Adaptation Theme Study

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TSKB

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Abbreviations

°C	degree Celsius
WWTP	Wastewater Treatment Plant
EU	European Union
ADB	Asian Development Bank
AF	Adaptation Fund
AfDB	African Development Bank
LDN	Land Degradation Neutrality
BOD	Biochemical Oxygen Demand
CIF	Climate Investment Fund
COP26	26th Conference of the Parties
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
GCF	Green Climate Fund
GEF	Global Environment Facility
IDBG	Inter-American Development Bank
IDFC	International Development Finance Club
IPCC	Intergovernmental Panel on Climate Change
IsDB	Islamic Development Bank
COD	Chemical Oxygen Demand
MDB	Multilateral Development Bank
OIZ	Organized Industrial Zone
SCF	COP Standing Committee on Finance
TSKB	Industrial Development Bank of Turkey
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WBG	World Bank Group

1. INTRODUCTION

The risk dimension of climate-related impacts depends on the complex interactions between climate-related hazards and the vulnerability, exposure and adaptation capacity of human and natural systems. Current levels of global greenhouse gas emissions progress towards exceeding global temperature thresholds of 1.5 °C or 2 °C above pre-industrial levels, which would increase the risks of climate change impacts beyond what has been measured to date.

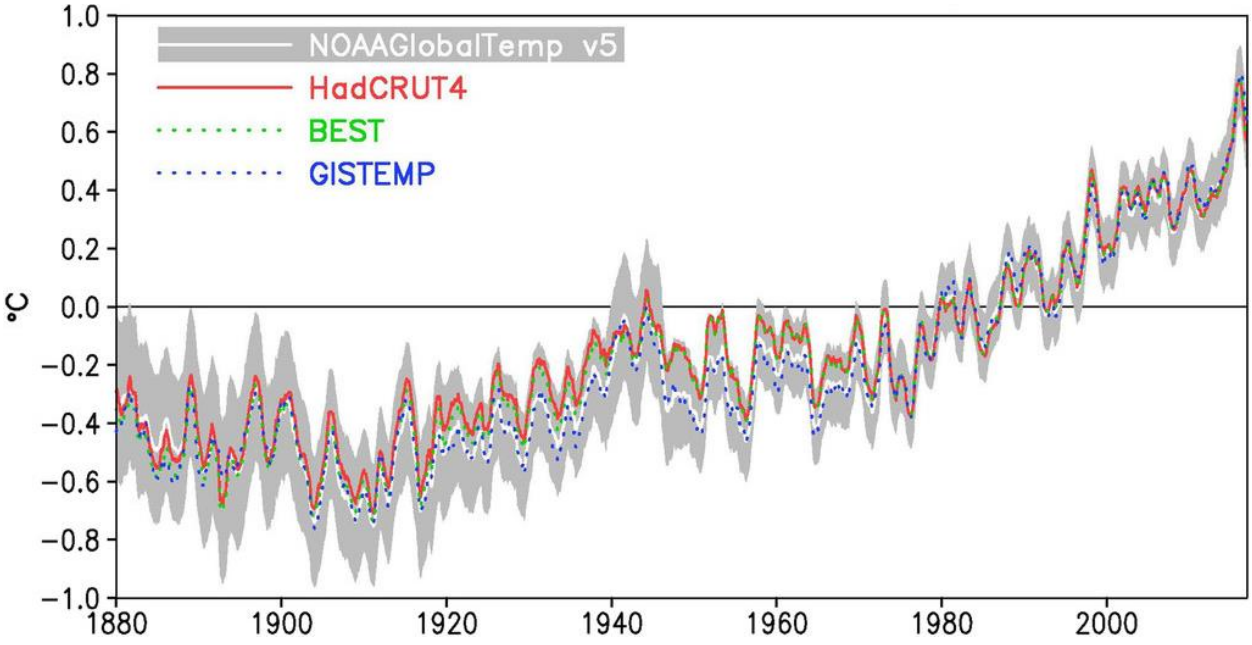

Chart 1. Global Temperature Change By Years

Source: American Meteorological Society (2020)

Climate events currently pose risks through impacts on health, food and water security as well as human security, livelihoods, economy, infrastructure and biodiversity. It is a fact that climate change also has impacts on ecosystem services[1].

Intense precipitation has caused massive floods, dam collapses, landslides and the displacement of millions of people in Bangladesh, China, India, Japan, Pakistan, Nepal, Republic of Korea, Turkey and Vietnam. Heavy flooding and landslides were experienced especially in China, where 29,000 houses were destroyed as a result of the floods and more than 2.2 million people were evacuated from the flood zones by mid-July 2020.[2]

[1] **Ecosystem Services**: These are the contributions of the ecosystem structure and function to human well-being. *Source (Burkhard B, Maes J (Eds.) (2017) Mapping Ecosystem Services)*

[2] WMO (2021). "State of the Global Climate 2020".

In February 2020, a total of 41 people lost their lives due to the avalanche disaster in Bahçesaray district of Van. In September 2020, 6 people were injured due to the impacts of the severe dust storm in Ankara's Polatlı district.[3]

Figure 1. September 2020 Polatlı Sandstorm

Source: www.ekonomist.com.tr (2020)

Climate change primarily affects infrastructure and superstructure, given their long lifespan and high investment costs as well as their fundamental role in the functioning of society and economy.

Structures may be vulnerable to climate change due to their design (such as vulnerability to storms) or their location (such as flood risk areas and landslide zones). Because of this vulnerability, structures may be damaged or become unusable due to changing climatic conditions or extreme weather events (rise in sea levels, flood, drought, extremely low or high temperatures, strong winds, etc.). Resilient structures and systems against these climate events are important to ensure the continuity of existing services, to prevent human and biodiversity losses, and to minimize its economic impact dimension. This resilience will be achieved through adaptation investments.

1.1. Definitions

1.1.1. Climate Change

A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1992).

[3] Turkish State Meteorology Service (2021). “State of the Turkey's Climate in 2020”, Ankara.

Halting all greenhouse gas emissions would still not prevent the climate impacts that are already occurring. These will continue for decades, even if global and European efforts to cut greenhouse gas emissions prove effective results. Even drastic temporary decreases of emissions, like those caused by the 2008 financial crisis or the economic disruption from the COVID-19 pandemic, have little effect on the overall trajectory of global warming.[4]

The frequency and severity of climate and extreme weather events continue to increase. In the last two decades, a rise has been observed in the number of natural disasters and the damage caused by them. Many climate change impacts materialize from forest fires and heatwaves just above the Arctic Circle to devastating droughts around the Mediterranean, ravaging hurricanes in the EU and the forests destroyed by bark beetle infestations in Central and Eastern Europe.

1.1.2. Adaptation

In IPCC (2014) report, adaptation is defined as "the process of adjustment to actual or expected climate and its effects". .[5] Adaptation can be expressed as creating opportunities based on existing conditions as well as preventing or reducing damage. In some natural systems, adaptation is facilitated by human intervention.

Changes made in any process, practice and structure to mitigate possible negative impacts or to take advantage of climate change-related opportunities can be considered as adaptation practices. Therefore, countries and societies adopt adaptation practices to minimize the emerging impacts of climate change and to prepare for future impacts.

Anticipatory adaptation – The type of adaptation that occurs before the impacts of climate change are observed. It is also called proactive adaptation.

Autonomous adaptation – An adaptation that does not produce any conscious response to climatic stimuli, but is triggered by ecological changes in natural systems and market or welfare changes in human systems. It is also called spontaneous adaptation.

Planned adaptation – A type of adaptation that is the result of a deliberate policy decision based on the awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve the desired state.[6]

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[4] European Commission (2021). "Commission Staff Working Document Impact Assessment Report | Forging a climate-resilient Europe – The new EU Strategy on Adaptation to Climate Change", Brussels, Belgium.

[5] IPCC (2014). "Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change", Geneva, Switzerland.

[6] IPCC (2007). "Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change", Cambridge University Press, Cambridge, United Kingdom.

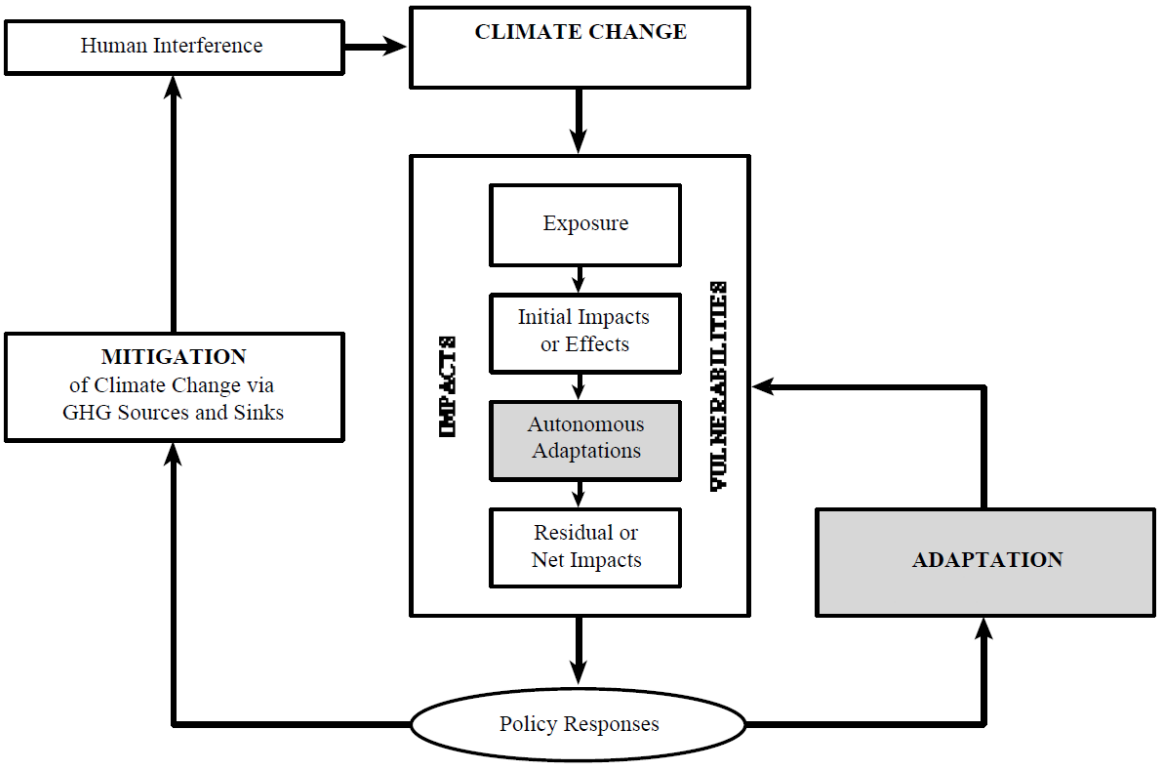

Figure 2. Climate Change and the Place of Adaptation

Source: IPCC (2018)

Adaptation requires adequate knowledge of the risks and vulnerabilities involved to identify the needs and appropriate options needed to mitigate risks and build capacity. While creating an adaptation approach to climate risks, it is important to involve individuals with different knowledge, experience and background in the process to reach a common approach.

