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THE EFFECTS OF NATURAL DISASTERS CAUSED BY CLIMATE CHANGE



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THE EFFECTS OF NATURAL DISASTERS CAUSED BY CLIMATE CHANGE

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ABBREVIATIONS

EU	European Union
USA	United States of America
ADPC	Asian Disaster Preparedness Center
AFAD	Disaster and Emergency Management Authority
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
CDERA	Caribbean Disaster Emergency Response Agency
CEPREDANAC	Central American Integration System for Natural Disaster Prevention, Mitigation and Response
COP	Conference of Parties
ECHO	European Civil Protection and Humanitarian Aid Operations
EFDRR	European Forum for Disaster Risk Reduction
EM-DAT	Emergency Events Database
GDP	Gross National Product
HFA	Hyogo Framework for Action
IOM	International Organization for Migration
IPA	Instrument for Pre-Accession Assistance
IPCC	Intergovernmental Panel on Climate Change
MGM	General Directorate of Meteorology
PREDECAN	Andean Community Disaster Prevention Project
SAARC	South Asian Association for Regional Cooperation
SDG	Sustainable Development Goals
SOPAC	Secretary of the Pacific Islands Applied Geoscience Commission
NGO	Non-Government Organization
TDIP	Turkey Disaster Intervention Plan
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children's Emergency Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

Disasters have been defined by United Nations (UN) as natural events that disrupt the socio-economic and socio-cultural activities of the community significantly, cause life and material losses which "cannot be coped with local capabilities". According to this definition, destructive events of Biologic, geologic, hydrologic, meteorological and climatic character are related to nature, so they are "natural" disasters. The world is exposed to many natural disaster risks; disaster types other than the earthquake and volcanic eruptions are defined as meteorological disasters. When we consider ecosystems, we see that natural disasters we experience are in interaction with each other and trigger each other. The most important feature that differentiates disasters of meteorological character is that they can be prevented with monitoring and prediction works or they allow minimization of possible damages with early warnings. In recent years, there are increases in the number of meteorological, climatic and hydrologic disasters and in the damages, they cause in the world, especially hurricane-typhoon and tropical cyclone disasters, with the effect of climate change.

Vulnerability to climate change is the situation of a community or system being affected by ecologic or socio-economic climate change stress or pressure related to physical geography. Adaptation to climate change, on the other hand, covers, in general, the adaptation activities that are performed in advance to be ready for expected climate change and climate variability for the purpose of mitigating the harmful effects of climate change and benefitting from possible useful opportunities. While climate change causes relatively minor damages in some regions, changing hazard patterns and high fragility levels caused by climate change in some regions of the world are expected to raise general losses even more. Climate change is one of the underlying reasons for the disaster risks. They affect situations

such as rising of sea level, increasing temperatures, ocean acidification, withdrawal of glaciers, soil and forest deterioration, loss of biological diversity, desertification and extreme weather events.

As indicated in "Sendai Framework for Disaster Risk Reduction" prepared by the United Nations (2015-2030); because of the disasters that occurred between years 2005-2015 over the world, more than 700,000 people lost their lives, more than 1,4 million people got injured and approximately 23 million people became homeless. In general, 1.5 billion people were affected by disasters. Women and children sustained more damage as disadvantaged groups. The total economic loss was greater than 1.3 trillion US dollars. Also, 144 million people were forced to emigrate from their places of living because of disasters between the years 2008-2012. Due to the disasters that get even worse because of climate change and whose frequency and intensity increase, the income gap between the developed and developing countries widened even more and countries' capability to reach their sustainable development goals were significantly hindered.

Even though climate change is obvious, there are still uncertainties about how and how much it will change exactly. Changes to be experienced in climate components depend on the greenhouse gas level in the atmosphere and the response of the global/local average surface temperatures to the increase in greenhouse gases. Another way of investigating the uncertainty situation is to use climate change scenarios and projection models and to determine risk levels of different climate change scenarios in hazard and risk assessments to define possible changes in climate change components.

As a result of global climate change, Turkey must cope with problems such as desertification,

increased hydro-meteorological disasters and rising sea level. Considering the evaluation of long years in the general sense, it is seen that the most frequently experienced natural disasters in Turkey are earthquakes, storms, floods, droughts and forest fires. These disasters cause economic, social and environmental losses in addition to life losses and cause direct economic losses at the rate of 3% of Turkey's Gross National Product (GDP) every year.

