Climate Change and Public Health in Turkey

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Prof. Dr. Muzaffer Şeker
Prof. Dr. İslami Koyuncu
Prof. Dr. İzzet Öztürk

July 2020 - Ankara
The Report on
Climate Change
and
Public Health in Turkey

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Never-Ending Demands of Humankind and Ecological Damages

The perspective of homo-economicus, which is profit-maximization centered, and gain-oriented, implies that all human activities are based on rational thinking and cost-benefit analysis, emerging from the periods of Mercantilism, Capitalism, and rapid industrialization. The spread of this perspective led to the artificialization of natural life with destruction and causes environmental pollution such as air, soil, and water. Humankind is forming a habitat that affects biodiversity negatively with an ambition of earning more and more. As a result of excessive and uncontrolled production, the increase in carbon dioxide emissions and the direct disposal of industrial wastes without the necessary treatment processes divest the rights of future generations to live in a clean world. Humankind has consumed and wasted the natural resources heritage of their ancestors unconsciously and inefficiently until today. Therefore, the resources left to the next generations have higher processing costs and threaten the future of human beings.

The dimension of destruction caused by developed countries is understood in the last global epidemic process. It has clearly observed that environmental problems have been significantly reduced by people staying in homes, decreasing production, and minimizing transportation during the global epidemic of COVID-19. This is a striking indicator of the impact of people’s destruction on nature. All stakeholders and countries must work together for a more livable world and sustainable resource management. The effect of the struggle on this issue will be increased with projects such as “Zero Waste” project conducted by Turkey and spreading similar initiatives all over the world.

It is necessary to underline with the awareness that climate change, environmental problems, and public areas are interconnected. Public health problems are related to so many different multidisciplinary aspects but mostly considered climate change, environmental issues, and economic situations. The purpose of such reports, which is valuable for human beings, is to leave a livable world to future generations. It should not be forgotten that we have only one world that we can protect and live on.

Prof. Dr. Muzaffer ŞEKER
TÜBA President
1. Introduction

1.1. Sustainable Development, Climate Change and Public Health

Sustainable development, which aims to make it possible to meet the needs of future generations along with the needs of today’s generations, took its place on the world agenda in the late 20th century. One of the 17 Sustainable Development Goals adopted at the United Nations summit in 2015 is to combat climate change and its impact.

The increase in greenhouse gases in the atmosphere is expected to cause regional and global changes in climate and climate related variables such as temperature, precipitation, air and soil moisture. In addition to the significant temperature increase observed in the global climate, according to the projections made with advanced climate models, an increase in global surface temperatures is expected between 2-4.5 °C in the period 1990-2100. Depending on the increase in global surface temperatures, the change of hydrological cycle, melting of land and sea glaciers, narrowing of glacial areas, especially in polar regions, rising sea levels, shifting climate belts, changing dynamic processes in the atmosphere, heat waves are more severe and frequent. In some regions, excessive precipitation and floods and in some regions droughts are more severe and frequent, and drought epidemics and pests due to high temperatures may occur. The predicted effects of climate change are given in Table 1.

<table>
<thead>
<tr>
<th>Global Temperature Change</th>
<th>Predicted Effects of Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 °C</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>Increase in crop yields in some areas at higher latitudes</td>
</tr>
<tr>
<td>2 °C</td>
<td>Decrease in crop yields in many places, especially in developing regions</td>
</tr>
<tr>
<td>3 °C</td>
<td>Decrease in crop yields in many developed regions</td>
</tr>
<tr>
<td>4 °C</td>
<td>Severe difficulties in accessing water in many regions, including the Mediterranean and South Africa</td>
</tr>
<tr>
<td>5 °C</td>
<td>Sea water rise threatens big cities</td>
</tr>
<tr>
<td>Food</td>
<td>Small mountain glaciers disappear, water supply endangered in some areas</td>
</tr>
<tr>
<td>Water</td>
<td>Extensive destruction of coral reefs</td>
</tr>
<tr>
<td>Ecosystems</td>
<td>An increasing number of species are at risk of extinction</td>
</tr>
<tr>
<td>Extreme Weather Event</td>
<td>Exacerbation of storms, forest fires, droughts, floods and heatwaves</td>
</tr>
<tr>
<td>Major Irreversible Changes</td>
<td>Increased risk of hazardous feedback mechanisms and large-scale sharp changes in the climate system</td>
</tr>
</tbody>
</table>

Table 1: The predicted effects of climate change

Projected effects of climate change. Each line describes the dangers that may arise as the global temperature change increases.

(Source: Stern Review, 2008)
These changes are expected to directly affect socioeconomic sectors, ecological systems, human life and other living creatures on a global scale (TÜBA, 2010). In addition, due to the fact that climate changes are not at an equal level globally, they will react differently in different ways in relation to the impact of individuals and countries. As a result of these effects, an average of 1.2 million people every year due to urban air pollution, 2.2 million people due to inability to access safe drinking water resources and diarrhea caused by poor hygiene, 3.5 million people due to malnutrition and 60 thousand people due to natural disasters are losing their lives.

As a result of global warming and its other components affecting human health, studies on this subject have been accelerated. In this context, the World Health Organization has determined the 2008 World Health Day theme as the effects of global warming and climate change on health and creating awareness in this regard (TÜBA, 2010).

1.2. Climate Change and Health Expectations

Situations that arise as a result of climate change are among the biggest problems facing humanity in the 21st century. This situation has taken the first place in the international agenda in recent years. If the progress of the current industrialization and the related energy consumption are not controlled by the global and regional policies, the temperature increase will continue and reach critical levels. To keep the temperature rise at 2 °C, it is necessary to stabilize the atmospheric intensity of carbon emissions at 450 ppm and to reduce the existing carbon dioxide emissions by 80% till 2050.

The impact of climate change on human health occurs in various ways, including direct and indirect impacts (TÜBA, 2010). The direct impacts of this change are seen as a result of extreme changes in weather events. As a result of these changes, the weather being too cold, too hot, too humid or too dry affects human health negatively. For example, excessive heat exposure can lead to physiological stress, illness, and even death of the individual. As a result of the indirect effects of climate change, infectious diseases and vector-borne diseases occur due to the increase in temperature. In the third evaluation report of the IPCC (Intergovernmental Panel on Climate Change), it is stated that the effects of climate change on human health will be more common in tropical and subtropical countries and low-income countries, although it is all over the world (IPCC, 2001).

Globally, all countries are at varying degrees of risk against the negative health effects of climate change. This effect is expected to occur most intensively in low-income countries. In addition, disadvantaged groups such as those living in the cities, the poor, the elders, the children, those who earn their living by farming and those living in the coastal area are at higher risk. The level of economic development is the most important indicator of countries’ adaptation to climate
change and its impacts. However, even countries with high levels of economic development cannot fully protect themselves from the situations caused by climate change and its effects. Factors such as the level of economic development and the reflection of this situation on the society, the creation of education and health infrastructure play an important role in shaping public health (SB, 2015).

1.3. **Purpose and Scope of this Report**

This report is prepared at the request of the Association of Asian Science Academies and Communities (AASSA), to contribute to the report to be prepared to address the health effects of climate change in countries in the Asian Region. The aim of this report is to address the effects of climate change on health in Turkey. Within the scope of the report, the first section covers the introduction part, the second section covers a country scale of the current climate change situation, future projections, and current situation of health and health infrastructure in Turkey, the third section covers climate change impact on health, the fourth section covers the climate change adaptation and impact reduction studies on health, and in the fifth section results and recommendations are presented.
2. **Studies on Climate Change and Public Health**

2.1. **Previous Publications on Climate Change and Public Health**

The possible effects of climate change have been addressed by many institutions and organizations. “Assembly Research Commission Report on the Effects of Global Warming and Sustainable Management of Water Resources” was completed in 2008 by Grand National Assembly of Turkey and drawn attention to the impact of climate change on health (TBMM, 2008).

TUBA (Turkey Academy of Sciences) published “Turkey in the world in terms of Climate Change” report in 2010 and it contains extensive information about climate change and its impacts on health (TUBA, 2010).

A report titled “The Impact of Climate Change on Health” was prepared by the General Directorate of Meteorology of the Ministry of Forestry and Water Affairs in 2012 and the subject was discussed in detail in this report. With the “National Program and Action Plan for Reducing the Negative Effects of Climate Change” prepared by the General Directorate of Public Health of the Ministry of Health in 2015, studies, meetings and symposia on the impact of climate change on health have increased. The “Climate Change Education Modules Series” prepared by the Ministry of Environment and Urbanization in 2019 also includes the issue of the impact of climate change on human health.

The relationship between climate change and health is increasingly being investigated and researched in universities. This report is expected to contribute to the studies to be carried out in the field of climate change and health.

2.2. **Turkey’s General Situation and Climate Change Projections**

2.2.1. **Geographical Location, Demographic Structure and Population**

Turkey is located between the eastern and western cultures in a location where the continents of Asia, Europe and Africa approach each other (Figure 1). Located on the southwest tip of the Asian continent, Turkey is on the Anatolian peninsula. Some of its territory is on Thrace, which forms part of the Balkan peninsula in the southeast of Europe. Turkey is therefore both Asian and European country. Turkey is also a country of the Middle East and as some of the Middle East
countries are a part of African countries therefore for Turkey “a country that is in contact with the African continent” designation would be correct.

Turkey is among the subtropical zone and temperate zone. Turkey is surrounded by sea on three sides, extension of the mountains and the variety of landforms; causes different types of climate to be experienced. While temperate climate is seen in coastal areas due to effects of seas, the sea influence is prevented by the North Anatolian Mountains and Taurus to enter the inner part of the country (Figure 2). Therefore, continental climate features are seen in the inner parts. According to climate classification Mediterranean, Marmara (transition) and Black Sea climate types are found in Turkey (Atalay, Rel., 1997, Şensoy et al, 2020).
According to TSI 2020 data, the population of Turkey is 83,154,997 as of December 31, 2019. 50.2% of the population is male and 49.8% are female. The 0-14 age group population constitutes 23.4 percent of the total population. In demography of Turkey, urbanization rate is the most important changes that occurred over the years. In 1927, while 75.8 percent of the population lived in rural areas and 24.2 percent in urban areas, today this ratio has been reversed. Since year 2011, 23.2 percent of Turkey’s population live in rural areas, 76.8 percent of them live in urban areas (TSI, 2020).

2.2.2. Energy Consumption and Greenhouse Gas Emissions

Turkey is the eighth largest economy among the OECD countries and is in the position of a fast-growing country. According to the OECD report of 2019, fossil fuels make the largest portion of energy consumption in Turkey between the years 2005-2017. As of 2017, fossil fuels represent 88% of the total primary energy supply (Figure 3). Turkey meets its energy supply mostly with imported energy (oil and natural gas). Turkey has a large number of renewable energy sources and can minimize its foreign dependence on the result of the effective use of these resources. Turkey has an energy self-sufficiency rate of 25%. In order to reduce the greenhouse gas emission accumulated in the atmosphere, it is aimed to switch to renewable energy, especially by increasing the production capacity through energy production, solar and wind energy and by using hydroelectric, geothermal energy potential more efficiently. Recently, there has been a decrease in greenhouse gas emissions rates contrary to economic growth (Figure 4) (OECD, 2019).