In the past, the identification of needs for adaptation was mostly based on impact assessments (or risk-hazard analyses), but the assessments of social vulnerability or resilience are also increasingly used. Rooted in risk and disaster management, the risk-hazard analysis focuses on the potential negative impacts of natural disasters and other climate risks on a particular location. The focus in this approach is on the physical and biological aspects of impacts and adaptation. Social vulnerability focuses on the reasons and ways in which individuals, groups and communities are vulnerable to climate risks. The focus is on how different factors such as institutions shape socioeconomic conditions that put human populations at risk. Therefore, it is observed that there are overlaps and complementarities between different analysis types regarding risk assessments.

Climate change may be very rapid and severe in certain regions and at any time, and adaptation may become impossible. As a result, strategies to manage risk may not be available or may be costly. In that case, climate change may have reached a threshold or limit for adaptation. Limits may be ecological, economic, physical, social or technological. To give an example on an economic limit; the cost of

protecting any asset (residence, business, touristic facility, power plant, etc.) against sea level rise by constructing a sea dam is acceptable where the level of protection covers the risk within a few decades, but the economic limit is exceeded when the cost required to manage the risk exceeds the value of the protected asset by far. However, if the ecosystem and society are protected against the related climate risk, it becomes clear that adaptation investment should not be considered only in terms of assets, even if the economic limit is exceeded.

1.1.3. Vulnerability and Resilience

The measure of how vulnerable a system is to the adverse effects of climate change is called vulnerability. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, or its adaptive capacity.[7]

Resilience is the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions. In terms of environment, it is the sum of policies, infrastructures, services, transportation, energy infrastructure and planning that position local, private and national administrations against natural disasters and the adverse effects of climate change.

The extent of any climate change risk is generally measured by the degree of exposure, the extent of the hazard, and the resilience of the asset or system affected by that risk.

1.2. Background

Climate change has been on TSKB's agenda since the 2010s, and recognizing that there are activities that can be carried out by the private sector aside public sector for the adaptation sub-title, TSKB has initiated the process for conducting research on climate change adaptation, analyzing potential adaptation investments and reviewing practices relevant to Turkey in 2021. In this framework, global and national practices related to climate change adaptation have been compiled.

This Report has been drawn up with the aim of defining the current status and raising awareness for possible adaptation investments in Turkey, which is vulnerable to climate risks among many others, and of extending insights on adaptation finance as for the existing and the future investments.

[7] UNFCCC (1992). “United Nations Framework Convention On Climate Change”, FCCC/INFORMAL/84 GE.05-62220 (E) 200705, Secretariat of the United Nations Framework Convention on Climate Change, Bonn, Germany.

2. CLIMATE FINANCE

2.1. Global Climate Finance Practices

Climate finance can consist of local, national or international financing that can be obtained from public, private and alternative sources of financing and is critical to addressing climate change. Large-scale investments are required to reduce emissions and support adaptation policies, especially in sectors that cause large-scale greenhouse gas emissions. Climate finance is equally essential for adaptation, where significant financial resources will be similarly required to help societies and economies adapt to adverse impacts and mitigate the effects of climate change.

Many underdeveloped-developing countries and small island nations lack financial resources required to prepare for and cope with the effects of climate change (prolonged droughts, intense storms, extreme temperatures, wildfires and rising sea levels, etc.) and to complete their transition to clean energy. The United Nations Environment Programme (UNEP) estimates that developing countries may need $300 billion annually by 2030 and $500 billion annually by 2050 to cope with climate change.[8] Therefore, climate finance—private or public funding for investments in adaptation and mitigation measures—is a key point in tackling the climate crisis. Access to such financing (loans or funds) will help developing countries invest in their transition to clean energy and mitigating climate risks. Therefore, climate finance will be one of the top agenda items among developing countries during the 26th Conference of the Parties (COP26) to be held in Glasgow, Scotland in November 2021.

During COP15 in 2009, developed countries committed to mobilize an annual amount of USD 100 billion by 2020 to raise funds from a variety of sources, including governments, multilateral development banks (MDB), and private organizations so as to help underdeveloped countries with their transition to green energy and adaptation to climate risks. However, this commitment has not been fulfilled so far, and according to the estimations of the Organization for Economic Cooperation and Development (OECD), the climate finance achieved in 2018 remained USD 20 billion below the target.

Estimates of the climate finance gap vary by geography, sector and time scale. The World Development Report published in 2010 states that the financing need within the scope of mitigation and adaptation activities in developing countries is USD 140-175 billion per year for mitigation regarding the upcoming two decades and USD 30-100 billion per year for adaptation for the period covering 2010-2050.

Since 2012, the European Investment Bank has disbursed EUR 170 billion in climate finance to reduce emissions and help raise people's awareness of climate change and biodiversity reduction in Europe and around the world. 20% of the entire European Union (EU) budget for 2014-2020 is allocated for climate finance, and the European Commission recommends increasing this share to at least 25% for 2021-2027 period. In addition, the European Investment Bank defines itself as the EU's climate change bank and states that it has increased its targets in financing environment and climate investments for the 2021-2030 period.

[8] United Nations Environment Programme (2021). “Adaptation Gap Report 2020”, Nairobi, Kenya.

The "Catalyzing Climate Finance" report published by UNDP in 2011 summarizes finance flow regarding climate finance in

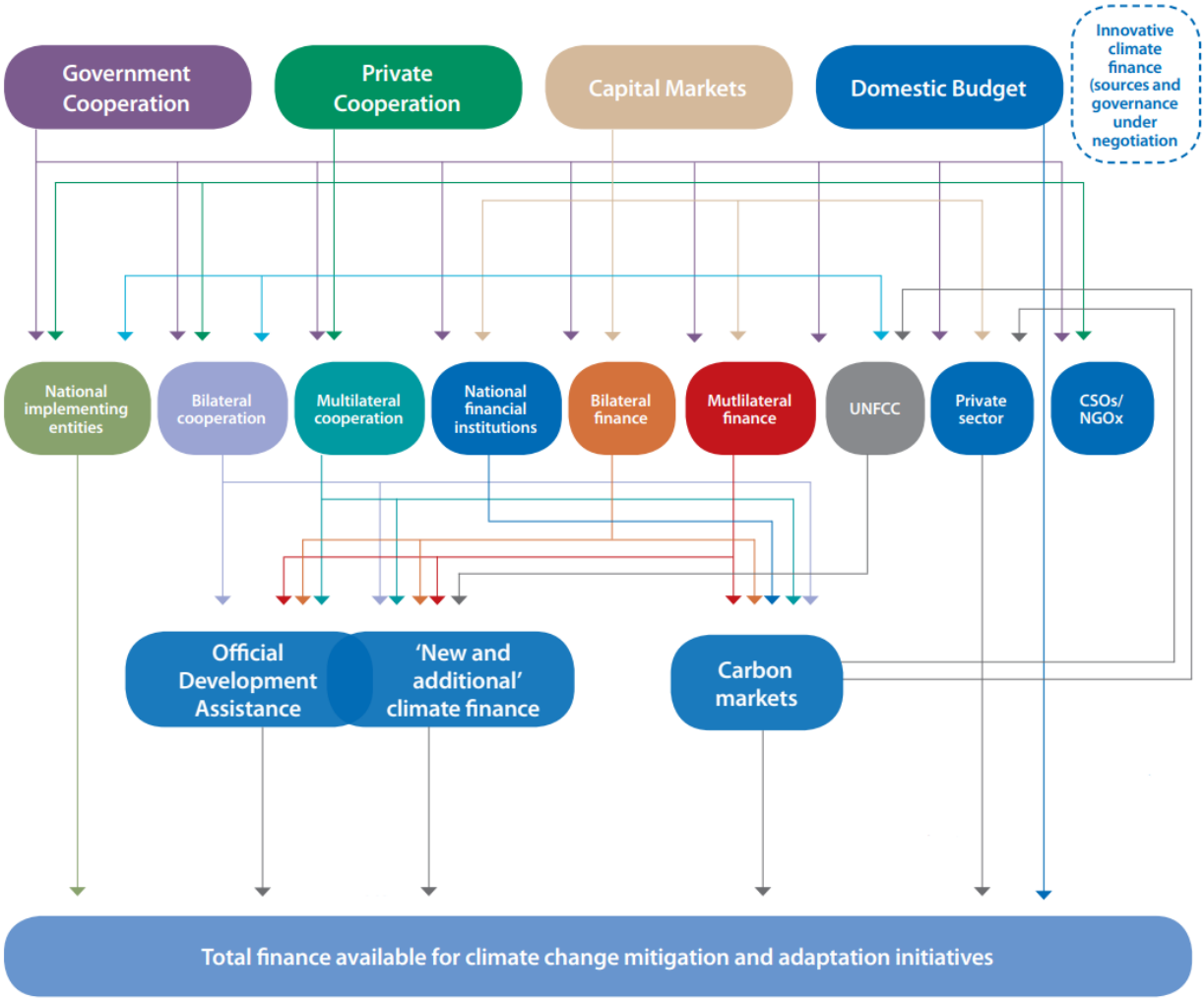

Figure 3.

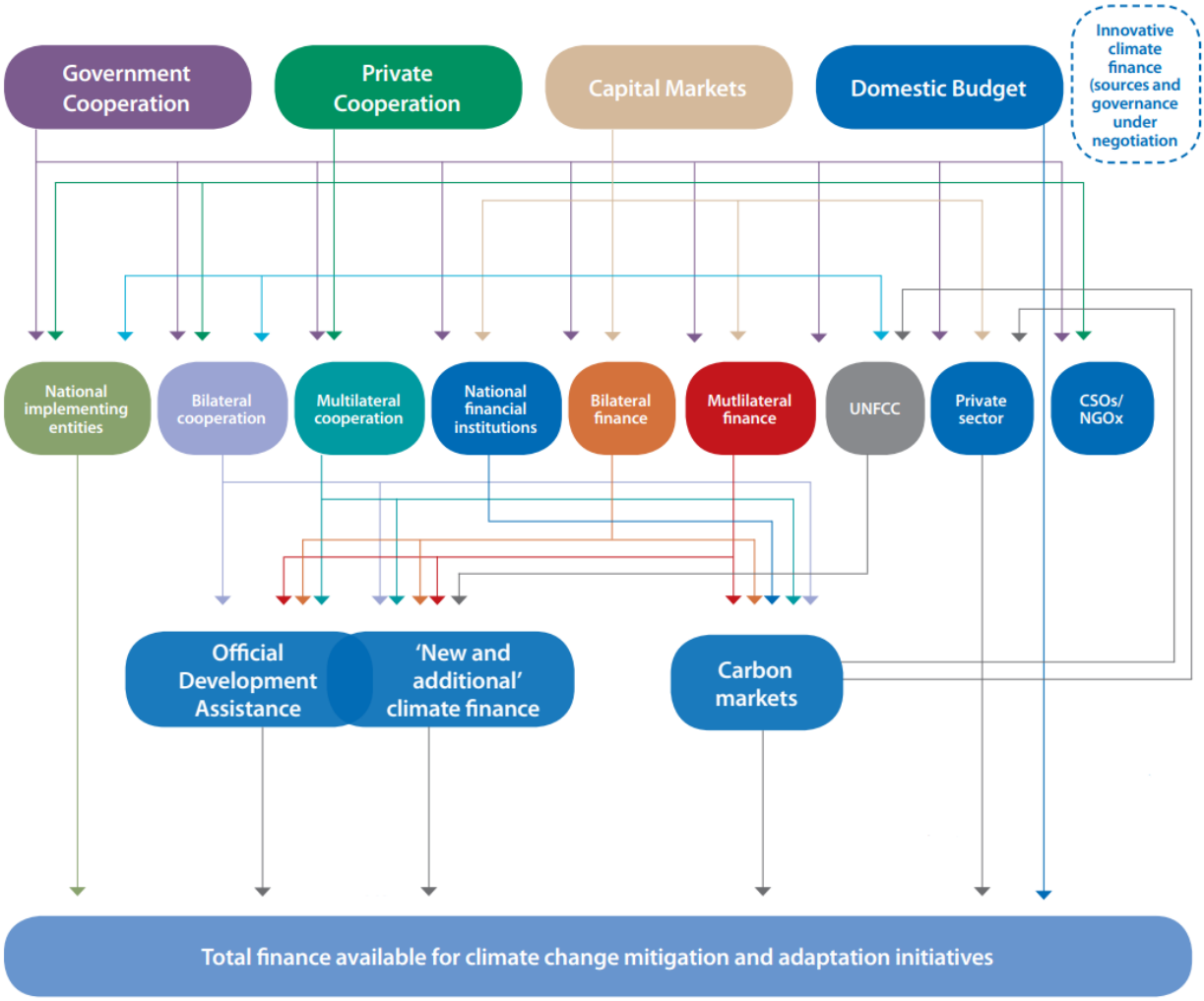

Figure 3. Climate Finance Flow Chart

Source: UNDP (2011)