Developing financial analyses to support the mitigation of disaster risks across the world is getting, even more, complicates due to the requirement of determining proper budgets supporting disaster risk mitigation programs. These kinds of programs are generally included in national strategies each of which is in the area of authority and responsibility of a different organization or ministry with different levels of coordination between them. Even though the preventive measures to be taken against climate change do not exhibit their effects immediately in the short term, they are expected to be effective in the next 10-20 years.

Transformation of the climate change phenomenon and its consequences to disasters, which increasingly occupy the agenda of the whole world, became the starting point of this study. Within the scope of the study, assessments were made on the consequences of disasters caused by climate change in the world in general and in Turkey in particular. Hydro-meteorological and climatologic natural disasters, whose effects are ever-increasing, caused as a result of climate change were discussed and explained in general sense; earthquakes and detailed information about other disasters were left out of the scope. However, it would be appropriate to point out that the number of studies that uncover the links between earthquakes and other disasters of geologic and climate change is steadily increasing.

In this study, definitions related with a flood, mass movement (rockfall, landslide, avalanche, collapse), storms, extremely hot and extreme cold waves, drought-desertification and fire disasters and their consequences were given in detail. An analysis of the present situation was made, and risks were presented related with mitigation of climate change risks from international scale to local scale, and a road map was drawn for the measures and the steps that must be taken.

Platon points out the disasters in his work titled Timaeus and says: "There have been many and diverse destructions of mankind. We know this because we possess the records of those who witnessed the events and survived. Now the stories as they are told have the fashion of a legend, but the truth of them lies in the shifting of the bodies in the heavens that recurs at long intervals." (UNISDR, 2015).

INTRODUCTION

At the present time, the effects of climate change doubtlessly began to influence countries. Especially, our country is experiencing adverse effects caused by climate change frequently. Whirlwind and hurricane incidents that occurred in the recent period in Aegean and Mediterranean regions, which we are accustomed to seeing, unfortunately, began to take lives. These disasters cause economic, social and environmental losses in addition to life losses.

Awareness concerning disasters caused by climate change in the international area has accelerated when the Intergovernmental Panel on Climate Change (IPCC) initiated by United Nations (UN) shared its 4th Report with the public in 2007. It has been acknowledged that climate crisis is imminent and the reason for that is not only naturally developing global warming but climate change caused by human activities. Even though the responsible parties for the emergence of human-induced global warming are technologic developments and "industrialized northern countries" that strengthen their dominance largely with fossil fuels, the ones that are exposed to adverse effects of this problem are "Southern Countries", which have the least share in greenhouse gas emissions that cause climate change.

As for America, it became aware of the reality of climate crisis when hurricane Katrina hit New Orleans and hurricane Rita Huston and Texas one after the other. At the same time, unfairness experienced in the capacities of people coping with disasters related to climate even in the country was made evident in these two disasters that the

disadvantaged groups without home or car not being able to evacuate their homes, processes required for evacuation and search and rescue not being operated caused about 1000 people to lose their lives in the area which was caught unawares of the hurricane. Also, in the return process, while the rich neighbourhoods repair their homes and come back, poor one-third of the population faced accommodation problems because they did not have enough money to repair their houses. Reports received from different southern countries from Bangladesh to Sudan besides America in recent times show that bloody conflicts are being encountered because of climate change and drought. For example, drought in East African countries caused the water wells to dry up, animals to die and rural communities to face famine (Waititu, 2008); drought and floods caused losses of up to 60% in agricultural products in India (Jardley, 2009). Furthermore, according to the UN Convention to Combat Desertification data, it was stated that approximately 10 million people were forced to immigrate in Africa because of drought and desertification¹ (Tokar, 2014).

Transformation of the climate change phenomenon and its consequences to disasters, which increasingly occupy the agenda of the whole world, became the starting point of this study. Within the scope of the study, assessments were made on the consequences of disasters caused by climate change in the world in general and in Turkey in particular. An analysis of the present situation was made and risks were presented related with mitigation of climate change risks from international scale to local scale, and a road map was drawn for the measures and the steps that must be taken.