![Figure 3. Distribution of energy resources (OECD, 2019)](image-url)
2.3. Climate Change and Projections

2.3.1. Meteorological Parameters

Worldwide, particularly in Europe and in most of the countries adjacent to the Mediterranean basin and Turkey in many regions, especially in spring and summer seasons, a statistically and climatologically significant increase trend was found in the minimum temperature values measured at night. The change in climate of Turkey is stated to be related to widespread, rapid and increasing urbanization in our country. Asymmetrical or symmetrical fluctuations in different magnitude on the maximum and minimum values of the measured temperature during the night is an important indicator of climate changes in Turkey (Figure 5). The increasing tendency of the daily average air temperatures is considered as a natural result of the reflection of the significant increase observed especially in the night hours after 1992 (Türkeş et al., 2002). As seen in Figure 6, in recent years in Turkey the number of hot days has been increasing. In 2019, an average temperature of 14.7 °C is obtained in Turkey and this value is 1.2 °C higher than the normal 1981-2010 (13.5 °C) temperature. In addition, 2018 was the second and 2019 was the fourth hottest year since 1971 (Figure 7) (MGM, 2019).
Figure 5. Annual; A) Maximum, B) Minimum, And C) Tmax-Tmin; Spatial Distribution Models of Temperature Trends of 70 Stations in Turkey (TÜBA, 2010; Türkeş et al, 2002)
Drought, starting in the 1970s, has effect in subtropical zone in some part of the Mediterranean basin including Turkey. Due to drought tendency, the most effected regions are Aegean, Mediterranean, Marmara and Southeastern Anatolia Regions (Figure 8). In studies on climate change it is indicated that in Turkey, along with many other countries in the Mediterranean basin significant climate change has been seen and Turkey will be adversely affected by future climate change (TÜBA, 2010).

2.3.2. Impacts of Climate Change on Turkey Water Resources

The most comprehensive study on climate change and its impacts on water resources in Turkey is “Impacts of Climate Change on Water Resources Project” (OSIBE, 2016). As part of the climate projections, the first stage of projection works, outcomes of three global models selected from CMIP5 (Coupled Model Intercomparison Project 5) archive (HadGEM2-ES, MPI-ESM-MR ve CNRM-5.1) and RCP4.5 and RCP8.5 release scenarios and RegCM4.3 regional climate
model forming the basis of the 5th Evaluation Report of Intergovernmental Panel on Climate Change (IPCC) were studied including whole Turkey. Total 8 parameters and projections of 17 climate indices representing extreme conditions were formed in river basin scales (25 river basin) through model simulations, and the differences of the studied parameters until 2010 were calculated as seasonal and annual averages for 10 and 30 years periods based on the reference period accepted as the simulations of 1971-2000. For the first time with this project, 3 global climate model with 10x10 km resolution results were obtained for Turkey (OSİB, 2016).

Figure 8. Geographic Distribution of Long Term Rainfall Trends in A) Winter, B) Summer for Turkey (TÜBA, 2010; Türkeş et al., 2007)
Climate simulations at 50x50 km first and then 10x10 km resolution were obtained by using start and limit conditions (ERA-40 reanalysis data) (Uppala et al., 2005) for the reference period within the scope of climate change projections. Afterwards, reference period climate simulations were performed with 10x10 km resolution of HadGEM2-ES, MPI-ESM-MR and CNRM-5.1 global climate models selected from the CMIP5 database. Comparisons were made with the simulations performed by using reference period simulation observation data of the global model, and the bias of the global model in the climate simulations was examined. Every three global models, simulations based on RCP4.5 and RCP8.5 representational concentration routes against the 4.5 W/m² and 8.5 W/m² climate forces in 2100, and climate simulations at 10x10 km resolution between 2015-2010 with RegCM4.3 regional climate model were obtained (OSİB, 2016).

As part of the hydrologic projections, the second stage of the projection works, for the first time in Turkey, the water potentials of all river basin in Turkey were calculated using SWAT (Soil and Water Assessment Tool) hydrologic model supported by WEAP (Water Evaluation and Planning System). Using hydrologic models with the outcomes of the climate models, precipitation values were converted to flow values, and water potential modeling/calculation study was carried out considering the current situation of surface water and groundwater sources and the estimated situation for projected periods.

In the simulations performed with the outcomes of climate models using with WEAP supported SWAT hydrologic model, the status of the median gross water potentials forecasted for 3 sub-projection periods is compared with the median value of the reference period (Tables 1 and 2). As can be seen in Table 1, the lowest gross water potential estimates were obtained with the HadGEM2-ES climate model outputs in both scenarios (RCP4.5 and RCP8.5) and 3 sub-projection periods. Although the gross water potentials obtained as a result of hydrological modeling based on the outputs of the other 2 climate models (MPI-MSM-MR and CNRM-CM5.1), the results are quite close to each other, they remained below the reference period values for all 3 periods (OSİB, 2016).

As can also be seen from Table 2, the median water potential estimated for the period 2041-2070 with hydrological modeling for the HadGEM2-ES RCP4.5 scenario is expected to be equal to or less than 111,000 million m³, with a 50% probability. According to Table 3, with the hydrologic modelling base on the outcomes of HadGEM2-ES climate model, it is anticipated that the median gross water potentials for 3 sub-periods in the 2015-2100 period will decrease 40-45% compared to the median value of the reference period. Under the same conditions, it is forecasted that the decrease ratio of the median gross water potential obtained from the hydrologic model projections performed by the outcomes of the MPI-MSM-MR climate model will remain at the range of 15-20%(OSİB, 2016).
Table 2. Probability of occurrence of gross water potential obtained using hydrological modeling for Turkey in accordance to climate projections (OSİB, 2016).

<table>
<thead>
<tr>
<th>Projection Period</th>
<th>Probability of Occurrence (%)</th>
<th>HADGEM RCP4.5</th>
<th>HADGEM RCP8.5</th>
<th>MPI RCP4.5</th>
<th>MPI RCP8.5</th>
<th>CNRM RCP4.5</th>
<th>CNRM RCP8.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
<td>271.307</td>
<td>141.081</td>
<td>142.539</td>
<td>196.715</td>
<td>215.517</td>
<td>220.161</td>
</tr>
<tr>
<td>2041-2070</td>
<td>50</td>
<td>193.499</td>
<td>111.015</td>
<td>95.687</td>
<td>162.900</td>
<td>147.515</td>
<td>168.470</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>271.307</td>
<td>140.465</td>
<td>132.900</td>
<td>212.991</td>
<td>219.495</td>
<td>215.963</td>
</tr>
<tr>
<td>2071-2100</td>
<td>50</td>
<td>193.499</td>
<td>117.363</td>
<td>107.045</td>
<td>153.613</td>
<td>135.158</td>
<td>161.939</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>271.307</td>
<td>147.596</td>
<td>136.372</td>
<td>181.192</td>
<td>213.077</td>
<td>178.743</td>
</tr>
</tbody>
</table>

Table 3. The median values* deviation of gross water potential obtained using hydrological modeling for Turkey in accordance to climate projections for from reference** period median (OSİB, 2016).

<table>
<thead>
<tr>
<th>Projection Period</th>
<th>HADGEM2-ES RCP4.5</th>
<th>HADGEM2-ES RCP8.5</th>
<th>MPI RCP4.5</th>
<th>MPI RCP8.5</th>
<th>CNRM RCP4.5</th>
<th>CNRM RCP8.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015-2040</td>
<td>193.499</td>
<td>117.508 (-39%)**</td>
<td>118.864 (-39%)**</td>
<td>169.903</td>
<td>174.607 (-10%)**</td>
<td>169.353 (-12%)**</td>
</tr>
<tr>
<td>2041-2070</td>
<td>193.499</td>
<td>111.015 (-43%)**</td>
<td>95.687 (-51%)**</td>
<td>162.900</td>
<td>147.515 (-24%)**</td>
<td>168.470 (-13%)**</td>
</tr>
<tr>
<td>2071-2100</td>
<td>193.499</td>
<td>117.363 (-39%)**</td>
<td>107.045 (-43%)**</td>
<td>153.613</td>
<td>135.158 (-30%)**</td>
<td>161.939 (-16%)**</td>
</tr>
</tbody>
</table>

* 50% probability of occurrence
** Values in parentheses indicate relative deviation rates from the reference period value.

The net water deficit/excess situation of the river basins in Turkey for the 2015-2100 period has been prepared in thematic map format for three models and two scenarios separately (Figure 9). The thematic maps showing the water excess/deficit may also be used in the future to determine the possible water transfer between the neighboring basins. In Fırat-Dicle Basin, East Mediterranean Basin and Konya Closed Basin, significant water deficit is observed in all period (OSİB, 2016).

The amounts of water that Turkey undertakes to release to the countries located at the river mouths from Fırat-Dicle Basin are taken into consideration for thematic maps. The outcomes of each three models show that in Fırat-Dicle Basin, water deficit levels of up to 2-12 billion m³/year are expected in the 2015-2100 period. These data show that a new evaluation is required to be made regarding the amounts of water that Turkey has undertaken to release to the countries located at the river mouths of the basins.
Figure 9. Thematic Map Showing the Basin Based Water Excess/Deficit According to the MPI-ESM-MR RCP4.5 scenarios of Climate Projections for Turkey (2041-2070) (OSİB, 2016)

(For Fırat River Basin, the amount of 500 m$^3$/s that Turkey undertakes to release to the countries located at the river mouths are taken into consideration. For Dicle River Basin, the average flowrate value of 342 m$^3$/s that releases to the river mouths between the years 2011-2015 is taken into consideration (DSİ).)

2.4. Current Situation and Infrastructure of Public Health in Turkey

2.4.1. Current Situation of Public Health Services

In our country, there has been an improvement in many health indicators as a result of changes in health care professionals and infrastructure and health management in recent years. For example, the increase in immunization rates, increase in follow-up of pregnant, child and puerperium, decrease in maternal mortality and infant mortality rates, and increase in hospital and health care professionals developments in health services and health care in Turkey will be discussed in three different categories.

- Demographic and Public Health Indicators

In this section important indicators of Turkey’s population and the potential future changes in these indicators are given. In 2019 Turkey’s population is approximately 83.1 million, while the population growth rate is 13.9%. TSI (Turkey Statistics Institute) estimates, the population of Turkey is expected to be 83.9 million in 2023. Along with the total population, the distribution of the population by age groups is more important. Until recent past in Turkey, as a result of high fertility rates and rapid population growth it can be said to have a young population. According to TUIK data, as of 2019, the working age population in the 15-64 age group constitutes 67.8% of the total population. In addition, 23.1% of the population is in the 0-14 age group and 9.1% is in the 65 and above age group. When the future predictions of TUIK are analyzed, it is thought that while the young population size decreases, the older population will increase (Figure
The population ratio above the age of 65, which was 5.7% in 2000, increased to 9.1% (with an increase of approximately 59%) in 2019 and reached 10.2% in 2023 and 20.8% in 2050. It is estimated to reach 27.7% in 2075 (TÜİK 2019).

According to TSI estimates, the total fertility rate, which was 2.17 as of 2002, will decrease to 1.85 in 2023 (Figure 11). If this value falls below 2.1, it means that there will be no population increase.

When all these demographic changes are evaluated, it can be said that the aging population will significantly affect the demand for health services, it will also have significant effects on the burden of disease that the health system and health financing will encounter. Another important determinant of demand for health services are said to be possible developments in crude birth rate. Accordingly, there is a decrease in crude birth rate and this downward trend is expected to continue in the future. (KB, 2018). Crude birth rate refers to the number of live births per thousand population. While the crude birth rate was 18.6 per thousand in 2002, it was 16.1 per thousand in 2017 (Figure 12) (TUIK, 2018).
Among the most important criteria used in evaluating a country’s health status are average life expectancy, infant mortality rate, child mortality rate under 5, and maternal mortality rate. The average life expectancy in Turkey was 72.5 years in 2002. In the year 2018 it has increased to 78.3 years. In general, women live longer than men and the difference in life expectancy at birth is 5.4 years in 2018 (Figure 13).

While in 2002 the infant mortality rate, child mortality rate under 5, and maternal mortality rate were 31.5, 42, and 64, respectively, in 2018 these rates declined to 9.2, 11.3, and 13.6, respectively. Consequently, it is observed from the Table 4 that life expectancy has increased and death rates have decreased significantly in 16 years period (SB, 2018).

