Over the last decades, the switch to more water-intensive cash crops has dramatically depleted groundwater aquifers and dried out entire river systems. This has forced many farmers to drill illegal wells that tap already low groundwater. Agriculture's staggering water consumption is also due to the ages-old irrigation techniques of Türkiye's farmers: open channels and raised canals that deliver water to crops overland. It is estimated that these systems suffer water losses of 35 to 60 percent through evaporation, seepage, and leakage. The agriculture sector is expected to be most severely affected by climate change. As a result of droughts in the past years, farmers in Konya, Edirne and İzmir, already reported below-average harvest of wheat and other crops, forcing Türkiye to increase grain imports.

Water is essential for energy security. More than 25 percent (or 57.5 TWh) of the country's electricity demand is supplied from hydropower which also constitutes 60 percent of Türkiye's total installed renewable energy capacity.¹¹ There are more than 700 dam/reservoirs in Türkiye, with varying sizes. The water collected in these dams' is essentially used for three purposes: irrigation, domestic water supply and for electricity generation. Climate change effects, especially alterations in evaporation, river discharge, temporal precipitation patterns, frequency of extreme meteorological events, and glacial melt rate, could potentially induce appreciable change in Türkiye's hydroelectric production.¹²

10) 2016 World Water Development Report – Water and Jobs: <https://www.unescap.org/sites/default/files/2016%20UN%20World%20Water%20Development%20Report-%20Water%20and%20Jobs.pdf>

11) Source: <https://www.hurriyetdailynews.com/hydropower-capacity-grows-despite-drought-lowering-output-167560>

12) Hydropower Vulnerability and Climate Change: A Framework for Modeling the Future of Global Hydroelectric

Water is indispensable for industry and tourism. Tourism is one of the most dynamic and fastest developing sectors in Türkiye: in 2018, Türkiye attracted around 46 million foreign tourists, ranking it as the 6th most popular tourist destination in the world. Travel and Tourism contributed around 12 percent of Türkiye's total economy and supported 2.2 million jobs (or 7.7 percent of total employment).¹³ However, tourism makes great seasonal demands on local resources, in particular, water supply and sewerage facilities, and the environment. During the tourist season from May to September, the resident population increases more than five-fold in coastal settlements located on the Aegean and Mediterranean coasts. In these areas, water is being supplied mostly from groundwater and in excessive amounts to satisfy the demand of the newly developed settlements, which has already led to lowering the water table and resulting in sea-water intrusion in most of the coastal aquifers. Likewise, sewage generated by congested population has caused pollution of bathing waters to exceed the standards relating to human health and environmental protection.¹⁴

Water and the Environment

Water and its related ecosystems, including lakes, wetlands, and coastal zones, provide a wide range of benefits, such as natural water storage, flood protection, and biodiversity conservation. Yet, Türkiye's water-related ecosystems are under increasing stress from factors such as, widespread water pollution due to the discharge of untreated or insufficiently treated industrial and municipal wastewater effluents, high levels of groundwater withdrawals, and agricultural activities.

The combination of drought and excessive abstraction of water has already led to the drying up to several lakes and wetlands. The Lake Tuz in the Konya basin was once the country's second largest lake, and it was visited by thousands of flamingos each summer in the past. Almost half of the famous salt lake has dried out and has begun the process of transforming into salt basins due to drought and continuous water withdrawal for irrigation. The same conditions affect Eregli Marshes and Bafa Lake.

Resources.

13) World Tourism Organization, (2019).

14) Harmancioglu and Altinbilek, (2019).

The discharge of untreated wastewater into freshwater bodies and the sea, and pollution from agricultural practices have caused widespread water quality and pollution concerns. While wastewater treatment capacity has steadily increased in the last decade, about 16 percent of domestic wastewater and 38 percent of industrial wastewater is still not treated before being discharged into water bodies.¹⁵ A third of Türkiye’s lakes and up to half of its rivers are considered either “contaminated” or “highly contaminated” by phosphorus and nitrogen.¹⁶ Climate change induced warming of receiving water bodies exacerbates the impacts of excessive nutrient discharges (mainly nitrogen and phosphorous) from inadequate wastewater treatment – such as on the Marmara Sea, resulting in the Mucilage crisis in 2021.