¹ For more detailed information, See "No Place Like Home: Where Next Climate Refugees" Report, London, prepared by Environmental Justice Foundation in 2009.



1. NATURAL DISASTERS IN HISTORICAL PROCESS AND RELATED CONCEPTS

Throughout history, people felt helpless and unprotected against natural disasters and they tried to find logical explanations for them as much as possible to suppress their fear. In this section, first of all, it is investigated how natural disasters affected civilizations in a social, communal and economic sense in the historical process, and then a conceptual framework is drawn related with natural disasters. Further, the concepts used in international literature related to natural disasters and climate change are explained.

1.1. Historical Background of Disasters

People who became helpless against disasters searched for solutions to deal with this situation since ancient times; sometimes they thought they made the gods angry and gave sacrifices. It has been discovered with archaeological excavations that people who became helpless against disasters performed consecration and sacrificing ceremonies since the beginning of human history. It is possible to give the example of Las Liamas Desert, which was found in the excavations made in Peru and confirmed to be caused by a meteorological disaster, to recently discovered archaeological findings (Figure 1). The largest ritual ruins of sacrificing humans to appease the anger of gods after a climate disaster were found at the north coast of the country in Huanchaquito, under Las Liamas Desert.

Figure 1: Huanchaquito-Las Liamas Desert Mass Grave (Milliyet, 2019)



The site was discovered by anthropologist John Verano from Tulane University and the reason for mass sacrificing of children approximately 600 years ago to stop the rains, floods and muds were linked by researchers to the flood disaster that occurred in that era, known as 'El Nino - The Child' (Milliyet, 2019).

Natural disasters caused many civilizations to expand their borders or just the opposite, affected the fates of wars even changed their outcomes. It is possible to learn lessons from the natural disasters that occurred in the past and to conduct effective management against disasters that may occur in the future. In this context, disasters that occurred on the soils of our country in the past will be of guidance for the future. In the Ottoman Empire period, natural disasters related directly with a climate such as those caused by flood, extreme cold weather conditions and drought come to the forefront. As the focus of this study is on disasters caused by climate change, the given examples are limited to those caused by meteorology and climate change.

In the Byzantine Empire period, natural disasters were seen as a punishment given by God for the sins they committed. Throughout the last century of the empire, sins were placed in the framework of civil wars that devastated the Byzantine soils and facilitated Turkish conquest. They began to regard first the civil wars (1321-1328) then the Turks who pressed down on borders of Byzantium and made raids as punishment sent to them by God as punishment for their sins. When describing the advance of the Turks, Byzantine historians sometimes mention natural disasters in relation to military activities. It has also been observed in the historical process that while natural disasters cause catastrophe for one nation they may provide benefits for another one. For example, the first natural disaster that weakened the Byzantines and facilitated Ottoman conquest in Bithynia was overflowing of Sakarya River. Even though

Byzantines protected the banks of the river at their side with fortifications they built for this purpose, according to Byzantine historian Pakhymeres a horrible flood caused the river bed to change as "a sign of Divine wrath" around the year 1300 and destroyed the fortifications of Byzantium. This natural disaster facilitated the entry of Turks into Byzantine soil easily (Zachariadou, 2001).

In the campaign that Suleiman the Magnificent set out in 1529 to lay siege to Vienna, while the weather conditions were very favourable at the beginning, the siege was not successful because of unexpected extreme rains and extraordinary cold airwave. J. von Hammer's study on references of the First Vienna Siege (*Wiens Erste Aufgehobene Türkische Belagerung*, Pest, 1829) has shown parallelism with Christine Turetschek's studies (*Die Türkenpolitik Ferdinands I. von 1529 bis 1532*, Vienna, 1968, s. 110-129), Hungarian historian György Szeremi's and Turkish references of Ferdi and Celâlzade's studies and it was verified based on documents that it was the cold weather conditions that forced the Sultan to cut the siege short. Even though adverse weather conditions' affecting a siege cannot be qualified as natural disaster, considering the outcomes, these conditions were transformed into a catastrophe for the Ottoman Army by making the food and weapons insufficient regarding time and causing soldiers to fall sick.