**Figure 12.** Annual Crude birth rate (TÜİK, 2018)

**Figure 13.** Life expectancy by gender and age (TÜİK, 2018)
Table 4. Infant mortality, child under 5 mortality and maternal mortality rates in Turkey between the years 2002 and 2018 (SB 2018)

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant mortality rate (per 1000 live births)</td>
<td>31.5</td>
<td>9.2</td>
</tr>
<tr>
<td>Child under 5 mortality rate (per 1000 live births)</td>
<td>42</td>
<td>11.3</td>
</tr>
<tr>
<td>Maternal mortality rate (100 000 live births)</td>
<td>64</td>
<td>13.6</td>
</tr>
</tbody>
</table>

b) Health Transformation Program

Between the years 2003 and 2011 Turkey Health Transformation Program have been established. According to the World Health Organization, the health system of a country should be designed in a way to ensure the high quality of the necessary health care for everyone. This service should be effective, affordable and socially acceptable. It is recommended that each country develop its own unique health system by considering these factors. The situation of the Turkish health system at the end of 2002 required radical changes in many areas from service delivery to financing, from health care professionals to information system. For this purpose, Health Transformation Program was launched in 2003. The program was inspired by past knowledge and experience, particularly the socialization of health services, recent health reform studies and successful examples from around the world. In this period, hospitals of other public institutions, especially SSK hospitals, were transferred to the Ministry of Health. The VAT rate on the drug has been reduced and the drug pricing system has been changed. These regulations played an important role in promoting access to medication. Not only in cities but also in villages, “112 Emergency Health” service has started to be offered, the number of stations has been increased and ambulances are equipped with the latest technologies. Air and sea transport vehicles were also added to the system. Primary health care services, especially preventive health and maternal and child health services have been strengthened, family medicine practice, which is one of the basic elements of modern health understanding, has been started and spread to the whole country. Comprehensive programs have been implemented to prevent deterioration of health and premature deaths due to noncommunicable diseases. In this context, national programs have been planned and implemented for certain diseases, especially cardiovascular diseases, cancer, diabetes, chronic respiratory diseases, stroke, kidney failure. Indicators in infectious diseases have reached the level of developed countries after the implementation of the Health Transformation Program. Regions where buildings, equipment and health personnel are lacking are considered to be a priority, and imbalances in this regard have been largely eliminated (SB, 2012).
c) Health Care Professionals and Health Infrastructure

The total number of physicians, which was 91,449 in 2002, increased to 153,128 in 2018. Likewise, the number of nurses increased from 72,393 to 190,499 between 2002 and 2018. In the same period, the number of midwives increased to approximately 15,000, the number of pharmacists to 10,000 and dentists to 14,000. While the total number of physicians per 100 thousand people in 2002 was 138, it has been increased to 187 in 2018 (Figure 14). The number of physicians, dentists, pharmacists, nurses, midwives (Public + Private Sector) per 100,000 people are shown in Table 5.

In addition, the number of applications per physicians have increased over time. For example, in 2002, while a patient was applying to the physician with an average of 3.1 times a year, this number reached 9.5 in 2018.

A total of 1,534 hospitals, including 577 in private sector, 68 in universities and 889 in the Ministry of Health exist in Turkey as of 2018. The Ministry of Health owns the greatest number of hospitals in Turkey and plays a decisive role in the medical and therapeutic services (Figure 15).

<table>
<thead>
<tr>
<th>Table 5. Health care professionals in Years (SB, 2018).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals</td>
</tr>
<tr>
<td>Family Medicine Unity</td>
</tr>
<tr>
<td>Other Institutions</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Specialist Physician</td>
</tr>
<tr>
<td>Practitioner</td>
</tr>
<tr>
<td>Physician Associate</td>
</tr>
<tr>
<td>Total Physician</td>
</tr>
<tr>
<td>Total Dentist</td>
</tr>
<tr>
<td>Pharmacist</td>
</tr>
<tr>
<td>Nurse</td>
</tr>
<tr>
<td>Midwife</td>
</tr>
<tr>
<td>Other medical staff</td>
</tr>
<tr>
<td>Recruitment of</td>
</tr>
<tr>
<td>Other Staff and Services</td>
</tr>
<tr>
<td>Total Staff</td>
</tr>
</tbody>
</table>
Table 6. Number of health care professionals per 100,000 people in 2002 and 2018 (SB, 2018).

<table>
<thead>
<tr>
<th>Number of health personnel per 100,000 people</th>
<th>2002</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Physicians</td>
<td>138</td>
<td>187</td>
</tr>
<tr>
<td>Dentist</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>Nurses and Midwives</td>
<td>171</td>
<td>301</td>
</tr>
</tbody>
</table>

Figure 14. Total Number of Physicians Per 100,000 People in Years (SB, 2018)

Figure 15. Total number of hospitals by sector in years (SB, 2018)
Within the scope of the second leg of the health transformation, the first city hospital in Turkey was put into service in February 2017 in Mersin. As of 2020, 11 city hospitals continue to serve. By the end of 2021, the number of city hospitals is planned to reach 18. While the total actual bed capacity in our country was 164471 in 2002, it reached 231913 as of 2018 (Figure 16). In 2002 the number of intensive care units was 2214, in 2018, this has reached to 38098 in Turkey (SB 2018). When the graphics are considered; It can be said that the number of hospitals, intensive care bed capacity and increased health care professionals play a major role in combating the Covid-19 pandemic.

![Figure 16. Total actual bed capacity in 2002 and 2018 (SB, 2018)](image)

![Figure 17. Total Number of Intensive Care Beds by Sectors in Years (SB, 2018)](image)

2.4.2. **Preventive Health Services**

Preventive Health Services are health services provided to protect people from getting sick, injured, disabled and premature death. Preventive Health Services are within the scope of primary health care services. As a result of the Health
Transformation Program of the Ministry of Health, community health centers and family health centers, and centers where babies, children, women’s health, elderly health, cancer screening programs and many Preventive Health Services are provided have been established.

a) Family medicine

The family physician is obliged to provide preventive health services and primary care, primary diagnosis, treatment and rehabilitative health services to each person in a certain and continuous manner, regardless of age, gender and disease, providing mobile health services to the extent necessary and working on a full-day basis. The family physician is a medical practitioner or a specialist who receives the training prescribed by the Ministry of Health.

The pilot implementation of the family medicine model started in Düzce Province in 2006. As of the year 2010 in Turkey, all health centers have been transformed into family medicine unit. The family physician is responsible for the health of all members of the family including fetus and the elders, and all kinds of health problems. The family physician is obliged to take care of a maximum of 4000 people.

Family physicians cooperates with the community health center of the region in the planning of the health service in the region they work. They provide preventive health services and primary diagnosis, treatment, rehabilitation and consultancy services for each patient. Family physicians provide guidance for their patients regarding health and provide health-promoting and preventive services. They also provide mother-child health and family planning services. They make follow-up and scans for their patients regarding their age, gender and disease groups (cancer, chronic diseases, pregnant, maternity, newborn, infant, child health, adolescent, adult, elderly health and so on).

As shown in Figure 18 as a result of the increase in the number of family physicians, the population per family physician also decreased. In Turkey, as in 2016, a family physician serves an average of 3267 people. The target of the Ministry of Health is to gradually decrease this number over the years and for each family physician to serve to 2000 people in 2023.

One of the biggest reasons for the transition to the family physician system is to increase the rate of immunization in the society and to better follow up the pregnant, puerperant, baby and child. The data of these criteria between 2002 and 2016 are shown in Table 7. It is seen that the number of the follow-up have increased significantly when 2002 and 2016 years are compared.
their age, gender and disease groups (cancer, chronic diseases, pregnant, maternity, newborn, infant, child health, adolescent, adult, elderly health and so on).

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### Table 7. Population per family physician in years (SB, 2016)

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization percentage (DaBT3, BCG, HBV, KKK)</td>
<td>77.3</td>
<td>97.5</td>
</tr>
<tr>
<td>Average number of follow-ups per pregnant</td>
<td>1.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Average number of follow-ups per child</td>
<td>0.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Average number of follow-ups per puerperant</td>
<td>0.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Average number of follow-ups per baby</td>
<td>3.4</td>
<td>8.4</td>
</tr>
</tbody>
</table>

### b) Community Health Center Services

Community Health Center is defined as the health institution that; focuses on improving and protecting the health of the community living, determine health risks and problems, makes plans overcome these problems and implementing these plans, organizes primary preventive, curative and rehabilitative health services in the referral and administration of the directorate, monitors, evaluates and supports the efficient delivery of these services, and ensures the coordination between the health institutions in the region and other institutions and organizations.

In order to establish a community health center in a compound, the population must consist of at least 100,000 people. The community health center carries out activities such as registration and statistics, planning and scheduling, monitoring and evaluation, control of infectious and non-infectious diseases, tuberculosis and malaria combat services, and reproductive health services. As of 2018, Turkey has 776 community health centers (Table 8) (ITO, 2010).
### Table 8. Number of Primary Level Establishments in Years (SB, 2018).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Health Care Center</td>
<td>5.055</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Family Health Center</td>
<td>-</td>
<td>6.829</td>
<td>6.902</td>
<td>7.636</td>
<td>7.774</td>
<td>7.979</td>
</tr>
<tr>
<td>Community Health Center</td>
<td>-</td>
<td>970</td>
<td>970</td>
<td>970</td>
<td>972</td>
<td>776</td>
</tr>
</tbody>
</table>

#### c) Satisfaction Level in Health Services

In terms of level of satisfaction, according to the results of “Life Satisfaction Survey” done by Turkey Statistical Institute (TÜİK), over the years, citizens in general say that the satisfaction level of health services tends to increase. The level of satisfaction in health services, which was 39.5% in 2003, increased to 70.4% by 2018 (Figure 19) (TÜİK, 2018).

![Figure 19. Annual Health Services General Satisfaction Rate in Years (%) (TÜİK, 2018)](image)

**2.4.3. The Budget Allocated to Health from Turkey’s National Income**

In 2002 in Turkey, total health expenditure per capita was $187, in 2018, was realized as $430 (SB, 2018). Gross domestic product ratio of total health expenditure in Turkey (GDP) was 4.4%.

**2.4.4. Actions on COVID-19**

Within the scope of the fight against the epidemic, it was carried out under the leadership of the Presidency in our country, it was implemented by taking fast, effective and frequently updated decisions. In conclusion; After the first case was detected in China on 31.12.2019, the Coronavirus Scientific Board was established by the Ministry of Health on 10.01.2020. During the process, Wuhan-Istanbul flights were stopped on 24.01.2020 and all flights from China on
05.02.2020 were stopped. The land border gates between Turkey and Iran was closed on 02.23.2020. The first case was seen in our country on 11.03.2020 and one day later, on 12.03.2020, education was interrupted in primary, secondary education institutions and universities. On 13.03.2020, the cancellation of public activities and the temporary closure of collectively gathering places started to be implemented. In order to prevent the spread of the virus, flexible working in the public has been initiated, and curfew has been introduced at different dates for people over the age of 65 and under 20. Curfew restrictions have been applied on weekends and long-term holidays. As of 03.04.2020, entrance and exits to 30 Metropolitan and Zonguldak provinces have been subjected to special permit (Travel permit), and it has been made compulsory to wear masks in places of work, süper markets and marketplaces. On 06.05.2020, the Minister of Health announced that the 1st Period has been completed in the fight against the epidemic. As of 29.05.2020, the worship in the mosques, which were interrupted, was allowed within the scope of limited times and Friday prayers were started to be performed again in accordance with the social distance and mask rule in the open area. As of 01.06.2020, the travel restriction of metropolitan cities was removed and the transition to controlled social life was started within the framework of the previously announced calendar (TÜBA, 2020).

During the epidemic of Covid-19, arrangements have been made in order to provide healthcare services free of charge to patients in both private sector and public institutions by social security institution (SSI). Cooperation with the relevant ministries has been realized to present various incentive and support packages including deferral in tax payments and discount for the businesses that have been suspended due to the epidemic and continue to produce and employ personnel within the scope of obligation or volunteering. In this context, with the “We Are Enough For Us” campaign and the support of all segments of the society, contribution was made to the social benefits planned to be made to households. The needs of individuals over the age of 65, people with disabilities and chronic illness who were curfewed, were fulfilled through teams established with the support of local governments, security forces and various non-governmental organizations (TÜBA, 2020).