Water and the Society

Water is at the core of human capital development. Türkiye has made steady progress in increasing access to safely managed water and sanitation services to its people. In 2021, 99 percent of the population were connected to a piped water network, and 78 percent of the population had access to safely managed sanitation services. This relatively high sanitation coverage has also contributed to declining mortality rates: the under-five mortality rate has significantly declined from 75 percent in 1990 to 9.5 percent in 2020.

Türkiye is currently hosting over 3.5 million refugees. While Türkiye’s refugee response has been progressive and provides a model to other countries hosting refugees, the refugee and migrant influx has put significant pressure on existing municipal infrastructure, especially in the Southeastern part of the country. The population in the most affected municipalities has increased between 20 and 95 percent. In some of the impacted municipalities, the most vulnerable refugees are dwelling in informal urban and peri-urban settlements, some of which have inadequate access to water supply and sanitation services.

Türkiye’s Climate Change Policies and Road to Decarbonization

In 2021, Türkiye ratified the Paris Climate Agreement and committed to net zero by 2053. The country is now preparing its long-term climate change strategy and action plan to enhance adaptation, accelerate mitigation of greenhouse gas emissions, and increase co-benefits for cities, sectors, and ecosystems. Accordingly, Türkiye will update its Nationally Determined Contribution (INDC) submitted in October 2015.

15) OECD, (2019).

16) Turkey Water Sector Engagement Note, 2020: 11.

There are also some encouraging signs at the domestic and regional levels. Türkiye's 11th Development Plan (2019-2023) acknowledges its commitment to undertake a “green transformation”. In addition, Türkiye's Ministry of Environment, Urbanization, and Climate Change launched a Regional Climate Change Course of Action, in which it identified necessary actions to combat the adverse effects of climate change and underlined its awareness of the need for new strategies to preserve water sources, reduce water consumption, increase rain harvests, recycle water, and install drip-irrigation systems.

Opportunities Await

Despite the above, Türkiye still lacks a binding Water Law that can regulate state mechanisms, as well as civil society. Türkiye has strong water resource management capacity in general. However, its water resource management governance framework is fragmented, with multiple administrative and legislative shortcomings that limit efficiency in core functions.

Various institutions take part in different stages of flood and drought risk management processes such as planning, design and implementation of structural and non-structural measures on risk reduction, preparedness, response, and recovery. The Ministry of Agriculture and Forestry (MoAF) is currently preparing a new Floods Law which could be a good opportunity for elimination of unclarities and overlaps in terms of institutional responsibilities. With regard to drought management, the National Strategy and Action Plan for Drought Management for 2017-2023 was published in 2016. In addition to this Strategy, the MoAF - DG of Agrarian Reform recently announced the Strategy and Action Plan for Agricultural Drought for 2023 – 2027. However, there is a need for development of an integrated approach for drought management which considers all types of droughts (hydrological, meteorological and agricultural) and clear description of roles and responsibilities for all related institutions.

In 2003, Türkiye adopted an Integrated Water Resource Management Policy. The DG of Water Management is currently preparing River Basin Management Plans, Flood Management Plans, Drought Management Plans and Sectoral Water Allocation Plans in line with European Union Directives related to water as required per the Policy. However, further efforts are needed for disaster and climate resilience principles to be systematically integrated into all above mentioned policies, regulations, and investments for flood and drought risk management.

In conclusion, there is a need for further review and strengthening of the governance framework to improve efficiency and effectiveness, through completion of sector reforms, including enactment of the Draft Water Law pending Parliament approval since 2016. The new Law is expected to eliminate overlapping responsibilities of different government authorities to ensure effective co-ordination among different institutions and enable public participation in water management practices.