As another example, it is possible to mention the meteorological disaster event that occurred in 1853-1856 Crimean War, which is the first modern world war and one of the most important wars of the 19th century. Crimean War is the first war where Ottoman Empire fought with England, France and Sardinia against Russia upon Russia's demands on Balkans and Straits and also the first war that introduced the phenomenon of emigration and emigrant to Ottoman Empire. Despite the Paris Treaty, Crimean Turks living on Russian territories immigrated to Ottoman territories (T.R. Prime Ministry, 2006). An

unexpected storm that broke out suddenly at the beginning of the Crimean War on 14 November 1854 destroyed the British navy and failed the military operation.² Information related to the failure of the army is included in diaries of eyewitnesses, official letters, the report sent by Lord Raglan to his government and various documents. It is stated that this storm changed the outcome of the war and the reason behind the delay in Sebastopol siege was the outcome of this natural disaster (Hazai, 2001).

Due to the fact that the documents related with natural disasters are quite limited in Ottoman archives, there are not many references about the flood disaster that occurred in year 1100/1688-1689 and destroyed the meadows and crops in Edirne region and even changed the agricultural production pattern in the region. Scarcity of documents draws attention that can be obtained about the valleys open to floods such as Meriç, Tunca and Arda. Even if we put aside locusts and other pests³ it is certain that fires and droughts caused harm to Ottoman villages. Despite the limited number of documents related to natural disasters, effected social life and their reflections on documents could be very enlightening. For example, as understood from tax books of the time, a change attracts attention from melon and flax agriculture, which require extensive labour, to animal husbandry. Farmers made a change of crop because of a flood; local farmers made a change to crops that were more suitable for the moist soil they had to work on. Tax records in archive allow us to follow the tracks of a very important change that occurred in rural production patterns because of a devastating disaster that occurred in the century between years 1579-80 and 1688-89. Grains such as rye, wheat and barley field melon production and

two types of legumes, probably used as animal feed, and fodder gained more importance in village economy at the end of the 17th century than the previous tax books showed. The emergence of neither vetch, which was nor an important crop at the end of the 16th century is a sign in the same direction because it was used animal feed, also. This change in social life was from an economy where garden culture was prominent and processable products at least existed, to a new lifestyle where animal husbandry made a contribution to crop agriculture. This change in agricultural activity also occurred at times when the rural population decreased in addition to flood disaster from garden culture requiring extensive labour towards animal husbandry, which allows saving from labour (Faroqhi, 2001).

1559-1560 are the years when Ottoman territory at the north of Black Sea, that is, Crimean Khanate territory at the north edge of the Empire under the Sultan's rule was exposed to drought and famine disaster. During the military interventions of the empire, drought and famine were also influential in the sense of distance of the region. Drought and famine made it difficult for Ottoman's intervention at these distant regions and no solution could be found for this problem that was caused by the climate. It was stated that villagers of the region did not have any alternative agricultural food source, fishing and hunting were also affected by the prevailing drought and people were left alone with famine. The reason why all these obstacles did not affect the position of Ottoman Empire at the north of Black Sea in a logistic sense is that drought and famine-affected other countries at the same rate (Veinstein, 2001).

² For more detailed information: The November Hurricane and its Effects, Pictorial History of the Russian War, 1854-55-56, with Maps, Plans and Wood Engravings, Edinburgh and London, 1856, p. 283-86 and A.W. Kinglake, The Invasion of the Crimea: its Origin, and an Account of its Progress down to the Death of Lord Raglan, c. VI. The Winter Troubles, Edinburgh and London, 1858, p. 160-67; Chr. Hibbert, The Destruction of Lord Raglan. A Tragedy of the Crimean War, 1854-55, London, 1963, p. 200-208.

³ Locusts are one of several natural disasters investigated by Ottoman experts: R. Jennings, "The Locust Problem in Cyprus", BSOAS, 51 (1988), p.281- 313 and G. Veinstein, "Sur les sauterelles à Chypre, en Thrace et en Macédoine à l'époque ottomane". Armağan, Festschrift für Andreas Tietze, I. Baldauf, Suraiya Faroqhi and R. Vesely, (ed.), Prag, 1994, p. 211-26.