Multilateral climate funds (Intergovernmentally-managed funds) are important for climate finance. The largest multilateral climate funds stand out as the Climate Investment Fund (CIF), Green Climate Fund (GCF), Adaptation Fund (AF) and Global Environment Facility (GEF). In 2016, these four funds approved USD 2.78 billion in project support. India gets the highest support as a single country followed by Ukraine and Chile. Tuvalu receives the highest fund per capita, followed by Samoa and Dominica. While the USA is the country offering the largest support among the four funds, Norway gives the largest contribution by population density. Most multilateral climate funds use a wide variety of financing instruments, including grants, loan, equity and risk mitigation options. The new strategy programs launched by CIF in 2020 are as follows:

- Renewable Energy Integration into Power Systems Program
- Climate-Smart Urbanization Program
- Program to Accelerate the Low-Carbon, Climate-Resilient Transition in Industry
- Nature, Human and Climate Investments Program

- Relevant programs for the future developed within the scope of the Strategic Climate Fund

While the aforementioned Climate-Smart Urbanization Program is an initiative aimed at supporting the climate resilience of cities, the Renewable Energy Integration into Power Systems Program will offer climate finance to support developing countries within the framework of creating technology pathways that balance the need for different infrastructure requirements across the renewable energy sector. It is expected that Turkey will apply to the said Renewable Energy Integration into Power Systems Program in 2021.

Climate finance of the six largest MDBs rose to a seven-year high of USD 35.2 billion in 2017. According to IRENA, the global energy transition could contribute USD 19 trillion in economic gains by 2050. At the Climate Action Summit in New York in September 2019, MDBs unveiled their annual climate action targets for 2025. Accordingly, MDBs aim to offer at least USD 65 billion USD of climate finance, of which USD 50 billion will be transferred to low and middle-income countries; to raise the contribution to adaptation finance to USD 18 billion; and offer USD 110 billions of co-financing, including a private direct mobilization of USD 40 billion.

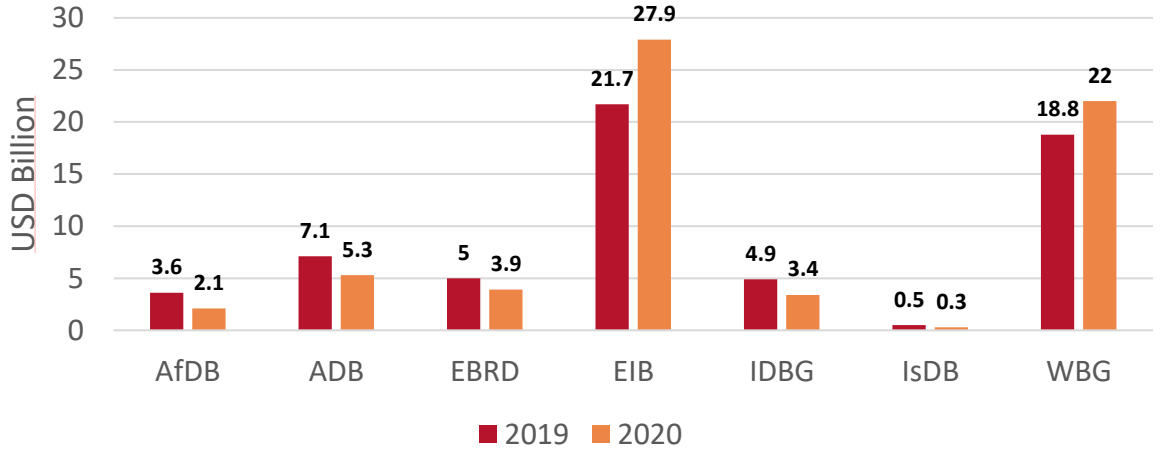

Chart 2. 2019-2020 Climate Finance Commitments of MDBs

Source: MDBs Joint Report and TSKB (2021)

As can be seen from the chart, the institutions that contributed the most to climate finance in 2019 and 2020 are the European Investment Bank (EIB) and the World Bank Group (WBG). According to the report prepared jointly by MDBs every year, the total amount of climate finance in 2020 stood at USD 66 billion and USD 38 billions of this amount were disbursed to low and middle-income countries.

According to the report of MDBs, it is seen that the climate finance in Turkey has decreased over the years as reflected by Table 1.

Table 1. Climate Finance in Turkey

	2015	2016	2017	2018	2019	2020
USD Billion	2.58	2.14	1.79	1.45	1.45	1.38

Source: Joint Report on Multilateral Development Banks' Climate Finance (2021)

In climate finance, public funding has been a primary source of infrastructure investment. However, public budgets are often insufficient for larger and more complex infrastructure projects, especially in low-income countries. Investments made against climate risks have higher investment requirements than traditional measures and may carry higher financial risks due to the high upfront costs of projects. If countries are to access necessary financing, it is important to consider the full range of financing sources and needs, as well as the different mechanisms offered based on them and how they can be combined. Therefore, private financing is needed to close the climate finance gap.

The private sector is considered to be relevant for integration into sustainable urban infrastructure projects where an adequate return on investment is estimated based on project revenue streams or low-risk repayments. For this reason, the prerequisite for attracting the private sector is the credibility of projects. Potential sources of climate finance include private ventures, commercial banks, investment firms, pension funds, insurance companies and government wealth funds. These different types of investors will have different risk-return expectations.

Contributions to climate finance will not reach a sufficient level without private capital, as is frequently emphasized in the reports published at different times by the IPCC, UNFCCC, and MDBs. It is strongly expected that attracting the private sector to climate finance will become the priority of states, intergovernmental organizations and MDBs in the future in order to achieve net zero targets.

2.2. Green Finance and Adaptation

Roles of various actors in society such as the government and the private sector, the content of adaptation strategies, the types of benefits and costs, the role of timing and a number of other factors are determined by economic studies related to adaptation.

2.2.1. MDB Adaptation Finance

In 2015, MDBs and the International Development Finance Club (IDFC) agreed on a set of Common Principles for financing climate change mitigation and an initial set of Common Principles for financing to support climate change adaptation. The aim was to adopt a common approach to climate finance reporting in the near future, together with monitoring activities. In December 2019, MDBs and IDFC members jointly published the "Framework and Principles for Climate Resilience Metrics in Financing Operations" document to introduce a framework for climate resilience measures in financing operations and also to reveal the basic concepts and features of these criteria.

As stated in the 2021 report jointly prepared by MDBs, adaptation aims to mitigate risks or vulnerabilities caused by climate change and improve climate resilience. Determination of adaptation financing is the result of a three-stage process and in order for a project to be fully or partially considered within the scope of MDB adaptation financing, it is necessary:

- to set out the context of the project's vulnerability to climate change;
- to make a clear statement of intent for eliminating vulnerability as part of the project; and

- to indicate that there is a clear and direct link between the vulnerability and specific project activities.

In 2020, MDBs announced a total commitment of USD 16.1 billion for adaptation financing, out of which USD 13.3 billion (83%) was transferred to low and middle-income economies. In addition, USD 10.3 billion of the adaptation financing in 2020 was offered through investment loans. Investment loans are followed by policy-based financing and grants. From a sectoral point of view, financing was mostly transferred to energy, transportation and infrastructure within the scope of adaptation finance in 2020.

2.2.2. World Bank Group

WBG published the Climate Change Action Plan for 2021-2025 in June 2021, following the 2016-2020 Climate Change Action Plan that was published for the first time. The Action Plan aims to advance WBG's Green, Resilient and Inclusive Development (GRID) approach. Since the Action Plan is intended for offering measurable improvements for adaptation and resilience and measurable reductions in greenhouse gas emissions, it aims to support countries and private sector investors in order to boost the impact of climate finance.

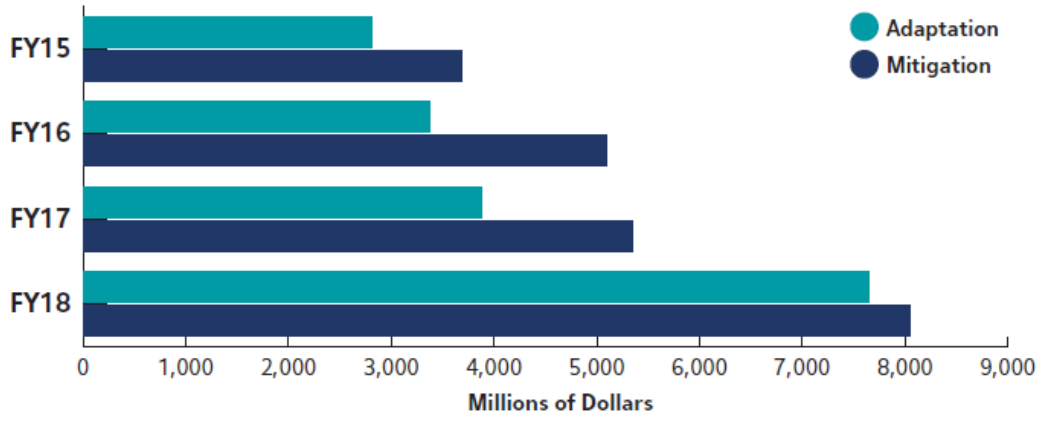

Chart 3. WBG's Adaptation/Mitigation Financing in 2015-2018

Source: World Bank (2019)

It is important that climate and development become integrated with each other in order to successfully create adaptation and mitigation and to achieve sustainable economic development. Within this framework, WBG has set three goals. These are as follows:

- Increasing country-level participation in climate and development diagnosis, planning and policies to help countries achieve their climate and development goals;
- Aligning WBG's financial flows with the objectives of the Paris Agreement so that the climate issue can be further mainstreamed into WBG's development activities; and
- Increasing the climate finance allocated for adaptation and mitigation.