In this process, Turkey has launched the production of its medical supplies as well as the personal protective equipment of the health personnel. In addition, It provided medical equipment and protective equipment to various countries (USA, UK, Italy, Spain, Serbia, China, Pakistan, Syria, Sudan, Somalia, Bosnia and Herzegovina, Libya, Iran) within the scope of international solidarity. This attitude of our country is very important in terms of economic and political relations (TÜBA, 2020).
3. Climate Change and Its Impacts on Public Health

Turkey is one of the countries in that are at risk in terms of potential effects due to the global climate change. Due to the decrease in water resources, forest fires, erosion, change in agricultural productivity, drought and ecological deterioration, deaths due to heat waves and increases in vector-borne diseases, floods and related diseases or deaths and urban air pollution as a result of the observed and expected change in climate, chronic respiratory diseases are expected to increase. The chances of catching health risks caused by climate change are higher in low-income countries and regions with poor health care. In this context, preparation plans are needed to provide safe drinking and utility water in both cities and rural areas, to prevent and fight bad weather events that may affect health services (SB, 2015). The possible effects of climate change are of interest not only by the Ministry of Health but also in many different institutions and the relationship between climate change and health has been increasingly investigated in recent years. In this section, climate change and health effects in Turkey are discussed.

3.1. Heat Effects

The change in temperatures can directly affect human health and life. These effects are mostly seen acutely and often cause casualties (Atay et al., 2012). These effects can be examined in two groups as hot and cold air waves.

Especially in cities, the effect of the hot air waves is important. The effect of hot weather and temperature waves on human health depends on the level of exposure to hot air, the density of the population (frequency, degree and duration) exposed and the sensitivity of the population. The direct effects of high temperature on health appear as sunburn, heat cramp, heat fatigue, heat stroke or sunstroke. In addition, it can lead to worsening or even death of the person’s health. Individuals with chronic diseases such as hypertension and coronary artery disease, asthma, respiratory system diseases such as chronic obstructive pulmonary disease, diabetes, and vulnerable groups such as the elderly, pregnant women and children are particularly at risk. Due to the climate zone in which our country is located, the probability of seeing hot air waves is very high. In this respect, the Southeastern Anatolia Region is at a higher risk regionally than the Marmara Region. However, since the population of the Marmara Region is denser, it is likely that the effects of hot air waves are higher (SB, 2015).
The maximum temperatures in June 2006 and 2007 and the daily mortality rates for the same months are given in Figure 20. It can be said that there is a parallel between high temperatures and the increase of mortality rates (SB, 2015). In another study, three hot air wave events in Istanbul in 2015, 2016 and 2017 showed an increase in the risk of death by 11%, 6% and 21%, respectively. The highest risk rate was seen in the summer of 2017. People are less tolerant of extreme temperature in the first weeks of summer. The second heat wave in 2017 did not increase mortality rates (Can et al, 2019).

The Ministry of Health continues its efforts to inform the public against hot air and temperature waves, especially in the summer months. With regard to chronic diseases, ministry is carrying out Prevention of Cardiovascular Disease and Control Program, Turkey Chronic Respiratory Disease (asthma and COPD) Prevention and Control Program Action Plan and Turkey Diabetes Control Program Strategic and Action Plan programs (SB 2015).

Cold weather continues to be a problem in the northern regions of the world, where cold air is suddenly formed and the air reaches very low temperatures for a long time. Exposure to cold weather is more problematic among those who work outside, homeless people and similar social conditions and the elderly. In countries that have adapted to cold weather and cold air waves, there may be an increase in the death rates from cold if there is a problem in the electricity and heating system (SB, 2015). There is no statistical information regarding the impact of cold wave in Turkey.

As previously mentioned in the future scenarios of climate change, the average temperature is expected to increase between 2-3.5°C and 4-6°C for two different pollution emission scenarios (Rcp 4.5 and 8.5). The highest temperature increase is expected in South East Anatolia and Mediterranean Regions. Especially,
summer and autumn months are the most sensitive period during the year (Öztürk, 2019). Along with these estimates, the groups that are more sensitive to temperature increases may be affected more by the effects of climate change.

3.2. Extreme Weather Events, Floods and Effects

The most frequently experienced natural disasters in Turkey are storms, floods, droughts and forest fires. These disasters can often cause injury to individuals and sometimes even death. 2019 was the year with the most extreme events with 935 extreme events. There is an upward trend in extreme event trends, especially in the last two decades (Figure 21). Most of the extreme events recorded in 2019 were heavy precipitation/flooding with 36% and a storm with 27%. Other incidents were hail with 18%, lightning with 7%, heavy snow with 5%, landslide with 3%, and avalanches of 1% and to a lesser extent avalanche, wildfire, sandstorm and fog (Figure 22) (MGM, 2019).

![Figure 21. Number of Annual Extreme Events in Turkey (MGM, 2019) (The Same Figure is Taken)](image)

![Figure 22. Distribution of Extreme Events in Turkey of the Year 2019 (MGM, 2019) (The Same Figure is Taken)](image)
As one of the extreme events in the most common type of natural disaster, floods, has led to significant loss of life and property during the historical period for Turkey. Floods have started to have devastating results at higher rates with their incidence and severity, especially in the last 10 years (Akay, 2019). In Table 9, the list of floods that led to death of at least 10 people between 1995-2004 in Turkey are given. When the causes of deaths due to floods were investigated, the causes of death were found to be drowning, injury and hypothermia. Stress and psychological trauma are also the most important effects of individuals as a result of floods (TÜBA, 2010). In addition, excessive rainfall, stagnant water or overflow of rivers cause increases in infectious diseases due to the increasing number of flies. Until the end of the 21st century, Turkey is expected to be the most effected country from extreme weather conditions among the Eastern Europe, the Balkans, Eurasia and the Turkic States (Figure 23) (Baettig et al, 2007).

Table 9. Floods that happened between 1995-2004 years in Turkey and led to death of at least 10 people (TÜBA, 2010).

<table>
<thead>
<tr>
<th>Year</th>
<th>Place</th>
<th>Number of Influences (Loss / million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2004</td>
<td>Erzurun, Batman, Bitlis, Konya, Silifke</td>
<td>15 deaths</td>
</tr>
<tr>
<td>June 2002</td>
<td>Rize</td>
<td>39 deaths</td>
</tr>
<tr>
<td>August 1999</td>
<td>Trabzon (Beşköy)</td>
<td>60 deaths, 1000 affected people</td>
</tr>
<tr>
<td>June 1998</td>
<td>Diyarbakır</td>
<td>22 deaths</td>
</tr>
<tr>
<td>May 1998</td>
<td>Zonguldak, Karabük, Bartın</td>
<td>10 deaths, 47 injuries, 1200000 affected people (Loss:1000000000 million US dolar)</td>
</tr>
<tr>
<td>July 1995</td>
<td>Ankara, Istanbul, Isparta</td>
<td>74 deaths, 10000 affected people</td>
</tr>
</tbody>
</table>

Figure 23. 21. Near Geography Countries where the biggest increases will be experienced in extreme climatic conditions until the end of the 21st century (Baettig et al., 2007)
3.3. Infectious Diseases

3.3.1. Vector Source Diseases

While the changes in climate conditions affect ecology and biodiversity, they also change the pattern of disease, the source of the disease, the variety, structure, amount, strength of the disease factors, the means of transmission of the factors, the carriers, the living and inanimate places where the factors reside, and the environmental features in which they live. Carriers that mediate the transmission of diseases to humans and animals are called vectors. Changes in temperature and humidity, excessive precipitation, changes in winter temperatures, urbanization, increase in vegetation, decrease, structural changes may cause vectors to be seen in a different place than expected, to increase or to increase more than expected (Kiraz, 2019).

Due to the increase in temperature with climate change, animals with miscellaneous dimensions on land and at sea tend towards cooler places to get out of the hot zone. Also in addition to climate change, deforestation, habitat change or the destruction of some ecosystems can indirectly cause the movement of animals to different places and the spread of diseases. With the movement of animals to different regions, it creates an opportunity for them to come into contact with other animals they do not normally live with, and in this case pathogens enter new environments. Pathogens can transform with mutations in their new environment. For example, the bird flu virus found in wild water birds can spread to wider areas with birds forced to migrate with the destruction of wetlands (Tolunay, 2020). Findings revealed as a result of studies on the effects of climate change on human health show that hot climate belts will shift to the north and cause the distribution of some infectious disease vectors to change (SB, 2015). As a result of rising temperatures and uneven distribution of precipitation, there has been an increase in vector-borne diseases such as avian influenza, tick-borne diseases, cholera, ebola, parasitic diseases, plague, lyme, harmful seaweeds, scarlet fever, sleep sickness, tuberculosis, yellow fever, malaria, western nile virus, chikungunya and dengue fever (Kiraz, 2019).

a) Malaria

Malaria is the most susceptible to long-term climate change among the vector-borne diseases. The increase in average temperature in the external environment will affect the mosquito-mediated vector distribution. In the coming years, it is expected that it will be seen in tropical and subtropical regions where malaria has not been seen yet and it will increase in the regions where the disease is seen. European countries are an endemic region for some of the vector-borne diseases. Malaria is endemic in some Eastern European countries, including Turkey (SB 2015).
In the past 30 years, there have been two periods associated with a high number of malaria cases (Figure 24). These are the periods between 1977-1987 and 1993-1998. The average temperature in Adana between 1977 and 1987 was found to be significantly higher than the average temperature between 1930 and 2004. This is an important result that shows a parallelism between high temperature and malaria cases in the period between 1977 and 1987. Distribution of malaria cases varies according to different regions. The average temperature in Sanliurfa and Mardin was found to be significantly higher than the sum of the years examined in the 1993-1988 period. This finding may be related to the high number of malaria cases in the region (Atay et al, 2012).

Within the scope of the studies carried out within the scope of Malaria Elimination Program being implemented in Turkey, very successful results have been obtained. In 2010 and 2011, no new domestic malaria cases were reported, only overseas malaria case reports were made (CSB, 2013). Turkey is one of the 16 countries that has not encountered with malaria cases for 3 consecutive years between 2007 and 2017 (WHO, 2018) (Figure 25). The primary malaria agent, falciparum malaria parasite, is projected to spread to new areas by 2050, as shown in Figure 26. According to the light of this data, the incidence of malaria in Turkey can be increased by 2050 (UN, 2019).

Mankind has struggled with this pest by applying different methods in order to get rid of the disturbing and disease bearing effects of malaria vector from the beginning of his life until today. Today, we can gather the techniques used to combat vectors under the headings of chemical, biological, mechanical, cultural and integrated struggle. In the fight against pests, the type of struggle that enables to reach the result in the shortest time and in the most effective way is the chemical struggle. Biological struggle is a sustainable pest management method that takes place as a natural phenomenon and does not harm the environment with little or no careful manipulation. The definition made as mechanical struggle can also be called physical struggle. The main aim in this struggle is to eliminate the breeding and feeding habitats of the vectors by improving the
physical infrastructure. Cultural struggle, which constitutes one of the important components of the struggle against vectors, is raising awareness of employees and practitioners in education and arguments, especially for the local people who live in the region (Alten and Çağlar, 1998).

Figure 25. International comparison of cases of malaria (100000 population, 2017 data, this number has been set to zero for Turkey in 2018.) (General Directorate of Public Health, the World Malaria Report 2018, UNDP)

Figure 26. Distribution of Malaria Parasites in the World until 2050 (UN, 2019)
b) Crimean-Congo Haemorrhagic Fever (CCHF)

Crimean Congo Hemorrhagic Fever (CCHF) is usually caused by a virus transmitted by ticks. Ticks are sensitive to climate and seasonal changes. Therefore, it is necessary to control the disease seasonally and take precautions when the disease is common (CSB, 2013). Figure 27 shows the geographical distribution of CCHF cases in the world limited to Asia - Europe - Africa. Although the disease shows seasonal characteristics, it generally starts with spring, reaches the highest level in summer and decreasingly disappear in autumn.