1.2. Definitions Related to Natural Disasters

The world is under the risk of many natural disasters. The most important feature that differentiates disasters of meteorological character is that they can be prevented with monitoring and prediction works or they allow minimization of possible damages with early warnings (TMMOB, 1999). Due to the fact that disaster is an interdisciplinary field, disaster has many different definitions in national and international literature. Definitions of disaster and related concepts made by the UN and European Union (EU) as well as dictionaries prepared by them are included in many different references.

In Turkey, a "Disaster Terms Dictionary" was prepared in 2014 by Disaster and Emergency Management Authority (AFAD)⁴, which was established in 2009 with law number 5902 under Prime Ministry at the time and was subsequently affiliated under the Ministry of Interior as of July 2018 for the purpose of building an integrated structure in disaster management; the purpose of preparing this dictionary was to provide for a common terminology on disaster and related concepts and prevent confusion of concepts. This dictionary was prepared by a committee formed by different professional disciplines and it constitutes an important infrastructure for experts conducting studies in this field (Akay & Özmen, 2017). Within the scope of this study, definitions taken from different references, especially the definitions made in this dictionary, were used as well as the United Nations' terminology⁵ and processes were described accordingly.

According to the Disaster Terms Dictionary;

Disaster: "Events of nature, technology or human origin that cause physical, economic and social losses for the entire society or for certain parts of it, that stops or interrupts normal life and human activities which exceeds the ability of the affected community or society to cope using its own resources

(AFAD, 2014). Also **Disaster:** "Any situation that has or may have serious effects on the property including people, environment or cultural heritage" (AFAD, 2017).

Disaster planning: "All planning activities that must be prepared before disaster under the names of preparation, readiness, prevention, risk reduction, disaster intervention and improvement plans" (AFAD, 2014).

Disaster policy: "All short, medium and long term activities that form the basis of national plans that show what the mission and vision of the political power governing the country on the subject of mitigating the risks and damages of disasters should be, what path should be followed to take which measures, how the organization should be done at central and local levels, what the priorities should be and what resources should be used" (AFAD, 2014).

Emergency plan: "A management process that analyzes potential events and emerging situations that may threaten the community or the environment and makes the necessary arrangements to make an intervention to such events and situations in a timely, effective and proper manner before the events occur" (AFAD, 2014).

Hazard: "A hazardous event, material, human activity or situation that may cause loss of life, injury and other health effects, material loss, loss of livelihood and services, social and economic disruptions or environmental damage" (AFAD, 2014).

Preparation: "The state of preparedness and adequacy that facilitates the rapid and effective intervention of human and material tools, structures, communities and entities to disasters as a result of actions taken in advance" (AFAD, 2014).

Prevention: can be thought of as "taking measures (i) to prevent disasters where possible (ii) to minimize their effects where it is not possible" (AFAD, 2014).

⁴ Within the context of changes made in Presidency Government System, AFAD has been affiliated to Ministry of Interior with the Presidential

Decree number 4 published on 15 July 2018.

⁵ See. <https://www.unisdr.org/we/inform/terminology>



Resistance: *“Capability of a system, community or society exposed to hazard to effectively resist, prepare, adapt and cope with hazard effects to cover the protection and restoration of their original structures and functions”* (AFAD, 2017).

Intervention: *“Any action performed in a disaster situation, during or after the disaster, to rectify the adverse consequences at a national or local level”* (AFAD, 2017).

Risk: *“Combination of (hazardous) consequences of an event and probability of its happening”*. **Risk determination;** *“general process covering risk identification, risk analysis risk assessment”*. **Risk identification;** *“process of finding, recognizing and identifying the risks”* (AFAD, 2017).

Risk analysis: *“Process of understanding the nature of the risk and determining the risk level”*. Risk assessment is *“action of determining whether the risk and/or its magnitude are acceptable and tolerable”* (ISO 31010) (AFAD, 2017).

Meteorology: *“Branch of science that examines and presents the formation, development and change of the weather events that occur in the atmosphere together with the reasons and the consequences of these events for living creatures and the earth”* (AFAD, 2014).