The Action Plan aims to increase the climate finance and the WB plans to place the theme of adaptation at the focus. In this context, at least 50% of IDA and IBRD's climate finance will be allocated for adaptation.

Thus, the WB aims to support projects (early warning systems, climate information services, flood and drought management, watershed management, etc.) to be carried out in line with the Climate Change Adaptation and Resilience Action Plan published by the WB in 2019.

2.2.3. IDFC

IDFC has been periodically mapping the green finance contributions of member institutions since 2011. During the 2019 UN Climate Action Summit, IDFC made several commitments including efforts to further align financial flows aimed at improving climate finance with the Paris Agreement and the Sustainable Development Goals. To this end, IDFC has taken a step forward and developed a strategic partnership with GCF. The partnership agreement with the GCF was signed in June 2019 to collaborate in integrating climate subjects in financial institutions and facilitate access to GCF resources through co-financing from IDFC members.

According to the report published by IDFC in 2020, member institutions announced a total green financing commitment of USD 197 billion in 2019, a rise of 47% year-on-year. Climate finance, on the other hand, amounted to around USD 187 billion corresponding to approximately 95% of this amount. However, the finance allocated for adaptation is around USD 19 billion, only 10% of the climate finance.

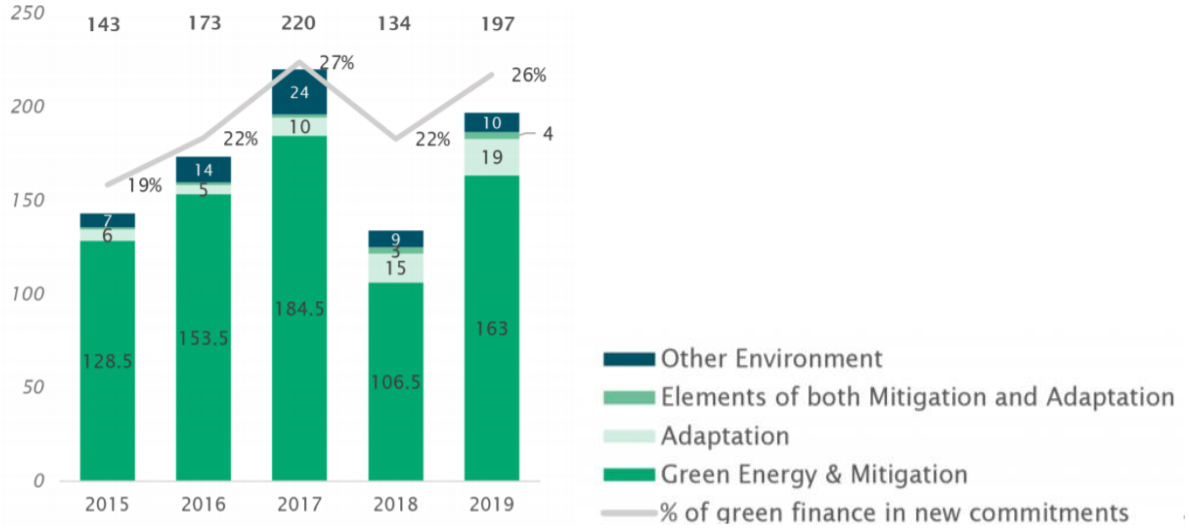

Chart 4. IDFC Green Financing Commitments

Source: IDFC (2020)

Although the adaptation monitoring methodology developed jointly with MDBs explains methods on how to follow or monitor the adaptation finance, there is a lack of clear investments in contrary to mitigation and there is still no clear-cut conclusion as to which investment can be considered for adaptation. Therefore, consultations with IDFC member institutions and other MDBs are ongoing to achieve clearer results in the adaptation finance methodology.

2.2.4. European Union

For adaptation and resilience, it is necessary to identify financial resources, especially for underdeveloped countries and developing small island nations. Globally, approximately 93% of public and private finance for climate action is conveyed to mitigation. The finance allocated for climate adaptation reached an average of EUR 25 billion per year in 2017, with real need estimated to be ten times that amount. The EU's overall climate finance support for the countries outside the union rose by 7.4% to EUR 21.9 billion in 2019, 52% of which was used for the adaptation of the EU's partners. The EU's share of climate finance, especially for adaptation, is expected to increase. The European Commission aims to increase resources and further mobilize larger-scale adaptation finance, including innovative mechanisms such as the European Fund for Sustainable Development Plus (EFSD+).

The EU's Adaptation Strategy sets out a long-term vision for the EU to be a climate-resilient community fully adapted to the inevitable effects of climate change by 2050.[9] Given the inevitable rise of climate pressures in the upcoming years, the Strategy document highlights how prepared the EU's financial risk management strategies should be to deal with the effects of climate change in any emissions reduction scenario. The gap analysis report prepared by the EU in 2021 argues that there is no effective mechanism for EU member states to collect, evaluate and report data on economic losses due to extreme weather events. Therefore, it is observed that even the EU, which has almost all necessary resources, should improve itself in the planning stage for adaptation.

2.3. COP26 and Its Implications

At COP16 held in 2010, the Parties decided to establish the Standing Committee on Finance (SCF) to assist the COP in fulfilling its functions related to the financial mechanism of the Convention. The SCF has four specific functions: assisting the COP in improving coherence and coordination in the provision of climate change finance; assisting the COP in rationalizing the UNFCCC's financial mechanism; supporting the COP in mobilizing financial resources for climate finance; and supporting the COP in measuring, reporting and validating the support offered to developing country parties. The SCF is also tasked with holding an annual forum on climate finance, providing draft guidance to the COP for operating entities, providing expert support in conducting periodic reviews of the financial mechanism, and drawing up a biennial assessment and overview of climate finance flows. In addition, SCF develops links and promotes coordination with climate finance-related actors and initiatives within and outside the Convention. At the 2015 Paris Conference, the Parties decided that SCF would also serve the Paris Agreement.

COP26's manifesto on action for adaptation states that further action is needed to prevent or minimize the loss and damage already caused by climate change. To that end,

[9] European Commission (2021). “Commission Staff Working Document Impact Assessment Report | Forging a climate-resilient Europe – The new EU Strategy on Adaptation to Climate Change”, Brussels, Belgium.

- It is necessary to engage in planning and financing for resilient infrastructure and agricultural investment so as to improve early warning systems, flood protection systems and prevent loss of life, livelihoods and habitats.
- Protecting and restoring the ecosystem is a powerful way to increase resilience to the effects of climate change.
- All countries are expected to produce an Adaptation Communication document that outlines the effects of climate change, the challenges they face, where they need help, and planning for subsequent stages.

Stating that the UK and other countries must "help those who are the ones most affected by climate change" to build confidence in the conference, COP26 President Alok Sharma adds that a significant increase is expected regarding the role of adaptation finance for COP26 and priorities have been set for facilitating the achievement of the "mobilization of USD 100 billion" target.

It is known that the emissions triggering climate change are mostly caused by developed countries, but the countries where the effects of climate risks are observed and expected to be observed the most are underdeveloped and developing countries. The countries that will be affected by climate change in the first place are those in the low and middle-income groups. One of the most obvious consequences of this change is extreme weather events. Therefore, if developing countries lose faith in the willingness of developed countries and MDBs for financial and technical support, this climate of insecurity may hinder progress regarding the decisions to be taken against climate change at COP26. Efforts to allocate adequate climate finance to combat the climate crisis will be of great importance in the upcoming period.

3. CLIMATE RISKS AND ADAPTATION PRACTICES

3.1. Climate Risks

The effects of climate change encompass the ecosystem and society. Following the increase in temperature, precipitation patterns change and the sea level rises. These changes pave the way for extreme weather events such as heat waves, droughts, hurricanes, blizzards and rainstorms and cause climate risks such as fire and flood to occur more frequently and intensely. As a result of climate change, the diversity of many terrestrial, freshwater and marine species is also affected. If temperatures continue to rise uncontrollably, the risk of extinction of some plant and animal species will increase. In addition, climate change may cause an increase in exposure to infectious diseases and/or emerging disease-carrying microorganisms or vectors.

Climate change affects all regions of the world and its effects are already observed. If adaptation and mitigation actions are not implemented within the scope of combating climate change, the severity of climate risks will intensify and continue to increase. Turkey is among the countries that will be affected by climate change, especially due to its geographical location, and is on the verge of experiencing rising heat waves, sudden precipitation, floods and drought disasters. The following sub-headings cover climate risks in Turkey and the consequences of these risks.

3.1.1. Heat Wave

Continuation of the seasonal normal temperatures 3 to 5 °C above the average maximum temperatures for 5 consecutive days or more is called a heat wave.[10] As greenhouse gas concentrations increase global temperatures, heat waves are becoming more frequent and intense, and climate change is increasing the incidence of heat waves and extreme weather events.

Turkey's average temperature in 2020 was 14.9 °C. This value was 1.4 °C above the average seasonal normal temperature (13.5 °C) between 1981 and 2010, and 2020 became the third warmest year since 1971. According to the Turkish State Meteorology Service (MGM), the weather temperature in Cizre district of Şırnak province on July 20, 2021 was 49.1 °C and was recorded as the highest value ever measured. July of 2021 was the second warmest month of the last 50 years[11].

[10] https://www.mgm.gov.tr/

[11] https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx

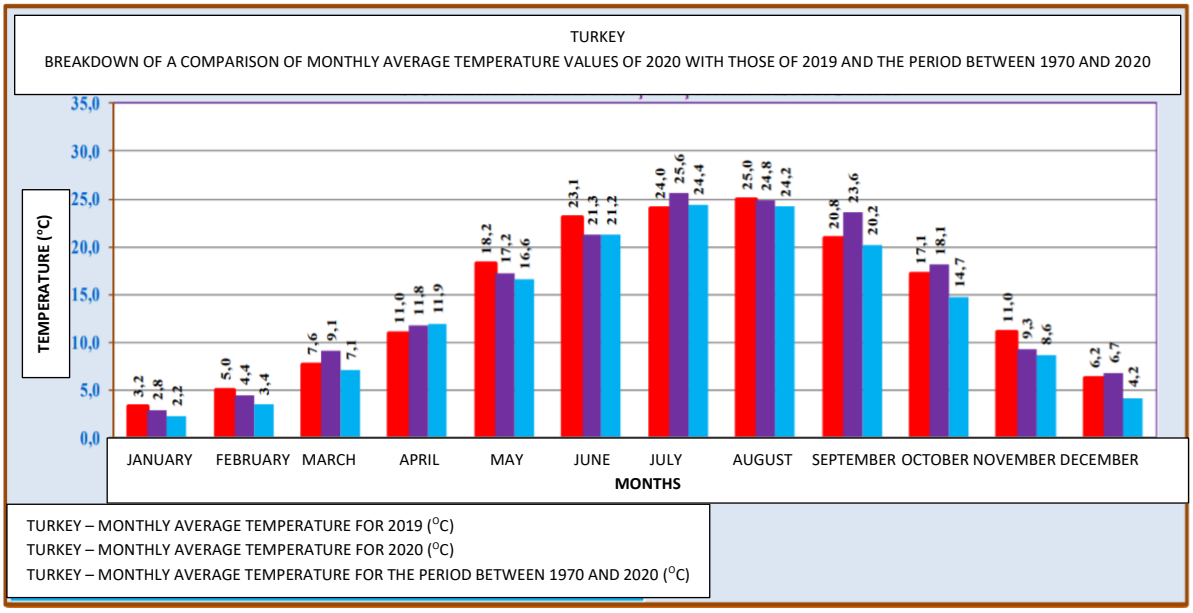

Chart 5. Turkey - Average Temperatures Between 1970-2020 and in 2019 and 2020

Source https://www.mgm.gov.tr/ (2021)

3.1.2. Flood and Inundation

Flood is a rapid increase in the amount of water in a river, stream and creek bed due to abnormal rainfall in the basin or the melting of the existing snow cover in the basin, causing damage to living creatures, lands and property around the bed. After long-term excessive and heavy rainfall, especially overly-sloping and impermeable soil is flooded. In addition, the melting of the snow cover as a result of a sudden rise in temperature in the basins where snowfall is also heavy can lead to floods and affect the flood flows.[12] Environmental factors such as global climate change and land use change can increase the flood risk.