One of the tick-borne infectious diseases, CCHF is a deadly viral infection that occurs in parts of Africa, Asia, Eastern Europe and the Middle East. The first viral hemorrhagic fever (VHF) detected in our country until today is CCHF. Since 2002, a large number of patients started to be registered. To date, 10562 cases have been recorded by 2017, mainly from Tokat, Yozgat, Corum, Sivas, Kastamonu, Karabuk, Gumushane, Erzurum, Amasya, Cankiri, Giresun and Samsun, 501 (5%) of them resulted in death (Figure 28). Deaths are most common in the 50-70 age group and 66% with the most engaged in farming and animal husbandry (THSK, 2016).

![Crimea-Congo Hemorrhagic Fever Distribution Map](image)

*Figure 27. Crimea-Congo Hemorrhagic Fever Distribution Map (THSK, 2016)*
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Figure 27. Crimea-Congo Hemorrhagic Fever Distribution Map (THSK, 2016)

Figure 28. Crimea-Congo Hemorrhagic Fever Cases and Death Numbers (THSK, 2016)

c) Tularemia

Tularemia is a disease caused by the bacterium of Franciscella Tularensis, which is transmitted to humans by direct contact with infected animals, contaminated water or food entering the body, tick bite, biting flies or mosquitoes, or inhalation of infected powders or sprays. Population movements, poverty, wars and migrations facilitate the spread of various disasters. The increase in cases of tularemia in Turkey in recent years, is attempted to be explained due to changes in some of the ecological balances. It is thought that the increase in the rodent population, especially after rainy seasons, has increased the number of tularemia cases (CSB, 2013). However, the contact of rodents with the water resources is seen as the most factor in clustering tendency of tularemia cases in Turkey and in general being seen as small-scale water-borne epidemics. Before 1998, very few cases of tularemia were seen in Turkey. However, many cases have been reported since 1998. The source of all these epidemics is polluted drinking water. While Tularemia was widespread in the Marmara and Western Black Sea Regions before 2005, new cases were also reported in the first half of 2009-2010, especially in the Central Anatolia and Black Sea regions (TSHGM, 2011).

d) Sandfly Fever

Sandfly fever is caused by a virus transmitted from sandfly (Phlebotomus papatasi). Sandflies are sensitive to climate and seasonal changes. The disease is transmitted to people by bite of sandflies. The sandfly feeds at night and is found in dark places during the day, such as wall cracks, caves, houses, and tree burrows. Therefore, it is important to monitor the disease seasonally and take the necessary measures when the disease is seen. Sand fly malaria is observed frequently in the Turkish Republic of Northern Cyprus, the Balkans and in Turkey’s southeastern neighbors (Iran, Iraq). In Turkey, in the studies in the Aegean and Cukurova regions, especially in Adana, disease-related antibodies have been identified. In Izmir, Ankara and Adana Over 106 patient study carried out, and SFCV SFSV type antibodies have been identified and Turkey-type virus (sandfly fever virus Turkey, SFTV) was isolated (CSB, 2013).
e) **Leishmaniasis**

Leishmaniasis is a disease transmitted by vectors affected by climate change. Climate change facilitates the spread of both infectious vectors and disease. Increases in temperature and humidity can spread the disease to the northern regions. Unplanned urbanization and poor infrastructure can facilitate the spread of sand flies carrying this disease. Leishmaniasis has been reported in all countries adjacent to the Mediterranean. The cutaneous form (Cutaneous Leishmaniasis) of Leishmaniasis is endemic in our country, especially in the Sanlıurfa and Cukurova regions, in the Southeast provinces. Migration and urbanization are important risk factors for cutaneous leishmaniasis. According to reports, with the increased agricultural irrigation due to the GAP (Southeastern Anatolia Project), the habitat of the infected flies will expand and the cutaneous leishmaniasis may increase.

f) **Cutaneous Leishmaniasis**

Cutaneous Leishmaniasis is known in Turkey since 1833. In the 1950s, it has decreased due to the fight against malaria and pesticides affecting the sand flies, but it started to spread again due to irrigation agriculture, unplanned urbanization and migrations. In all infectious diseases, control measures play an important role in reducing effects. In this context, health personnel should be trained and awareness of health personnel should be increased in the diagnosis and treatment of these diseases affected by climate change.

g) **Dengue**

Dengue is the world’s most important vector-borne disease. It was seen in only 9 countries in the world until 1970, and since 1995, it became problematic in countries more than 4 times than the countries in the previous period and continued to increase. It is stated that 40% of the world’s population is at risk for this disease. There are many studies investigating the relationship between climate and occurrence of dengue disease. In these studies, this reported relationship did not fully reveal the complex effects of climate change and other factors on transition. While excessive rains and high temperatures can cause an increase in transmission, studies have shown that drought can also cause it. The climate-based (temperature, rain, clouding) intensity maps of Aegypti, the main dengue fire vector Stegomyia (previously called Aedes), match the observed disease distribution. Approximately one third of the world’s population lives in suitable places for the spread of dengue disease (SB, 2015).
3.3.2. **Waterborne diseases**

Studies have found that there is a relationship between the time of occurrence of waterborne diseases and epidemics and the dates of heavy rains and floods. In both of them, the incidence of water-borne diseases increases due to secondary reasons such as excessive thirst and drought, poor hygiene conditions and weaknesses of immune system. It is estimated that water-borne diseases will increase over time with climate change (Atay et al., 2012).

Waterborne diseases can be transmitted by drinking polluted water, eating foods that have come into contact with these waters, and using polluted waters in green areas irrigation. Conditions such as temperature changes, extreme weather events, floods, increases in precipitation can increase waterborne diseases (TÜBA, 2010). Campylobacter, Salmonella and Shigella are the most common water and foodborne diseases. While infections caused by Salmonella and Shigella have been decreasing in recent years, an increase in Campylobacter infection, which is associated with high temperatures, has been shown. In cases where excessive precipitation was observed but drinking water chlorination was not performed, an increase in tularemia cases was observed. Chlorination of waters is very important in the tackling of Tularemi (CSB, 2013).

Sewerage and flood waters management is important in low income urban communities. Because the clogging of the sewage system is one of the most important reasons for the spread of diseases. Extreme weather events affect the water system both physically and administratively. Due to the decrease in precipitation, low flow occurs and thus, pathogens increase. Impairment of water quality increases the number of diseases such as cholera, typhoid, paratyphoid and childhood diarrhea and the incidence of related deaths (SB, 2015). As a result of climate change, it is expected that it will adversely affect water resources and water quality and that drinking water resources will decrease in these regions. It is expected that there will be an increase in diarrhea in the future due to the use of poor quality river waters or unsafe waters (TÜBA, 2010).

3.3.3. **Foodborne Diseases**

Changes in climate and severe weather events have an impact on human nutrition from different perspectives. The reasons such as regional lack of water, increase in salt rate in agricultural areas, damage of crops from disasters such as flood and plant diseases affect nutrition. Drought reduces the diversity of food and food consumption. This causes an increase in mortality in malnutrition and diarrheal diseases. One of the most important factors affecting this is the outdoor temperature. Foodborne diseases increase especially in summer months (TÜBA, 2010). Many studies confirm that high temperature affects salmonellosis food poisoning. These studies have shown that there is a linear increase in poisoning in each degree of temperature increase weekly and monthly. It is stated that the increase of the temperature in Campylobacter spreads most in Europe (SB, 2015).
In addition to extreme temperatures, excessive precipitation and strong winds can also increase foodborne illness. It is estimated that foodborne diseases will increase by 5-20% by 2050. Microorganisms are generally transmitted to humans through eggs, chicken and veal. The relationship between food and infectious species especially affects the susceptibility of heat carriers such as flying, rodent and cockroaches to heat. Flying insects are largely affected by ambient temperature rather than biotic factors. Warm weather and mild winter months increase flying insects in warmer countries. Other species that normally appear in the summer have begun to appear in the early spring months (SB, 2015), (TÜBA, 2010).

3.4. Mental Diseases

Psychological effects of global warming can range from simple stress issues to chronic stress or other mental disorders. Many of these problems are thought to be related to extreme weather events and heat waves (IWGCCH 2010). The effects of stress caused by extreme heat cause many health problems, from heart attacks, temporary loss of consciousness to traffic accidents. The broader effects of floods, forest fires, which occurred after extreme weather events such as hurricanes arises from the social trauma. In such a situation, people who lose their homes, jobs, relatives and social environments face many psychological problems (Yüksel et al., 2018). In particular, it can have negative effects in maintaining jobs that require attention. Increases in air temperature can often cause anxiety disorders among mental health diseases.

In addition, increases in humidity can create a feeling of restlessness for those with panic disorder, and the frequency of attacks may increase. While summer means relaxation, sea or vacation for most people, it is also a time when anger control problems can increase. Research has shown that many social-fact events coincide with summer or hot weather, and crime rates also increase. Many people can increase alcohol or drug use while going on holiday, and the holiday season can be risky for addicts or patients who are still being treated for easy access to alcohol or drug (Denizgil, 2018).

A study published in the Journal of the American National Academy of Sciences revealed that experiences at higher temperatures and additional precipitation were directly related to poor mental health. As people are exposed to these factors, their condition gets worse. Therefore, events related to climate change are expected to become more frequent and intense in the coming years. Women and low-income individuals were found to be the most affected by the link between temperatures and mental health. When the global temperature rise increases to the range above 2 degrees above average, it can have serious effects on human well-being, including mental health. It has also shows that climate change can increase suicide rates, causing tens of thousands of people to kill themselves in the middle of the 21st century, especially in the USA and Mexico (Obradovicha et al., 2018). Berry H.L. et al. (2018), 208 publications were reported in 9,672
publication searches produced with the terms “climate change and mental health” between 2007-2016. This number is very low and studies on the mental health of climate change should be increased.

In a study conducted in Bartın, it has been stated that climate change has various effects on people and it has been revealed by various researches (Akdağ, 2011). It has been seen 33 cases of depression in 2009 and 24 cases of depression in 2010. These depressions occurred in summer and autumn in 2009, while in 2010 they occurred in spring and autumn. This situation is important in terms of showing that people can be affected in a constantly changing climate environment. Located in the hottest region of Turkey a survey was conducted for high school students and teachers in Sanlıurfa. According to this study, the effect of air temperature on teaching and learning was investigated. The most appropriate working time for students and their teachers was determined as “sunny weather in winter”. In the summer months, students think that dusty air negatively affects the desire to work by 80.7%, while teachers think that hot air negatively affects the desire to teach 95.05% (Mollazade & Sahinalp, 2019).

3.5. Chronic Diseases

As a result of the additional burden of chronic diseases on the human body, the body gets weak. Individuals with chronic diseases are easily affected, even if climate change has mild effects (SB, 2015). Therefore, the group that is expected to be most affected by climate change is the group with chronic disease. With climate change, those with chronic diseases such as cancer, hypertension, cardiovascular diseases, blood-borne diseases, asthma, neurological diseases and disorders will be most affected.

The depletion of the ozone layer in the stratosphere causes the increase of ultraviolet rays reaching the earth. The increase in ultraviolet rays reaching the earth causes an increase in the tendency to catch infections and an increase in cancer tendency due to the weakening of the human immune system. The increase in ultraviolet rays also results in the occurrence of sunburn, early signs of aging due to a decrease in photosensitivity and skin elasticity (Çimen & Öztürk, 2010).

3.6. Acute Diseases and Allergies

Respiratory system disease, defined as “Metropolitan Disease”, is an important health problem in cities where crowded masses live together, especially in big cities. The number of individuals affected by this disease, which can also be defined as “Metropolitan Bronchitis”, is quite large.

Despite the fact that a large number of people living in crowded cities every year, especially children do not have a significant respiratory system disease such as
asthma, chronic bronchitis, pneumonia, allergic disease development, etc. They get sick and this reveals the importance of this problem (Çimen & Öztürk, 2010).