As a result of the heavy rainfall that started in the Western Black Sea region on August 11, 2021, floods occurred in Bartın, Kastamonu and Sinop provinces in Turkey. Ulus district of Bartın province, Azdavay, İnebolu, Bozkurt, Küre and Pınarbaşı districts of Kastamonu province and Ayancık district of Sinop province were affected by the flood and a total of 81 people including 70 in Kastamonu province, 10 people in Sinop province and 1 person in Bartın province were killed due to flood. [13]

[12] https://www.mgm.gov.tr/

[13] https://www.afad.gov.tr/

Figure 4. August 2021 Kastamonu Province, Bozkurt District Flood Disaster

Source: https://www.birgun.net/ (2021)

3.1.3. Mucilage

Mucilage (sea snot) is a soft, transparent and sticky organic substance excreted into sea water due to the excessive reproduction of phytoplanktons (planktonic organisms responsible for oxygen production), the first step of biological production in the sea, triggered by various environmental factors such as a rise in sea temperature and a rise in the phosphorus and nitrogen load in the sea, etc. Mucilage threatens the life of inactive creatures especially in the depths of the sea by covering them, and causes the death of sea creatures under the surface layers of the sea by preventing them from getting oxygen. In May 2021, mucilage formation was observed surrounding the water surface and depths of the Sea of Marmara.

Figure 5. May 2021 Mucilage in the Sea of Marmara

Source: https://www.dw.com/tr/ (2021)

3.1.4. Forest Fires

Hot weather and arid climatic conditions caused by climate change trigger forest fires. There were 299 forest fires in 54 cities across our country stretching from the Aegean Region to Southeastern Anatolia.[14] Only in Muğla and Antalya, approximately 124 thousand hectares of forest area burned down. Additionally, according to the data of the European Forest Fire Information System, the forest area burned down during the fires since the beginning of 2021 is around 178 thousand hectares. [15]

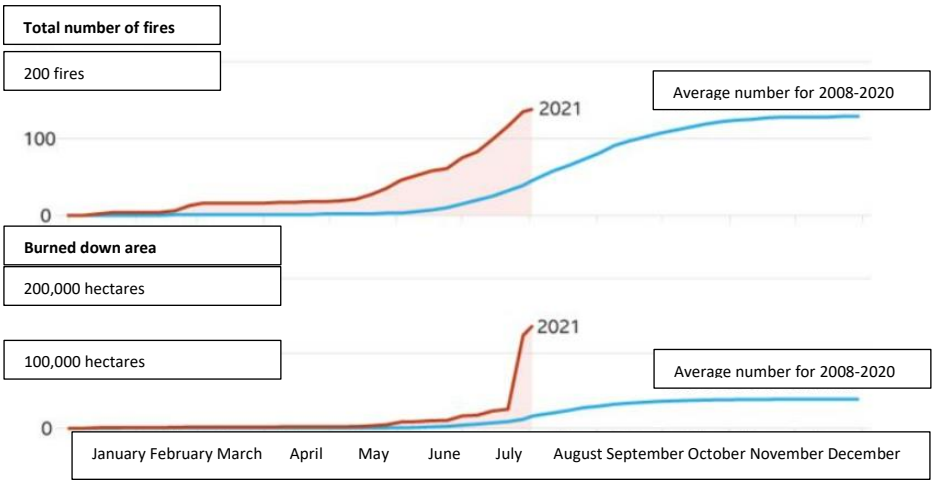

Chart 6. Forest Fire Statistics in Turkey

Source: https://www.bbc.com/turkce (2021)

Figure 6. 2021 - Forest Fire in Marmaris district of Muğla province

Source: https://www.haberturk.com/ (2021)

[14] https://web.ogm.gov.tr

[15] https://www.greenpeace.org/turkey/

3.1.5. Sand and Dust Storms

Sand and dust storms are low-atmosphere events caused by wind erosion releasing sediment particles from the ground surface. Sandstorms occur near the earth's surface, but finer dust particles can be lifted kilometers high into the atmosphere, where strong winds carry them for long distances. Vegetation cover, dust and climate are the main factors influencing the formation of a dust storm. Land degradation contributes to climate change through changes in the energy balance in the atmosphere and the formation of greenhouse gases and directly causes a rise in the dust. Climate change can lead to an increase in the frequency and intensity of droughts and dust storms.

On September 12, 2020, a severe sandstorm materialized in Polatlı and Haymana districts of Ankara province and 6 people were injured as a result of the storm.

Figure 7. 2020 - Sandstorm in Polatlı district of Ankara province

Source: https://www.posta.com.tr/ (2021)

3.1.6. Decrease in Water Availability

Water, which is the main source of life on earth, is a very essential and valuable environmental resource that is available in solid, liquid or gaseous form. Being a limited resource, “water” is among the resources most affected by the climate crisis. In the diamond-water paradox, the famous economist Adam Smith, presented to the world of economy in 1776, states that instead of valuing water, which is very important and essential for their own lives, people prefer to pay much higher amounts for minerals such as diamonds, which have no value for human life.[16] Given that food and energy owe their existence to water, the greatest danger would be the dehydration of a region. Therefore, the main question is what should be done so that water prices do not resemble diamond prices. At this point, the question of which regions are more endangered in terms of water availability becomes very important.

[16] TSKB (2019). SU: Yeni Elmas, https://www.tskb.com.tr/i/assets/document/pdf/TSKBBAkis_SUYeniElmas_Subat2019.pdf

Measuring the water potential for a particular country/region, the Falkenmark Indicator is calculated by the ratio of the current water resources of the relevant country/region to the number of people living in the relevant country/region. A value of less than 1,700 m^3/person/year within this indicator shows that the relevant region is under water stress. As this value decreases, the degree of water stress increases. The amount of water per capita in Turkey, 1,358 m^3/person/year according to the population values in 2019, decreased to 1,339 m^3/person/year in 2020 with the rise in population. It is estimated that the water potential of Turkey, which is expected to have a population of 87 million in 2023, will decrease to 1,289 m^3/person in 2023.

Some of the highly populated countries, such as Russia, the United States, and Brazil, have high Falkenmark Indicator values and do not face any water stress. Known for its richness of underground water resources, Norway is one of the countries with the highest Falkenmark Indicator value due to its relatively low population. Although China has the highest amount of renewable fresh water in the world, it has a low Falkenmark Indicator value due to its high population.

Table 2. Country Indicators Based on the Falkenmark Indicator

Country	Renewable Fresh Water Source (million m^3)	Population (2020)	Falkenmark Indicator (m^3/person/year)
Canada	2,791,500	38,005,240	73,450
Norway	384,015	5,379,480	71,385
Brazil	8,425,901	212,559,410	39,640
Russian Federation	4,507,250	144,104,080	31,278
Croatia	105,500	4,047,200	26,067
United States of America	2,478,000	329,484,120	7,521
Switzerland	53,512	8,636,900	6,196
Netherlands	89,680	17,441,140	5,142
Romania	42,293	19,286,120	2,193
China	2,861,900	1,402,112,000	2,041
Poland	63,100	37,950,800	1,663
Turkey	**112,900**	**84,339,070**	**1,339**
South Africa	31,738	59,308,690	535
Algeria	14,320	43,851,040	327
Israel	1,670	9,216,900	181
Malta	78	525,280	148

Source: *World Bank, United Nations, TSKB Economic Research*

Given the regional situation of Turkey, it is known that the country is located in a "semi-arid" region although it is surrounded by water on three sides. Turkey consists of 25 river basins with a total area of 780 thousand km^2. The Falkenmark Indicator differs in each basin. The reason for these differences is the population and water potential of the basins. According to the calculations, 5 river basins prove to be unluckier compared to the others. These unlucky basins include Marmara, Gediz, Küçük Menderes, Burdur and Akarçay. While Marmara basin consists of Istanbul, Kocaeli, Balıkesir, Bursa and a part of Edirne, one of the biggest threats in this basin is the high population within the region. Among the 25 basins, 9 basins, including the Tigris-Euphrates, Eastern Black Sea, Aras, Antalya and Çoruh basins, are more fortunate than the others.

Globally, a very high proportion of water is used in agricultural activities. Globally, approximately 69% of water resources are used for agricultural purposes, 19% for the industry sector and 12% for domestic use. Managing water resources more effectively is important in Turkey, as in many other countries. According to the most recent data published in 2018, Turkey's water use amounted to 61.5 billion m^3. In 2018, 17.8% of the total water used in Turkey was used by industry and 10.7% by households. During the same year, agricultural irrigation covering both groundwater and surface water uses accounted for 71.5% of the total water use in Turkey. However, these rates also vary regionally. It is expected that the ratio of industrial water use to total water use will be higher in regions with a more developed industry sector when compared to regions with more intensive agricultural activities.

Water Index

Calculated on a weekly basis by TSKB Economic Research, the Water Index (WI) depends on the relationship between water assets and water use estimates across Turkey. Although WI is not an indicator of the amount of water availability and water use, it is based on the relationship between these two values and shows this relationship at a more up-to-date and higher frequency. WI calculations make use of the databases owned by the Directorate General of State Hydraulic Works, the Turkish Statistical Institute, the Turkish State Meteorology Service, the Central Bank of the Republic of Turkey and Enerji Piyasaları İşletim A.Ş., as well as public databases from other countries and within the country.

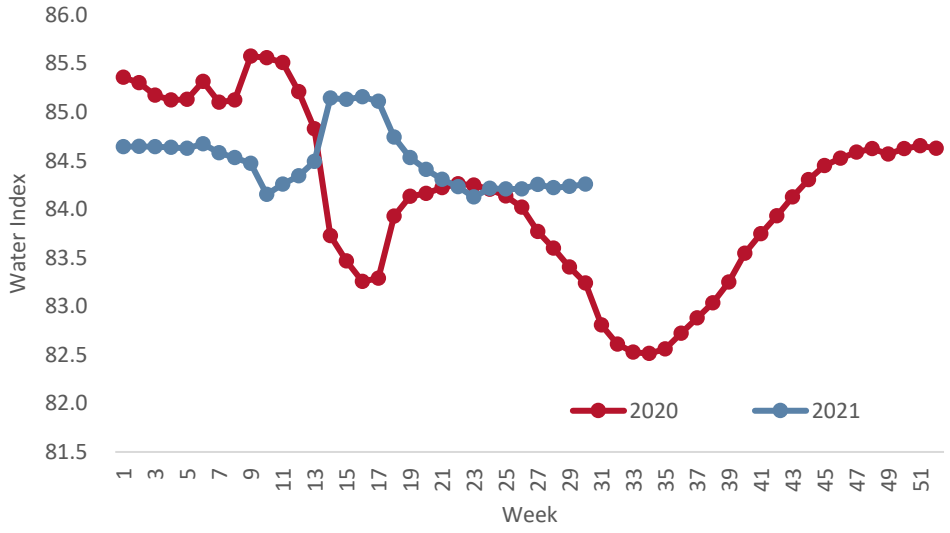

Chart 7. 2020-2021 Turkey Water Index

Source: TSKB (2021)

Methodology of the European Environment Agency is taken as reference when calculating WI. Within the scope of the calculations, weekly estimates of water use in households, industry and agriculture are produced using statistical and econometric methods. While the index generates a value between 70 and 130, a drop in the index indicates that water use increases relative to water assets and a rise in the index

points to a decrease in water use relative to water assets. Generating a value of 84.26 as of the end of July 2021, WI reveals the necessity of managing water resources in Turkey more effectively and efficiently.

3.2. Current Practices around the World

Climate change completely changes the benefits derived from ecosystem, biodiversity and ecosystem services or these systems. Climate change causes ecosystems to change, local and global extinctions, and the permanent loss of certain gene combinations. This increases the level of vulnerability in some sectors that depend on ecosystem services. Climate change is expected to have a relatively greater impact on underdeveloped regions or countries in economic terms due to lack of financial resources, reduced quality of housing, distrust in local ecosystem services, and limitation of basic services and basic resources. Therefore, the vulnerability of underdeveloped or developing countries to the effects of climate change will be higher.

The causes and solutions of vulnerability may occur at different social, geographical, temporal and political scales. For this reason, some social assessments should be performed from local to national dimensions, identifying institutional opportunities so as to disclose the critical needs of the affected population and the underlying conditions leading to these needs. Local assessments should assist in identifying existing vulnerabilities such as current policies, plans, strategies, natural hazards and contribute to building resilience.

In this framework, it is important to be prepared for current and yet unseen climate risks by determining the infrastructures (agriculture, health, energy, transportation, infrastructure, etc.) that are considered critical at local and national scale, and measuring the asset base of vulnerability and resilience.

In its report published in 2020, IDFC has summarized potential adaptation investments as indicated in the table below.

Table 3. Potential Adaptation Investment Areas

Category	Activity
Water protection	Basin management planning (Adaptation to decrease in stream levels)
	Domestic rainwater harvesting (Adaptation to increased salinity due to sea level rise)
	Rehabilitation of the water transmission infrastructure
Agriculture, natural resources and ecosystem-based adaptation	Crop diversification options
	Sustainable fishing methods
Coastal protection	Dam construction for the protection of coastal structures
	Natural barrier construction (mangrove forest, etc.) to prevent coastal erosion

Category	Activity
Mitigation of other disaster risks	Early warning systems for extreme weather events
	Improvement of drainage systems to prevent floods (Example: İzmir Grand Canal Project)
	Insurance against natural disasters
	Construction of resilient infrastructures (Example: integrating protection systems into dams, rehabilitation investments, etc.)
Climate change policy development	Contributions of local, sectoral or national budgets to the climate change adaptation policy

Source: IDFC (2020)

There may be sectors or sub-sectors that may be affected by many climate risks. Therefore, adaptation investments are also concentrated in these areas. These are resilience-building investments such as water efficiency, agricultural practices, infrastructure and energy investments, etc.

In its 2014 report[17], IPCC categorizes adaptation options under three main categories:

- Structural;
  - Engineered and built environment
  - Technological
  - Ecosystem-based
  - Services
- Social;
  - Educational
  - Informational
  - Behavioral
- Institutional;
  - Economic
  - Laws & Regulations
  - Policies & Programs

According to the report, there are many different ways to categorize the adaptation options available. While it is not possible to completely accept any categorization in general, such categorizations are intended to take into account the diversity of adaptation options for different sectors and stakeholders. Some options are divided into different scales; national, sectoral or local adaptation plans are also likely

[17] IPCC (2014). "Climate Change 2014: Impacts, Adaptation and Vulnerability. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

to include a set of jointly-implemented measures from various categories, including the above-mentioned structural, social and institutional options.

3.2.1. Water Management

Sustainable and climate-resilient water management is a critical building block for the climate resilience of industries, ecosystems and society at large. Therefore, water management or efficiency is of great importance in achieving the 2030 Sustainable Development Goals (SDGs) (especially 2, 6, 13, 15). Efforts to improve climate-resilient water management must be further strengthened through policy, research and innovation, knowledge generation and capacity building. Successful water management practices require coordinated action at all political-administrative levels, from local and national to cross-border. However, the resilience of water systems also heavily depends on sustainable practices and coordination between them, particularly in sectors such as agriculture, energy and urbanization (urban development).

Climate-resilient water management needs to be further strengthened as a cornerstone of adaptation and overall climate resilience.[18] Water management that is resilient to climate risks also opens up opportunities to create shared benefits for the economy, ecosystem and society at large, including mitigation impacts. While some nature-based solutions offer many benefits, including conservation of biodiversity and recreation, they can also yield successful results in water efficiency. For example, the restoration of wetlands for flood protection and water storage can support biodiversity and livelihoods and thus improve the quality of life at local level.

Achieving water-related climate resilience in the future will require fundamental changes in water management as well as in other water-using sectors, society and the economy. Progressive adaptation to climate change through sustainable water management may not be sufficient to prevent irreversible adverse effects on water systems or to protect the economy and society from water-related climate risks. Instead, systemic changes will be required in land and water use, consumption processes, agricultural production and urban planning.

According to a report published by the European Commission in 2020,[19] climate vulnerability was identified for the following areas regarding climate risks and the adaptive capacity of these areas was determined prior to identifying the adaptation investments and adaptive capacity concerning water management:

- Basin dependency;
    - glacial fields
    - urban landcover

[18] BMU (2020). “Climate change and the European water dimension – Enhancing resilience”. German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Bonn, Germany.

[19] Sophie Elmhirst, Helen Finney, and Richard J. Smithers (2020). “Quantitative and qualitative aspects of water safety under a changing climate: a thematic report to support an ex-ante impact assessment of the EU Adaptation Strategy”. European Commission, Brussels Belgium.

  - woodland cover
  - agricultural activities
  - industrial activities
- water storage;
- water abstraction;
- coastal zone management;
- infrastructure and
- water treatment efficiency.

Accordingly, climate vulnerability was scored in relation to the aforementioned areas to identify the most critical ones: glacial areas, agricultural activities, water scarcity, water withdrawal, coastal area management and infrastructure. Summary of the qualitative and quantitative assessment study is summarized in the table below.

Table 4. Areas Subject to Climate Risks Associated with Water Quality and Quantity

Area	Adaptive Capacity	Climate Vulnerability
Glacial fields	1	5
Urban landcover	3	3
Woodland cover	4	3
Agricultural activities	2	4
Industrial activities	4	2
Water storage	1	4
Water abstraction	2	4
Coastal zone management	2	4
Infrastructure	2	4
Water treatment	4	2

Source: European Commission (2020)

A Sweden-based institution exemplifies the following adaptation options that increase the climate resilience of society and ecosystems by improving access to water and ecosystem services so as to create sustainable ecosystems and livelihoods.[20]

- Increasing water supply and ecosystem services:
  - Expanding rainwater harvesting to improve surface water-fed cultivation and groundwater aquifer
  - Acceptance of water transfer schemes
  - Restoration of aquatic habitats and ecosystem services
  - Increasing storage capacity by constructing reservoirs
- Reducing water demand and water efficiency

[20] https://climate-adapt.eea.europa.eu/countries-regions/countries/sweden

  - Improving water use efficiency through water recycling
  - Mainstreaming of drought-resistant crops
  - Management of irrigated agriculture (Example: change of crop schedule, crop mix, irrigation method and repair and maintenance of irrigation infrastructure)
  - Extending financial incentives
  - Improvement of urban water and treatment infrastructure
- Improvement of flood protection
  - Expansion of coastal areas
  - Upstream storage methods
  - Restoration and maintenance of wetlands
  - Faster and more efficient studies regarding flood forecasting

In a practical adaptation activity carried out in rural areas of India, water losses were prevented by improving the water transmission pipes reaching the rural areas and repairing the open channels. In India, water harvesting areas were also identified in drought-vulnerable regions and water retention basins were created with impermeable materials. As a result of these activities, it has been observed that there was a remarkable increase in the water supply required for livestock and agricultural irrigation needs.

3.2.2. Agricultural Practices

Weather events such as floods, hails, storms, heat and cold air waves of increasing frequency and severity due to climate change, long-term increases or decreases in local precipitation regimes pave the way for significant losses uncertainties and risks for agricultural farmers and enterprises engaged in agricultural input-based production. Increasing meteorological and hydrological uncertainties bring along food security hazards and financial risks. Famines on a global scale threaten a larger part of the population day by day due to the rapid increase in both the regional spread and the world population. Approximately 1.5 billion people living dependent on rivers and water resources such as the Amazon, Nile, Yangtze and Ganges are at higher risk due to increased floods and famines. Increasing average water temperatures in the oceans also threaten aquatic life, significantly reducing the amount of aquaculture harvest and per capita consumption of aquatic products, posing a risk to the future of societies that depend on the sea for their livelihoods. In addition to the direct effects of climate change due to meteorological and hydrological characteristics, there are also indirect negative effects such as the loss of soil nutrients in agricultural areas due to forest losses, and the reduction of production areas due to erosion and eutrophication. Since the share of agriculture in the economy is relatively high in non-industrialized countries, which are more vulnerable to the climate change, factors that negatively affect agriculture such as decreases in the quantity and quality of agricultural production, erosion, decrease in and pollution of water resources affect the people living there more negatively.

In terms of adaptation to climate change, it is observed that many different technologies are developing that help to provide ideal conditions on digital technologies and value chain through the discipline of "precision agriculture", which is a rising trend in the world. In addition, the responsibilities of policy makers for creating better-functioning agricultural markets, creating effective and efficient legal frameworks, and supporting technology and productivity-enhancing investments stand out as other important focal areas in the field of agricultural practices.

The main objectives of precision agriculture practices are to increase the quantity and quality of harvested crops, to prevent losses on the agricultural value chain, to reduce the consumption of basic inputs such as water, soil, chemicals and energy per unit production within fields and greenhouses and agricultural production factories, while ensuring the sustainability of agricultural production. It is possible to talk about the existence of a vicious cycle in agricultural production, since approximately one third of the greenhouse gas emissions that cause climate change originate from the agricultural value chain and agriculture is one of the sectors most adversely-affected by climate change. There are many different agricultural practices and agricultural technologies used in the world and in our country in order to both mitigate the effects that cause climate change and strengthen adaptation to climate change.