Temperature variations and increases affected all living species and changes occurred in plants and pollen scattering. Storms were found to increase pollen-related asthma attacks. Air pollution increases the allergen properties of pollens. It is known that high temperatures and precipitation increase pollen production of many trees and herbaceous plants. According to a study conducted in North America, the pollen period of the Ambrosia plant extends seriously as it moves towards the northern regions. There are many studies indicating that this is also true for other plant species (SB, 2015). The main diseases caused by pollen can be listed as hay fever, asthma and eczema.

Some studies have been made in Turkey in this regard. In a study covering 14 provinces and conducted on 25,843 people, it was shown that the average annual temperature was associated with the prevalence of asthma and wheezing in both genders, and also linked to eczema in women (Metintaş & Kurt, 2010). It was determined that the amount of moisture was also effective on asthma in women and there was a relationship between the number of annual snowy days and wheezing in both gender. Due to the climate change the increase in the number of cockroaches, mites etc. in the houses and the increase of pollen and air pollutants in the external environment, diseases such as asthma are expected to increase (TÜBA, 2010). Treatment expenses and economic job losses caused by pollen and similar allergens that cause allergic reactions will cause billions of dollars of damage to the national economies.

3.7. Air Pollution, Pollutants and Effects

Carbon dioxide is the biggest factor in global warming and climate change. Besides, many compounds containing gas or particles known as ‘Climate Compeller’ have a significant impact on the amount of solar energy (including heat) that the earth retains and the amount it reflects back into space. These climatic compellers include air pollutants such as ozone, methane, particulate matter (PM) and nitrous oxide.

Depending on the particulate matter composition, it may have a cooling or heating effect on the local and global climate. For example, black carbon, which is one of the fine PM components and formed as a result of incomplete combustion of fuels, has a heating effect in the atmosphere as it absorbs solar rays and infrared rays in the atmosphere. Other PM types, which contain sulfur or nitrogen compounds, have the opposite effect. They acting as small mirrors, tend to reflect the energy of the sun into space and thus lead to cooling tendency. Simply stated, this situation depends on the color of the particle. Generally, “white” particles reflect daylight, while “black” and “brown” particles tend to absorb daylight. A similar phenomenon takes place in the soil. Some of the particles descend to the surface.
of the earth due to rain, snow and gravity. Black carbon, can be moved relatively away from the source, achieve the level of the snow and ice cover. In recent years, black carbon accumulations in the Arctic have gradually darkened white surfaces and reduced their reflective properties. This causes our planet to retain heat more. With the additional heat, the size of the white surfaces shrinks much faster in the North Pole.

Interestingly, many climate processes are controlled not only by the major components of our atmosphere, but only by some very small amounts of gases. The most common of these gases, called trace gases, is carbon dioxide, making up only 0.0391% of the air. Any changes in these very small quantities have the power to influence and change our climate.

Evidence for the health effects of particulate matter is stronger than ozone. Particulate matter seriously affects the number of deaths and diseases. Therefore, increased concentration increases negative effects on health (SB, 2015).

In a study investigating the effect of air pollution on respiratory system diseases in Istanbul province, it was found that outdoor air pollution in Istanbul increased hospital admissions due to respiratory system diseases, especially adverse impact in the elderly (> 65 years) and women (Çapraz et al. ., 2017). Another study investigating the effect of air pollution on deaths in Istanbul revealed a significant relationship between air pollution and deaths caused by respiratory and heart diseases (Çapraz et al. ., 2017).

The greatest risk for deaths from cardiovascular diseases generally occurs four days after exposure to pollution. The greatest risk for deaths caused by respiratory diseases generally occurs five days after exposure to pollution. The greatest risk for deaths caused by non-accidental causes show up is ten days after exposure to pollution for PM$_{10}$ and two days for SO$_2$ (sulfur dioxide). The serious risk is experienced when pollutant concentrations are well above normal levels. In such cases, the risk of death increases exponentially (Çapraz, 2013).

In 2013-2015, the relationship between hospital admissions and air pollution was investigated due to respiratory diseases from different age groups in Istanbul. The highest relationship was found between PM$_{2.5}$, NO$_2$(Nitrogen Dioxide) and PM$_{10}$ parameters, respectively, and hospital admissions. In addition, in the number of hospital applications in Istanbul, short-term exposure to these parameters has increased this number (Çapraz et al. ., 2017).

3.8. Food, Nutritional Safety, Agriculture and Effects

It is estimated that due to climate change in the Mediterranean Basin where Turkey located in, the temperature will increase, heat waves will be more intense,
up to 20% reductions would be in precipitation, soil moisture will decrease and sea level will rise. In the report prepared on this subject, it is reported that the temperature increases and changes in the precipitation regime will be more in semi-arid and tropical areas in the Mediterranean Region, and extreme weather events such as floods and droughts will be more intense and frequent. It is estimated that these changes will cause losses and destructions in agricultural areas and decrease in product yields. The report also reports that temperature increases of 2 and 4 °C worldwide will result in a 5% and 10% reduction in grain yields, while a decrease in yield will reach 25-35% in the Mediterranean region (CSB, 2013).

Turkey is estimated to be one of the countries most affected by climate change. A study conducted in seven geographical regions and national scales in Turkey, it was found that as a result of precipitation and temperature changes in the regions during the production periods of plants covering 85% of the production areas, changes in yields, and this change of Turkey’s agricultural production, inter-regional pattern of products, agricultural products prices, exports and imports of consumer, producer and social welfare effects have been identified (Dellal et al., 2011). As seen in Table 10, it has been determined that the production amount will decrease by 8.18% in wheat, 2.24% in barley, 9.11% in corn, 4.53% in cotton and 12.89% in sunflower. There will be changes in the production pattern by regions, exports in wheat and sunflower will decrease, imports in corn and cotton will increase, product prices will increase by 6.3% in wheat, 7.1% in barley, 12.6% in corn and 0.1% in sunflower. In the face of the increase in product prices it is estimated that producer welfare will increase by 8.3%, whereas consumer welfare will decrease by 1.7% and total welfare will decrease by 0.7% (CSB, 2013).

Table 10. Effect on the yield of agricultural products in seven regions in Turkey of climate change, % (Dellal et al., 2011).

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Barley</th>
<th>Corn</th>
<th>Cotton</th>
<th>Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Sea</td>
<td>-6.0</td>
<td>-7.0</td>
<td>-7.4</td>
<td>-5.0</td>
<td>-5.0</td>
</tr>
<tr>
<td>Marmara</td>
<td>-10.3</td>
<td>-8.5</td>
<td>-7.9</td>
<td>-5.0</td>
<td>-5.9</td>
</tr>
<tr>
<td>Aegean</td>
<td>-7.2</td>
<td>-7.2</td>
<td>-11.0</td>
<td>-3.6</td>
<td>-6.6</td>
</tr>
<tr>
<td>Mediterranean Sea</td>
<td>-6.5</td>
<td>-6.0</td>
<td>-10.9</td>
<td>-2.8</td>
<td>-6.8</td>
</tr>
<tr>
<td>Central Anatolia</td>
<td>-7.4</td>
<td>-8.2</td>
<td>-12.5</td>
<td>-7.3</td>
<td>-7.3</td>
</tr>
<tr>
<td>Eastern Anatolia</td>
<td>-8.3</td>
<td>-8.5</td>
<td>-12.1</td>
<td>-7.9</td>
<td>-7.9</td>
</tr>
<tr>
<td>Southeastern Anatolia</td>
<td>-7.2</td>
<td>-7.5</td>
<td>-9.2</td>
<td>-4.0</td>
<td>-6.3</td>
</tr>
<tr>
<td>Turkey</td>
<td>-7.6</td>
<td>-7.6</td>
<td>-10.1</td>
<td>-3.8</td>
<td>-6.5</td>
</tr>
</tbody>
</table>

3.9. Forest Fires and Effects

Meteorological factors that decrease the relative humidity and increase the temperature are particularly effective in the formation of forest fires, which are
closely related to drought (MGM, 2018). As a result of 30188 forest fires between the years 2005-2018 a total of 106 650 hectares of forest has burnt out in Turkey. According to annual statistics, an average of 2388 forest fires occurred annually. An average of 6665 hectares of forest were damaged annually in these fires. While 2167 forest fires occurred in 2018, 5644 hectares in total were damaged. According to 2018 statistics for Turkey, it has been introduced that 81% of forest fires originating from human intent and omission. Fires caused by natural causes are only 19% (OGM, 2018). These are fires caused by energy transmission lines, mostly due to lightning and storms (MGM, 2018). The year of the biggest fire was 2008, which makes up almost 27% of the burning areas in the last 10 years. The fact that 2008 was a dry year had a great impact on this. In 2008, largest forest fire in Turkey’s history has occurred in Antalya-Taşağıl (MGM, 2018).

The area damaged by fires decreases every year. Developing technology and increasing measures have a big share in this decrease (OGM, 2018). Protection and improvement of forest ecosystems, which have a very important role in combating climate change, have a special place. In Turkey, many studies are performed to preserve existing forests and rehabilitate deteriorated forest ecosystems. Many collaborations are carried out such as early warning and alarm systems (Akay, 2019). Forest fires cause burns and smoke inhalation and other injuries (e.g. accident while avoiding fire areas). Major fires lead to an increase in the number of patients in emergency departments. Toxic gases and particles are dispersed into the atmosphere, and these cause an increase in acute and chronic respiratory diseases, especially in children and the elderly, lung infection, upper respiratory tract diseases, asthma and COPD. Pollutants from forest fires negatively affect air quality even thousands of kilometers away (SB, 2015).

3.10. Migrations, Vulnerable Groups and Effects

Today, beginning with the rise in the number of asylum seekers coming to Turkey in excess of millions, notably economical many respects causes them to produce new policies in Turkey. Increasing disasters caused by climate change will lead to further increase in these waves of migration in all aspects (Akay, 2019). The absence of a legal framework makes it difficult to determine the protection status of these people called climate refugees. Climate refugees, whose legal status is uncertain, can cause social tensions due to resource shortages and indirect security problems (Yılmaz & Navruz, 2019).

The United Nations Human Rights Committee has taken a decision that governments cannot force people to return because of the climate crisis (Vatandaş, 2019). The decision in question is a first and it can also be an “entrance door” for people who are under threat due to global warming.

Since 2008, an average of 21.5 million people have been forced to migrate each year due to disasters such as floods and droughts. It is stated that millions of people
will demand asylum from Europe every year, even due to climate change, without political and economic factors. A study showed that citizens of countries with a temperature above 20 degrees demand more asylum than citizens of countries with less temperatures (EKOIQ, 2019). The top 10 migration movements in 2016 were due to the climate. The countries most affected by these migrations were the Philippines, China and India. Due to the climate and disasters in Turkey last 10 years, 275 313 people have emigrated (UNDP Turkey, 2019).

Turkey, especially refugees who escaped from the war and refugees in the camps where these can be classified as sensitive areas. While there were 58 thousand refugees in Turkey in 2011, the official number of Syrian refugees with only nominal August 2019 is 3.64387 million. According to unofficial data, this number is over 5 million. 89% of refugees in Turkey from Syria, 4% from Afghanistan, 3% from Iraq, 1% from Iran and remaining 3% from other countries. Most of these refugees live in camps in Southeast Anatolia and are vulnerable to climate change and epidemic diseases. In these camps, there is an increase in cases such as tuberculosis and measles. In addition, the incidence of some infectious diseases, such as aftosa disease, which is more common in immigrants, is gradually increasing.