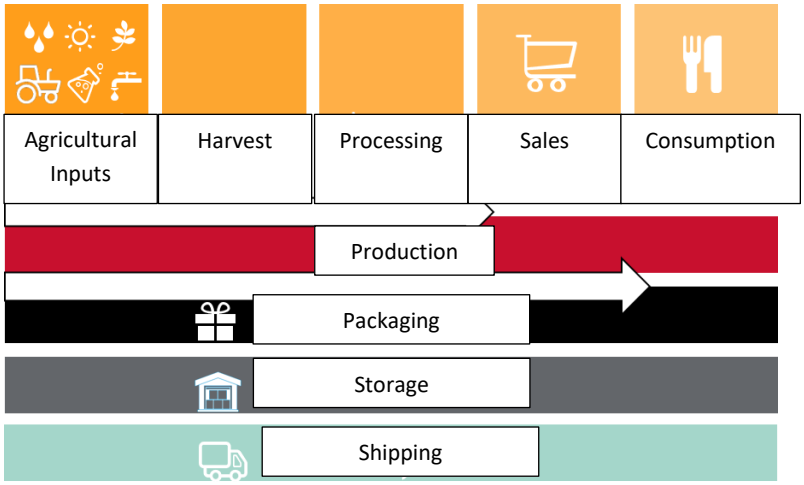

Figure 8. Agricultural Value Chain

Source: TSKB (2021)

In addition to natural resources such as sun, rain, soil and water, many different machinery and equipment, and various chemicals are required to combat pests and increase soil productivity for agricultural production in fields and greenhouses, which is the first stage of the agricultural value chain. We see the production of meat, milk and dairy products, bakery products, beverages, fisheries, canned fruits and vegetables, frozen food, olive oil and vegetable oils, sugary products, biscuits, pasta, food additives and similar products in which agricultural products are used as inputs as well as the sales and consumption stages of these products in the continuation of the chain. Production, packaging, storage and transportation activities are carried out in a way to partially or completely cover the stages on the value chain. When all stages and activities are evaluated from a climate change perspective, direct or indirect greenhouse gas emissions and carbon footprints can be observed at every step. The aim of agricultural practices in this sense is to reduce or, where possible, zero out the carbon footprints. Every positive step taken in this direction offers benefits in terms of protecting natural resources and global biodiversity, as well as mitigating the effects of climate change and increasing its adaptive capacity.

Given the climate-friendly technologies used on the agricultural value chain and increasing the adaptive capacity, examples of production and processing steps are as follows:

- directly generating based on renewable resources or purchasing from the power plants generating through renewable resources the energy required for reducing the direct and indirect emissions caused by the activities performed by fields, greenhouses and agricultural input-based production facilities;
- use of renewable energy, energy storage and electrification practices concerning the agricultural chemicals, machinery and equipment (tractors, irrigation systems, the machinery used in production lines, etc.), packaging and logistics services;
- precise irrigation and drip irrigation reducing water use in order to increase resource efficiency, ideal amount of point irrigation with the help of sensors measuring moisture, temperature and conductivity in the soil content, water-free agriculture using very little water and soil-free agriculture practices without any land use; and
- vertical fields, which are performed in indoor areas such as buildings and warehouses that are isolated from the negative effects of weather conditions and climate change, and which significantly increase the production quantity per unit area thanks to the third dimension production.

It is observed that technology and process management practices boosting the adaptive capacity of sales and consumption mostly aim to increase the resilience of retail chains, storage facilities, shipping fleets and other assets in case of climate-related emergencies and ensuring business continuity. Good practices implemented from this perspective can be listed as follows:

- designing infrastructure and buildings to be more resistant to climate events;
- the existence of insurance mechanisms, supports and efficient financial markets that will ensure the continuation of agricultural fields, greenhouses and agricultural input-based production facilities in case of extreme climate events;
- establishment of storage and transportation infrastructures ensuring that agricultural inputs, field and greenhouse crops as well as the products manufactured in enterprises producing agricultural inputs are preserved without spoiling until their dates of expiry; and
- performing all aforementioned technological infrastructure and good practices based on renewable energy resources and through the minimum use of natural resources, the remote monitoring thereof via digital tools and technologies and the management thereof under ideal conditions.

3.2.3. Other Adaptation Practices

As mentioned in the previous sections, adaptation investments can also be possible by intertwining one or more investment areas. For example, an adaptation investment made within the scope of water efficiency can also be included in agricultural practices. This section examines on a sectoral or spatial basis the adaptation practices, which can be related to water and agriculture or can be evaluated separately.

Most **healthcare**-related options can be categorized as options that do not make a big difference. Adaptation investments under this sector usually include warning, monitoring and information systems. Besides, civil protection options such as the provision of additional support and cool spaces for vulnerable groups of people are potential recipients of adaptation finance. Adaptive capacity can be achieved

through green roof practices and passive cooling methods to help increase the resilience of healthcare infrastructure against extreme temperatures and precipitation.

Options in the **building** industry mainly consist of robust construction and design options that include better insulation or passive cooling systems, as well as options designed to protect from storms and precipitation, such as fixing roof tiles with special clips. In addition to these, methods such as rainwater harvesting have started to take place in the building sector in order to increase the efficiency of water.

Adaptation of the **tourism** sector depends on specific regional threats from climate change and will require new infrastructure investments. The options proposed within the scope of tourism are short to medium-term options and should be supported by practices such as water level rise in coastal areas, increasing groundwater level and water efficiency for larger-scale investments.

Most of the options related to the **transportation** sector are classified as gray options as they are related to the infrastructure and climate resilience of vehicles. This option may include investments to make urban roads resistant to heat and heavy precipitation, or to install air-conditioning on local/regional trains. Alternatively, there may be investments in the integration of real-time information about travel and logistics information and weather forecasts with problems on the route in order to develop effective early warning systems. In relation to such practices in the transportation sector, long implementation terms and the costs associated with adjusting the transport infrastructure must be considered.

3.3. Current Practices in Turkey

Turkey is among the countries that will be most affected by climate change, and complementary actions have been created to raise awareness about, adapt to and combat the climate change.

3.3.1. Climate Change Adaptation Strategy and Action Plan

Turkey has drawn up the "**National Climate Change Strategy**" in order to reduce greenhouse gas emissions that cause climate change, mitigate the effects of climate change and contribute to global goals. This strategy covers short, medium and long-term objectives. Besides, this strategy aims to contribute to global climate change adaptation policies within the framework of "common but differentiated responsibilities", which is one of the basic principles of the UN Framework Convention on Climate Change (UNFCCC).

Turkey has implemented many policies and adaptation strategies in various sectors within the scope of combating climate change through many national plans, programs and strategies, especially development plans. However, Turkey aims to support, and facilitate its emission reduction and adaptation efforts by benefiting from financing and technology transfer facilities available to countries with similar economic development levels as Turkey as it is a developing country. [21]

[21] Ministry of Environment and Urbanization of the Republic of Turkey, Turkey Climate Change Strategy 2010-2023

Strategic goals in this context are as follows:

- To contribute by limiting the rate of growth of greenhouse gas emissions,
- To increase national preparedness and capacity in order to avoid the adverse impacts of global climate change and to adapt to these impacts,
- To comply with the implementation of global strategic objectives on mitigation, adaptation, technology transfer and finance,
- To increase access to financial resources required for undertaking mitigation and adaptation activities,
- To develop R&D and innovation capacities towards cleaner production,
- To facilitate climate change adaptation and mitigation activities by ensuring efficient and continuous coordination and decision-making processes based on transparency, stake holder participation, and a strong reliance on a science focus,
- To raise public awareness of all parties such as the public sector, private sector, universities and NGOs, etc.,
- To establish an integrated information management system.

In line with these strategies, Turkish and English versions of "**Turkey's Climate Change Action Plan 2011-2023**" for the period 2011-2023 and "**Climate Change Adaptation Strategy and Action Plan**" for the period 2010-2023 have been prepared to create climate change mitigation and adaptation policies and to cover the measures required for combatting the climate change. Turkey's Climate Change Adaptation Strategy and Action Plan focuses on 5 main topics. These are as follows:

- Water Resources Management
- Agricultural Sector and Food Security
- Ecosystem Services, Biodiversity and Forestry
- Natural Disaster Risk Management
- Public Health

3.3.2. Green Deal Action Plan

Encompassing 32 goals and 81 actions under 9 main headings, the "**Green Deal Action Plan**", a roadmap aimed at ensuring adaptation to climate change policies and supporting green transformation, was published in July 2021. In line with the goal of combating the climate change: [22]

- Turkey's Report on Combatting the Climate Change will be prepared.
- 2023-2030 Climate Change Action Plan and 2050 Climate Change Strategy will be prepared.
- Our country's position towards the Paris Agreement will be evaluated in a multidimensional way, taking into account our country's need for international finance.
- R&D projects and studies will be carried out to identify the effects of climate change on biodiversity and ecosystems, along with desertification and land degradation, and to take adaptation and mitigation measures.

[22] Ministry of Trade of the Republic of Turkey, Green Deal Action Plan 2021

- It will be ensured that the potential loss of coastal and fresh water as a result of climate change will be determined and nature-based adaptation measures will be put forward for coasts, lakes and/or wetlands.
- It will be ensured that a Land Degradation Neutrality (LDN) approach will be integrated into national investment programs, a decision-making support mechanism will be developed and LDN targets will be updated.
- In areas where land degradation is high, planning and implementation will be carried out in the light of LDN principle and dissemination studies will be carried out.
- Contribution will be made to increase carbon stocks and research activities will be carried out to increase carbon stocks.
- Trainings on sustainable agricultural techniques will be offered, R&D projects will be carried out in this regard and practices will be disseminated.
- Studies performed via the nature-based approach will be increased concerning land practices.

In addition, "**National Action Plan and Strategy Document for Combating Desertification**" for the years 2019-2030 has been prepared on combating desertification/land degradation, which is considered both as a cause and a result of climate change.

3.3.3. Sea of Marmara Protection Action Plan

Within the scope of combating mucilage, the "**Sea of Marmara Protection Action Plan**" consisting of 22 actions was prepared under the cooperation of the Union of Marmara Municipalities (MBB) and the Ministry of Environment and Urbanization. The actions identified in line with the goal of combating mucilage are listed below: [23]

- **ACTION 1.** In order to reduce pollution in the Marmara region and carry out monitoring activities, a Coordination Board composed of the Ministry of Environment and Urbanization, relevant institutions and organizations, universities, chambers of industry and NGOs will be created and a Scientific and Technical Board will be formed within the Union of Marmara Municipalities.
- **ACTION 2.** The Sea of Marmara Integrated Strategic Plan will be drawn up within three months and the activities will be carried out within the framework of this plan.
- **ACTION 3.** Efforts to designate the entire Sea of Marmara as a protected area will be initiated and will be completed by the end of 2021.
- **ACTION 4.** As part of emergency response, activities will be initiated to completely clean the mucilage in the Sea of Marmara through scientific methods, on a 24/7 basis starting from June 8, 2021.
- **ACTION 5.** All of the existing wastewater treatment plants in the region will be converted into advanced biological treatment plants. Studies will be carried out in line with the objectives of preventing the discharge of wastewater into the Sea of Marmara without advanced biological treatment.
- **ACTION 6.** Discharge standards of the wastewater treatment plants discharging into the Sea of Marmara will be updated and implemented within 3 months.