Five important risk factors such as the number of daily smokers, consuming less than 5 servings of fruits and/or vegetables per day, not meeting physical activity recommendations, the presence of overweight or obesity, and high blood pressure were examined for Syrian refugees. While only 0.3% of Syrian refugees in the 18-69 age group are in the low-risk group for non-communicable diseases, the proportion of those in the medium-risk group (1-2 risk factors) is 41.1% and the proportion of those in the high-risk group (3-5 risk factors) it is 58.7%. 45.7% of men in the 18-44 age group and 46.1% of women are in the high risk group. A striking finding is that men (81.7%) and women (87.1%) in the 45-69 age group are exposed to high combined risk (more than 3 risk factors) (Balcilar, 2016).
4. Compliance and Mitigation Policies

4.1. National Adaptation Plans for Climate Change and Public Health

Studies spread over a large area on climate change in Turkey in 2004 has begun with the signing of the Framework Convention on Climate Change in 2008, it has gained momentum with the signing of the Kyoto Protocol. In line with these agreements, some national documents have been prepared and these documents have directed the work to be done. In our country, there is a Climate Change Coordination Board (CBCC) under the coordination of the Ministry of Environment and Urbanization, which was established to carry out studies in this field. All policy work is coordinated by this board. The first document examining the effects of climate change on health is the First National Communication on Climate Change prepared in 2007 (TİDUB, 2007). In the first communication, it was decided to implement certain adaptation tools, such as identifying hazardous areas related to health, raising public awareness, creating risk maps related to diseases affected by climate change, and warning health units (TİDUB, 2007).

Grand National Assembly of Turkey basic document that examined the health effects of climate change in a systematic way (TBMM), Parliamentary Investigation Commission’s report was drafted in 2008 (TBMM, 2008). In the report, the interaction points of health and climate change are touched on and the health problems caused by the country’s climate change are mentioned. The most obvious of these are shown as health problems caused by heat waves, problems occurring due to the effects of changes in temperature and precipitation on epidemics such as malaria, CCHF and their vectors. In the report, a series of suggestions were made on reducing the effects of climate change on health.

Another document addressing the effects of climate change on health is the Climate Change 2010-2020 National Strategy Document published in 2010 (CSB, 2010). In this document, the effects of climate change are analyzed by sectors. Health is not considered as a sector. In the harmonization part of the document, the factors to be used in reducing the effects of climate change on health in the short, medium and long term are listed. In the short term, it is aimed to raise the awareness of the public against natural disasters caused by climate, to train the health personnel against the health risks of the climate change and to raise awareness among the health personnel. Although there are no direct health adaptation tools in the medium term, indirect applications in water resources,
agricultural production, energy efficiency and similar fields that can indirectly reduce the effects of climate change on health are also mentioned. In the long term, direct health compliance instruments such as monitoring WHO indicated (World Health Organization) disease and its vectors and reducing their effects, and minimizing the effects of extreme weather events on public health, have been specified.

The Climate Change Action Plan prepared in 2011 was prepared with a participatory approach under the coordination of the Ministry of Environment and Urbanization between 2009-2011 and was adopted by the Climate Change Coordination Board (CBCC) in May 2011 (CSB, 2011). The interaction between climate change and health exists as a harmonious topic. There are two aims in this title and four goals under these objectives. Under the first objective, the objectives of the extreme air events to investigate the effects on human health and the interaction between infectious diseases and health risks have been determined. The second objective includes capacity-oriented targets such as strengthening the infrastructure of risky areas and strengthening the capacities of health institutions. Detailed planning for these two purposes is detailed in Table 11.

The Ministry of Health General Directorate of Public Health (GDPH) is responsible for the impact of climate change on health. Ministry of Health (GDPH) contributed to the climate change action plan. In order to support the climate change action plan, the Ministry of Health has started to prepare an action plan to reduce the effects of climate change on health. Two preparatory meetings were held in Ankara in 2010 and 2011 with the financial support of WHO. WHO and stakeholder institutions (Ministry of Environment and Urbanization, Ministry of Education, Ministry of Food, Agriculture and Livestock, Directorate of Disaster and Emergency Management (AFAD), Ministry of Energy, Ministry of Forestry and Water Affairs, Universities and other relevant public institutions and organizations) have supported this study. GDPH organized a workshop with all stakeholders in Ankara on 5-6 December 2013.

The National Program and Action Plan for Reducing the Negative Effects of Climate Change on Health were launched in 2010 and approved on 21 January 2015. The report has been prepared in Turkish and is 122 pages.

It is planned to carry out studies under the following topics related to the things to be done in the field of climate change and health in the national program and action plan (SB, 2015):
Table 11. Climate Change and Health Issues in the Climate Change Action Plan (CSB, 2011).

<table>
<thead>
<tr>
<th>Goal 1. Determination of Threats and Risks for the Management of Natural Disasters Caused by Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target 1.1 Investigation of the effects of extreme weather events on human health</strong></td>
</tr>
<tr>
<td><strong>Actions</strong></td>
</tr>
<tr>
<td>1.1.1. Monitoring and evaluating the effects and risks of extreme weather events such as heat waves, hurricanes, floods and drought on human health based on current and future climate projections.</td>
</tr>
<tr>
<td>1.1.2. Establishing and extending early warning systems and making emergency warnings to reduce the effects of extreme weather events on human health.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Target 1.2. Investigating and monitoring the link between climate change, contagious diseases and health risks and identifying possible measures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 1.2.1. Investigation and follow-up of the current and future relationship between infectious diseases and climate change</strong></td>
</tr>
<tr>
<td><strong>Actions</strong></td>
</tr>
<tr>
<td>1.2.1. Investigation and follow-up of the current and future relationship between infectious diseases and climate change</td>
</tr>
<tr>
<td>1.2.2. Identifying risky areas and measures to be taken in terms of public health</td>
</tr>
<tr>
<td>1.2.3. Establishment of Tropical Disease Diagnosis Laboratories regionally or strengthening the infrastructures of Hygiene Laboratories in some provinces for this purpose.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Target 2. Enhancing the Capacity of Combating Risks from Climate Change in the National Health System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 2.1. Establishing emergency response action plans in risky areas and providing the necessary infrastructure</strong></td>
</tr>
<tr>
<td><strong>Actions</strong></td>
</tr>
<tr>
<td>2.1.1. Creation and implementation of pilot programs in the areas of epidemic and emergency health risk</td>
</tr>
<tr>
<td>2.1.2. Raising awareness of “National Medical Rescue Teams (UMKE)” in the field of adaptation to climate change impacts</td>
</tr>
<tr>
<td>2.1.3. Increasing the authority and enforcement skills of mobile health teams affiliated to Provincial Health Directorates in risky areas in terms of infectious diseases</td>
</tr>
<tr>
<td>2.1.4. Cooperation with international organizations and countries working on the effects of climate change on human health</td>
</tr>
<tr>
<td>2.1.5. To prepare and distribute guidelines explaining what citizens and institutions should do in case of possible infectious diseases, extreme weather events and periodic training.</td>
</tr>
</tbody>
</table>
### Table 11. (Continued) Issues on climate change and health in the climate change action plan (CSB, 2011)

<table>
<thead>
<tr>
<th>Target 2.2. Strengthening the capacities of health sector organizations against health risks due to climate change</th>
<th>Time Frame</th>
<th>Activity Details</th>
<th>Responsible Parties</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.1. Carrying out capacity building activities on health risks due to climate change for preventive healthcare/family health system employees</td>
<td>2011-2015</td>
<td>Capacity building activities</td>
<td>MOH, MFWM, GDF, Governorships</td>
</tr>
<tr>
<td>2.2.2. Announcement of ‘Ministry of Health - Climate Change Adaptation Program’ across the country</td>
<td>2011-2013</td>
<td>Communication campaigns</td>
<td>MOH, MFWM, GDF, Governorships</td>
</tr>
<tr>
<td>2.2.3. Establishment of the “Disaster Coordination Center” of the Ministry of Health in regions affected by climate change</td>
<td>2011-2015</td>
<td>Effective health coordination infrastructure</td>
<td>MOH, Governorships</td>
</tr>
<tr>
<td>2.2.4. Ensuring coordination and cooperation between related institutions and organizations regarding climate sensitive disasters and health risks</td>
<td>2011-2015</td>
<td>Ortaklıklar, Ortak projeler</td>
<td>MOH, AFAD, Governorships, Universities, NGO’s, Public and Private Hospitals</td>
</tr>
<tr>
<td>2.2.5. Strengthening of vector (carrier) mediated and zoonotic (from animals to humans) diseases, evidence-based protection, and treatment and control of infectious diseases (including vaccine programs, vector control), including integrated disease monitoring and monitoring</td>
<td>2011-2020</td>
<td>Strengthened public health monitoring and decision making system</td>
<td>MOH, Public and Private Hospitals, University Hospitals</td>
</tr>
<tr>
<td>2.2.6. Investigation / monitoring the effectiveness of possible adaptation measures to be taken in the health sector, including early warning, strengthened disease observation, information systems and other public health measures to protect against the effects of climate change</td>
<td>2011-2020</td>
<td>Strengthened public health monitoring and decision making system</td>
<td>MOH, Public and Private Hospitals, University Hospitals</td>
</tr>
<tr>
<td>2.2.7. Benefits of mitigation / compliance measures as well as the common investigation / monitoring of losses and compliance costs</td>
<td>2011-2020</td>
<td>Strengthened public health monitoring and decision making system</td>
<td>MOH, MEU, Universities</td>
</tr>
<tr>
<td>2.2.8. Strengthening the observation and preparedness of water availability, water quality and hygiene in rural and urban areas</td>
<td>2011-2015</td>
<td>Water and hygiene monitoring system, precaution and information guides</td>
<td>MOH, Governorships, Municipalities</td>
</tr>
<tr>
<td>2.2.9. Determining the health risks that may occur due to the increase of the population and increasing the capacities of the institutions in the region, which may be affected by the climate and in the areas of migration movements.</td>
<td>2011-2015</td>
<td>Research reports, Capacity building activities</td>
<td>MOH, Governorships, Universities, International Organizations</td>
</tr>
<tr>
<td>2.2.10. Cooperation with national and international organizations and countries working on issues such as migration movements, international trade and tourism that will affect human health due to climate change.</td>
<td>2011-2015</td>
<td>Possible disease spreads on a regional scale, sharing knowledge and experience, developing international measures</td>
<td>MOH, Governorships, Universities, International Organizations</td>
</tr>
</tbody>
</table>
• Reducing the impact of extreme weather events and the resulting natural disasters on human health and social life

• Strengthening the institutional infrastructure and increasing cooperation within and outside the institution for the follow-up of diseases seen in our country as a result of climate change.

• Ensuring water and food safety, combating water and foodborne diseases.

• Necessary studies to prevent vulnerable groups from being affected by the adverse effects of climate change.

• Reducing the negative contribution of health institutions to climate change.

• Raising public awareness for more effective protection from the negative effects of climate change on health.

• Conducting monitoring and evaluation studies.

4.2. Adaptation and Mitigation Approaches

After the adoption of the National Program and Action Plan on Reducing the Negative Effects of Climate Change on Health, on 21 January 2015, the National Program and Action Plan started to be adapted as follows:

• The Ministry of Health PHGD organized a workshop on January 12, 2016 and received the opinions of the institutions and academicians on the “National Program and Action Plan for Reducing the Negative Effects of Climate Change on Health”.

• The Ministry of Health General Directorate of Public Health organized a second workshop on “5-6 April 2016” on “National Program and Action Plan for Reducing the Negative Effects of Climate Change on Health” in order to establish implementation commissions. Commissions were created in this workshop. The commissions formed and their duties are given in Table 12.

• In line with the work of the commissions: targets are set, strategies are set and activities are listed.

• In addition to technical and scientific developments, it is time to create general / special models that will respond to awareness, and warnings in national, regional, local, city, neighborhood scales.

• Training meetings on National Program and Action Plan to Reduce the Negative Effects of Climate Change on Health were held in Bursa on April 19, 2016 and in Ankara on September 13-14, 2017.

• Water and Health Congresses were held in 2015, 2017 and 2019.

• City, Environment and Health Congresses were held in 2016 and 2018.
• Climate change training modules were prepared in 2019. These training modules include 17 training modules on climate change. 14 of these modules examine the effects of climate change on health.
• In 2019 TUBITAK (The Scientific and Technological Research Council of Turkey) Climate, Environment and issued calls for bilateral cooperation projects related to health.
• Trainings and other activities continue within the framework of the action plan.

4.3. Mitigation and Common Benefits

Turkey, due in part to the introduction of feed-in tariff renewable energy targets (30%) set for 2023 reached. Turkey has made enormous progress in reducing CO2 emissions while increasing the number of forests. It is important to reduce both emissions from agriculture and integrate compliance and promote low-cost climate-friendly measures (OECD, 2019).

Increasing energy efficiency and renewable energy use, supporting low emission clean transportation in public transportation, increasing the short-term renewable energy target and setting longer-term targets, promoting the use of renewable energy sources in transportation will both reduce emissions and reduce the impact of climate change. With all these studies, air quality will improve and cause less breathing-heart conditions. Thanks to the reduction of extreme weather phenomena, epidemics transmitted by water will be reduced and will also provide less spread of vector-borne diseases. Thanks to the reduction of extreme weather phenomena, epidemics transmitted by water will be reduced and will also provide less spread of vector-borne diseases.

Table 12. Duties of the Commissions (Kiraz, 2019b).

<table>
<thead>
<tr>
<th>Commissions</th>
<th>Health indicators commission</th>
<th>Early warning and intervention commission</th>
<th>Research - orientation - planning commission</th>
<th>Risk management commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks</td>
<td>• Determination of diseases that can be affected by climate change and their demographic indicators by considering ICD-10 codes and other related health indicators</td>
<td>• Determination of parameters affecting health for early warning and determining the capacity of the health system to respond to climate change</td>
<td>• Literature research</td>
<td>• Identification of risk maps</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Data Bank</td>
<td>Determination of intervention and information methods for adaptation of vulnerable groups to climate change</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Determination of research priorities</td>
<td>Determination and follow-up of the relationship between meteorological data and health</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Preparation of training material</td>
<td>Identifying potential health risks</td>
</tr>
</tbody>
</table>
4.4. Case Studies for Adaptation and Mitigation

A number of studies have been carried out by the Ministry of Health to reduce the effects of climate change, various teams have been formed and some systems have been put into operation. Details of these are given below (SB, 2015; CSB, 2013):

- National Medical Rescue Teams (UMKE) have been established within the Ministry of Health to respond to natural disasters and unusual situations. The staff working at UMKEs are trained and certified by the ministry to respond to disasters and unusual situations. UMKEs are coordinated regionally. It has structuring in 81 provinces including 21 regions. It has the necessary tools, equipment, mobile hospital, equipment and personnel, including the air ambulances system, for a possible disaster situation.

- The Health Disaster Coordination Center (SAKOM) has been established within the Ministry of Health, and the computer system installed at the center is continuously monitored for possible disaster situations.

- Emergency health services have sufficient capacity to prevent the possible effects of climate change. The existence of this capacity was also observed in the Covid-19 process.

- In cooperation with meteorology and other relevant institutions, planning is made to establish an early warning system and to alert the public in regions where disasters are likely to occur and to create a more effective and faster response.

- Studies on informing health personnel and the public about the possible effects of climate change, what to do and developing the right behavior continue.

- In-service training meetings are organized at the central and local level for healthcare workers related to infectious diseases.

- Educational materials, booklets, brochures and posters for infectious diseases were prepared by the Ministry of Health.

- Infectious diseases are monitored every month by the Ministry of Health.

The establishment of an early warning system is one of the most important studies in terms of compliance and impact reduction. In this context, a pilot scale study was carried out by Aydın Adnan Menderes University. The details of this study are given below (Kiraz, 2019):

- The thesis titled “Early Warning Model for Air Variables in Primary Protection”, conducted by Aydın Adnan Menderes University in Aydın, is the most recent climate and health study (Doğan & Kiraz, 2016).
• In this study, “Local Early Warning System Model” is planned in order to protect, raise and prepare the society about air variables.

• It is foreseen that the awareness and attitude-behaviors of the participants in the intervention group will increase by sending sms, e-mails, warnings and informative messages for the determined air variables.

• The research is an intervention study aimed at determining the change in the level of awareness before and after the intervention in the intervention and control groups determined in the Central Efeler District of Aydın province.

• The research was conducted between June 2014 and August 2016.

• All public information was made available on the website www.aydinerkenuyari.com.

• In this context, the awareness, attitude and behaviors of the intervention and control groups were determined with the first survey.

• When the threshold values determined for the air temperature, UV index and air quality index (air temperature: 27°C, UV index: 6 and air quality index: 101) are exceeded by the prepared computer program, a warning and SMS and e-mail informative messages were sent for one year.

4.5. Economic and Development Results

The effects of climate change, which take place as a result of long processes, appear at the end of many years due to the nature of the climate. Climate change affects the economy in this system and creates some reflections. In this context, it is seen that climate change has important impacts on employment and economic growth and sectors such as agriculture, tourism, energy. Climate change has serious effects on economies, especially as a result of temperature fluctuations and excessive fluctuations in precipitation regime. It is seen that the global net effect of climate change is negative. This negative picture reveals the necessity of an effective and urgent struggle with climate change.

Undoubtedly, reducing energy and water consumption is a more environmentally friendly action, and the demand is some of the things that can be done individually as part of combating climate change (Başoğlu, 2014). It is stated that the greenhouse gas emissions due to industrial processes and the use of fossil fuels will double in 2060 will bring a 5% slowdown in the growth rate of Asian countries. Similarly, it is estimated that the average annual growth rate of the world economy will decrease to 3.6% for 2014-2030 and 2.7% for 2030-2060. Behind these pessimistic projections are agricultural yield reduction, water scarcity, increase of new bacteria, spread of various diseases and similar climate change factors. According to the estimates, the expected effects on climate change will reduce the global real product in the world by more than 7% in 2100. However, complying with the Paris Agreement and limiting the temperature
increase to 0.01 °C annually may limit the fall in global real product to around 1% (Acar, 2020).

Extreme events, Turkey’s Gross National Product in (GNP) leads to direct economic losses of 3% each year. This is expected to increase gradually. Turkey is one of the countries that will suffer the most water stress. This will put the risk of both livability in our country, food systems related to drought and the availability of natural resources together with agricultural lands (Acar, 2020). The yields of products in all regions of Turkey were estimated to decrease (Dellal et al., 2011). Due to the decrease in yield, it has been determined that the production amount will decrease by 8.18% in wheat, 2.24% in barley, 9.11% in corn, 4.53% in cotton and 12.89% in sunflower (CSB, 2013).
5. Results and Recommendations

5.1. Concerns about Climate Change and Health

The following concerns are raised with regard to climate change and health:

- In addition to the significant warming observed in the global climate, an increase in global average surface temperatures is expected between 2-4.5 °C in the 1990-2100 period, according to the most advanced climate models.

- Depending on the increase in global temperatures important changes are expected to occur such as the change of hydrological cycle, melting of land and sea glaciers, narrowing in glacier areas, rising sea level, sliding of climate zones, more frequent and waxier heat waves, extreme rains, floods and droughts in some regions will directly affect the socioeconomic sectors, ecological systems and worldwide human life, because of the increase in epidemics and pests due to high temperatures.

- Hot air waves can increase the risk of unexpected death. With the risk of increasing UVB (Ultraviolet B), an increase in skin cancer, cataracts and blindness cases is expected.

- They will be directly affected by climate change, and will be indirectly affected by changes in water quality, food quality, ecosystem, agriculture, industry, settlements and the economy.

- Climate change also adversely affects many health needs. Among them are fresh air, clean water, adequate nutrition and healthy shelter requirements. Climate change will negatively affect water quality and accessibility. In some regions, in countries where food is cooked with biomass, nutritional deficiencies can be seen more due to famine, lack of access to healthy water as a result of desertification.

- The decrease or disappearance of transportation potential directly and indirectly affects human health.

- All these effects are expected to be felt in a wide area, affect a large number of people and occur over a wide period of time.
• All countries (even if not the same) are at risk against the negative health effects of climate change. Low-income countries will face this risk intensely.

• Those living in cities, the poor, the elderly, children, traditional societies, those who make their living with farming and those living in the coastal area are particularly at risk.

• It is not possible to fully protect even the economically developed countries from diseases and injuries caused by climate change.

5.2. **Things to be able to done about Climate Change and Health**

Below are the points that will reduce the health effects of climate change and eliminate worries:

• Monitoring studies should be conducted for food, temperature and waterborne diseases.

• Immigrants and asylum-seekers who are considered as vulnerable groups should be followed up with a good monitoring program.

• Trainings should be accelerated, trained manpower capacity in the field of climate change and health should be increased and a common language should be established on impacts.

• Studies should be made to reduce the vulnerability of vulnerable groups.

• The Ministry of Health should mobilize existing infrastructure to identify and implement early warning components of the effects of climate change on health.

• Database should be developed to reveal the relationship between climate change and health.

• Awareness-raising activities should be carried out at the social and individual level in order to avoid the negative effects of climate change on health.

• Healthcare physicians and other healthcare professionals should know the acute and chronic effects of climate change on health, and precautions should be taken with the approach of preventive medicine.

• In order to be protected from allergens caused by global warming and climate change, it is necessary to stay away from substances such as cigarette smoke, chemicals, aerosols in closed living places such as homes, schools and workplaces.

• Drinking and potable water tanks should be constructed to prevent contamination. Unsuitable ones must be improved.

• Decision makers should focus their attention on protecting human health against a high level of climate change.
• While producing solutions to the negative effects of climate change on health, solutions covering global health risks and all segments of the society should be produced.

• Cooperation between all parties should be developed and capacity should be increased. Interdisciplinary and cross-sectoral studies should accelerate.

• Continuous data collection and monitoring infrastructure should be strengthened to monitor the climate change process more actively and to develop action plans.

• All industry leaders who are parties to the subject should prepare their action plans for possible situations related to their fields.

• Emergency response mechanism should be developed in a more integrated way.

Ministry of Health General Directorate of Public Health and Head of Turkey Institutes of Health, is doing very serious study and projects on climate change and health effects. It is very important to have scientific studies, projects and dissertation done in the following periods and take it to a much higher level:

• Economic dimension of climate effects on health
• Monitoring studies and evaluation of data for climatic diseases
• Public health infrastructure and development studies
• Early warning systems and disasters preparedness
• Emergency response systems
• Sustainable conservation programs
• Diseases related to travels
• Diseases transmitted by vectors
• Cancer cases and climate relations

In addition, a separate AFAD-like structure should be established within the Ministry of Health to address these and similar issues more strongly, to plan, monitor, supervise and manage action plans.

As a result, Turkey has made very serious efforts in the process of adaptation to climate change in the last 15 years and continues to do so. A National Action Plan on the effects of climate change on health has been prepared by the Ministry of Health and studies are being carried out in line with this action plan. As seen in the Covid-19 process, Turkey’s health infrastructure is much better level of health infrastructure in many developed countries and increasingly being
developed. Thanks to having a strong health infrastructure in the disaster and epidemic situation can take an active and fast-paced action, because of trained human capacity, the effects of climate change on health are expected to be felt in the minimum level of Turkey.
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TÜBA COVID-19 GLOBAL OUTBREAK ASSESSMENT REPORT

TÜBA - COVID-19 Global Outbreak Assessment Report, which has been presented as open source on April 17, 2020 and published with the recent data on June 4, 2020, can be accessed from libraries and TÜBA internet site (www.tuba.gov.tr/en). The report, consisting of 5 parts, is prepared with an interdisciplinary approach.

i. Terminology, Definitions, History and Current Situation in Turkey

ii. Process Management of Pandemic, Interaction of Science Disciplines, and Information Technologies

iii. Social and Economic Projection in the Post-Pandemic Period

iv. COVID-19 Data Tracking Platforms

v. COVID-19: Scientific Approaches
ANATOMY OF THE PANDEMIC
THE FUTURE OF HUMAN and SOCIETY

Editors:
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   *TÜBA President*
2) Prof. Dr. Ali Özer
   *Ministry of Health, Scientific Committee Member*
3) Asst. Prof. Cem Korkut
   *Ankara Yıldırım Beyazıt University*

The book consists of 49 thematic articles. There are projections for a wide range of post-epidemic periods, from healthcare to education, information technologies to political science, economics to international relations, trade to philosophy, artificial intelligence studies, sociological analysis, environment and agriculture, space, and polar studies.

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Climate Change and Health in Turkey

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