[23] https://webdosya.csb.gov.tr/db/marmarahepimizin/eylemplani/

- **ACTION 7.** Reuse of treated wastewater will be increased and supported wherever possible. Clean production techniques will be applied.
- **ACTION 8.** Transition to advanced treatment technologies will be accelerated through rehabilitation and improvement activities for OIZs failing to duly operate their waste water treatment plants.
- **ACTION 9.** Public-private partnership models will be implemented to make the construction and operation of wastewater treatment plants much easier.
- **ACTION 10.** Arrangements will be made within three months to prevent the discharge of waste water from ships into the Sea of Marmara.
- **ACTION 11.** Cleaner production techniques will be mainstreamed in the shipyards.
- **ACTION 12.** Within the framework of the studies carried out by the Ministry of Environment and Urbanization, all wastewater treatment plants discharging into the receiving environment will be monitored online on a 24/7 basis. 91 monitoring points in the Sea of Marmara will be increased to 150. With the help of the Turkish Environment Agency, inspections in all basins associated with the Sea of Marmara will be increased using remote sensing, satellite and early warning systems, unmanned aerial vehicles and radar systems.
- **ACTION 13.** The Regional Waste Management Action Plan and Marine Litter Action Plan covering the coasts of the Sea of Marmara will be prepared and put into practice within three months.
- **ACTION 14.** Good agricultural and organic farming practices, pressure and drip irrigation systems will be mainstreamed.
- **ACTION 15.** In the basins associated with the Sea of Marmara, artificial wetlands and buffer zones will be created along stream beds, thereby preventing the pollution from reaching the sea.
- **ACTION 16.** In order to prevent pollution originating from olive black water and whey, technological transformations will be offered to reduce waste water.
- **ACTION 17.** Use of cleaning agents containing phosphorus and surfactants will be gradually reduced. Organic cleaning products will be encouraged.
- **ACTION 18.** All ghost nets in our Sea of Marmara will be cleared within 1 year.
- **ACTION 19.** It will be ensured that fishing activities be carried out on an ecosystem basis, and protected areas will be developed.
- **ACTION 20.** Economic support will be offered to fishermen suffering from the mucilage.
- **ACTION 21.** Efforts will be made to prevent marine pollution and to raise awareness of our citizens, and a platform will be created to inform the public.
- **ACTION 22.** Measures will be taken to mitigate the effects of cooling water and hot water from thermal facilities on the Sea of Marmara.

In this framework, surface cleaning activities were initially carried out in the Sea of Marmara and it was stated by the Ministry of Environment and Urbanization that the amount of mucilage collected was around 10,500 m^3. The Coordination Board included in the Action Plan was established and initially published the Circular on the Restriction of Discharge Standards Within the Scope of the Action Plan for the Sea of Marmara Basin on June 22, 2021. This circular mainly aims to reduce limits on the chemical oxygen demand (COD) parameter out of discharge standards and initially targets actions intended for waste water from industrial facilities.

Given the sectoral changes in the relevant Circular, it is considered that waste water infrastructure investments may be required for the food industry, coal production, oil industry, metal industry, shipyards, the processing and production of plastic materials, machinery industry and OIZs.

In addition, the Circular stipulates that the facilities subject to the Urban Wastewater Treatment Regulation (municipal wastewater treatment plants) are also covered in terms of COD, it is known that marine pollution load can be reduced in these facilities by creating a new limit related to the biochemical oxygen demand (BOD) parameter in addition to COD. For this reason, it is considered that this Circular is the first step for the Sea of Marmara and that circulars requiring amendments to new parameters, including BOD, may be published in the upcoming period.

Apart from these, the Coordination Board, which was established under the supervision of the Ministry of Environment and Urbanization, continue to perform its periodical activities. It is known that presentations were made by academicians in order to combat the problem of mucilage during the meetings of the Coordination Board held on August 3-4, 2021. In conclusion, considering the Action Plan, it is observed that additional treatment investments are needed, together with an effective control mechanism, in order to radically end the mucilage problem occurring due to climate change.

4. TSKB AND ADAPTATION

4.1. Adaptation Investments

Given the practices around the world, the effects of climate change encountered in Turkey and the proposed regulations, it is considered that TSKB can focus on financing adaptation projects, especially water management and certain agricultural practices. In this context, the potential of water management projects has been evaluated under this report, and it is planned to present agricultural practices within the scope of a separate report.

Some water efficiency investments, which could be described as adaptation investments under climate finance, were already financed under TSKB between 2014 and 2017. 1.2 million m^3 of water is saved annually owing to these industrial investments. The investments that can be financed in the upcoming period are compiled as follows.

4.1.1. Water Efficiency in Industry

Increasing water efficiency in industry can enable significant reductions in water demand and a range of environmental and socio-economic benefits. Behavioral, operational and technological changes can all contribute to increasing water efficiency in the industry.

The sectors with the highest quantity of process water supplied and consumed across our country are the manufacturing of food, textile, apparel, paper and paper products, coke and refined petroleum products, chemicals and chemical products, the manufacturing of other non-metallic mineral products and base metal industry products. Among these sectors, the first three sectors with the highest quantity of water lost (removed by evaporation, etc.) are the manufacturing of food products, the manufacturing of textiles and the manufacturing of non-metallic mineral products (glass, ceramics, cement, etc.).

Given the facilities covered by the manufacturing industry, it is known that there are many practices that can be integrated into processes for water efficiency. In order to create efficiency in these sectors, it is seen that industrialists adopt the EU Best Available Techniques (BATs) as a guide. These guidelines provide good practices on energy efficiency, water efficiency and raw materials as well as unit consumption ranges within the sector based on these practices. The main purpose of industrialists in applying these guidelines is to move the production technology towards international standards, rather than achieving water efficiency. Therefore, the investments made for water efficiency in industrial production processes are not common, and water efficiency is achieved during process improvement. Investment costs in this regard vary by sectors.

When the textile sector is considered as a water-intensive sector by itself, it is known that especially the facilities with dyeing function are vulnerable in terms of water. The decrease in well water depths in Ergene Basin within the Marmara Region requires companies operating in the forbidden zone to drill new wells to modify their operational activities. One of the various projects carried out for the textile industry in our country is the Cleaner Production Guide For the Textile Sector prepared under the leadership of

WWF.[24] In order to comply with this guide, process-based investments and water efficiency projects ranging between EUR 250,000 and 1,500,000 are carried out. These investments have also received support from some grant programs through the Development Agencies in Turkey.

4.1.2. Water Supply in Industry and Wastewater Treatment Plant Investments

Water for industrial purposes is supplied from the existing network, well waters or water resources such as seas and rivers. The inefficiency of well water or the limitation of its use due to climate change shows that the consumption of this resource will be restricted in the short and medium term. It is also known that the application of the limits preventing industrialists from supplying water from the network due to the decrease in dam waters is also considered by municipal administrations. In this case, it is known that industrialists are looking for alternative resources, especially rivers and seas, and resource use technologies for water supply. For the industry, recycling and reusing their own waste water is one of the practices considered in this context.

Desalination technology, which is the process of removing salt from sea water or process waste water and using it within processes, is being researched by industrialists today and its use is becoming widespread. Membrane-type reverse osmosis units are frequently used in desalination technology, which basically offers two types as thermal and membrane technology. The cost of a reverse osmosis unit designed to remove 1,000 m^3 of waste water from the salt per day and reuse it within the process in the chemical industry is approximately EUR 450,000 – 600,000. As the amount of water planned to be recovered increases, the unit cost decreases. The cost of another reverse osmosis unit designed to remove 27,500 m^3 of waste water from the salt per day and reuse it within the process in the chemical industry is approximately EUR 10,000,000. As a result, the cost varies depending on the amount of water to be treated and the water quality.

Regarding wastewater treatment plants (WWTP), it is known that industrial facilities can use their own WWTPs as well as the WWTPs within the respective OIZs. Many facilities have WWTP facilities performing pre-treatment in order to supply water to the OIZ WWTP.

The Circular published in the wake of the mucilage incident in the Marmara Region provides that the COD parameter be decreased for the sector. Impacts of the Circular were evaluated by meeting sector representatives that could be affected by this amendment as well as WWTP project companies. The general view across the sector is that the existing WWTPs meet the reduced COD parameter. If not, it is considered that this performance will be increased through the revisions to be made on the equipment of WWTPs. It has been noted that such rehabilitation investments in WWTPs with a capacity of 80 – 250 m^3/day in the sector vary between EUR 30.000 – 125.000.

New WWTP investments are also possible for increasing the capacities of the existing facilities or in cases where it is economical to replace the very old technology with a new one. From this point of view, it has been found out that the installation costs of WWTPs with a capacity of 80 – 250 m^3/day vary between EUR 75.000 – 250.000 in the metal industry and between EUR 60.000 – 200.000 in the chemicals industry.

[24] https://wwftr.awsassets.panda.org/downloads/wwf_turkiye_rehber_temiz_uretim_250918.pdf

In a large-scale chemical enterprise, the investment in a new treatment plant with a capacity of 45,000 m^3/day may reach the level of EUR 30,000,000.

4.1.3. Wastewater Treatment Plant Investments in OIZs

OIZs are used as a successful model in Turkey, offering the necessary infrastructure for the management of environmental issues in industrial areas. Hosting WWTP investments depending on the type of industry and capacity they serve, OIZs collect water with a certain pollution rate by presenting wastewater acceptance standards to the companies they serve. Acceptance standards are offered at even more reasonable levels in OIZs separated by sectors such as specialized chemistry or specialized machinery.

It is observed that the WWTP investments made in a newly-established OIZ in our country with an average capacity of 2,000 m^3/day was extended to 6,000, 20,000, 80,000 m^3/day capacities in the following years due to the companies within OIZs and their scales. The recent Circular introduces a 38% improvement restriction regarding the COD parameter for OIZs. This evokes the need for new investment, especially in OIZs where WWTPs with high duty cycles or high capacity utilization rates are operated.

Given the costs of WWTPs to be established in OIZs, it is known that a WWTP investment with a capacity of 2,000 m^3/day can be achieved at a cost of approximately EUR 500,000 in a mixed OIZ. However, this cost moves upwards with regard to water-intensive industries such as chemistry, textile, etc. and infrastructure investments that require advanced technological treatment. For example, a facility investment covering a WWTP of 90,000 m^3/day, treated water recovery of 30,000 m^3/day, process water preparation of 60,000 m^3/day and a drinking-potable water preparation facility of 2,000 m3/day was awarded by the Textile Dyehouses Specialized Organized Industrial Zone (TOSAB) in Bursa through a tender at a cost of EUR 8,300,000 and an operating right of 2 years in August 2021.

4.2. Conclusion and TSKB Roadmap

Since the beginning of 2021, when TSKB gave a start to its adaptation theme work, various events related to climate risks (increasing forest fires, mucilage, flood, etc.) have taken place in Turkey. These events once again showed how important investments in adaptation, which has gained importance on a global scale, are. Considering that one of the main themes of COP26, which will be held in Glasgow in November 2021, is adaptation, TSKB will continue to shape its activities around this theme in the upcoming period. The ratification of Paris Agreement in the Grand National Assembly of Turkey is expected to pave the way for the planned investments along with Turkey's roadmap.

In this context, as a result of both literature research and interviews with the companies in the portfolio, it comes to the fore that significant investments may be required on water efficiency in industrial and public areas. When Turkey is considered in particular, it is of great importance to involve the private sector in adaptation investments, which cannot gain importance only by transferring public resources. Therefore, a series of meetings will continue being held with both public institutions and sectoral representatives, and studies will be carried out to set a target for the dimensions, planning and financing of adaptation investments.

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