Meteorological disaster is defined in the dictionary as; *“Types of disasters that are caused by natural events such as flood, avalanche, lightning, drought which originate from atmospheric events such as temperature, precipitation and pressure”* (AFAD, 2014).

Definitions given in the distortionary regarding climate and climate change are as follows:

Climate is defined as; *“All extreme and average values of atmospheric conditions and meteorological*

parameters of a region or place in the world in the long term”. It refers to the general average of weather conditions happening every day in a long period of time (AFAD, 2014).

Climate change is defined as; *“Statistical changes that occur in the climate both in the general sense and in periods of 30 years or longer”*. This occurs because of the effects of the natural process of the earth or external forces or permanent changes that happen in the atmosphere because of human activities (AFAD, 2014).

Adaptation for climate change is defined in simple words as; *“The action of taking necessary precautions to prevent harmful effects of climate change and determining proper internal and external policies on this issue by reviewing the conditions of the country”*. It is also possible to define it as an adaptation of natural and human systems against the present and expected climatic warnings and their effects (AFAD, 2014).

1.3. Types and Classification of Natural Disasters

Natural Disasters are defined by UN as natural events that significantly disrupt socio-economic and socio-cultural activities of a community, cause life and property losses which “cannot be coped with local capabilities”. According to this definition, destructive events of biologic, geologic, hydrologic and meteorological characters are disasters related with nature, that is, “natural” disasters (Table 1) (UNDRR, 2004; UNDRR, 2015). According to the classification made by EM-DAT (Emergency Events Database), there are two main disaster groups (natural and technological), 9 disaster sub-groups; 17 disaster main types, 34 disaster sub-types and 12 disaster sub- sub-types (Table 1).⁶

⁶ See. <https://www.emdat.be/index.php>

Table 1: Disaster Groups and Types according to EM-DAT Classification

DISASTER GROUP	DISASTER SUB-GROUP	DISASTER MAIN TYPE	DISASTER SUB-TYPE	DISASTER SUB-SUB-TYPE
NATURAL DISASTERS	GEOLOGICAL/ GEOPHYSICAL	Earthquake	Ground motion	
			Tsunami	
		Mass Movements (Dry)	Rockfall	
			Landslide	
			Ash flow	
		Volcanic Activities	Volcanic mudflow (lahar)	
			Pyroclastic flow	
			Lava flow	
			Extra tropical hurricane	
		Tropical hurricane		
	Storm	Convective storm	Hail	
			Lightning/ thunder	
			Rain	
			Tornado	
			Sand/dust storm	
			Snowstorm	
			Storm	
			Wind	
			Severe storm	
			Extreme Temperatures	Cold wave
	Hot wave			
	Harsh winter conditions	Snow-ice		
		Frost		
	Fog			
	HYDROLOGIC	Flood	Coast floods	
			River floods	
Sudden floods				
Ice melt floods				
Landslide		Avalanche, debris and mudflow, Rockfall		
Wave		Extreme waves, giant waves		
		Seiche ⁷		

⁷ **Seiche:** Name of Switzerland origin, given to small waves that appear on water surface because of earthquakes, tide or atmospheric changes in lakes or closed bays

DISASTER GROUP	DISASTER SUB-GROUP	DISASTER MAIN TYPE	DISASTER SUB-TYPE	DISASTER SUB-SUB-TYPE	
	CLIMATOLOGIC	Drought			
		Glacier lake explosions			
		Large fires	Forest fires		
	Bush, meadow fires				
	BIOLOGIC	Epidemic	Viral diseases		
			Bacterial diseases		
			Parasitic diseases		
			Fungal diseases		
			Prion diseases		
		Insect infestation	Locust infestation		
	Animal accidents	Cicada infestation			
	EXTRATERRESTRIAL	Effect	Explosion in air		
		Spaceborne	Energized particles		
			Geomagnetic storm		
			Shock wave		
TECHNOLOGIC DISASTERS	INDUSTRIAL ACCIDENTS	Chemical leakage			
		Collapse			
		Explosion			
		Fire			
		Gas leakage			
		Poisoning			
		Radiation			
		Gasoline leakage			
	Other				
	TRANSPORTATION ACCIDENTS	Air			
		Road			
		Railroad			
		Sea			
	VARIOUS ACCIDENTS	Collapse			
		Explosion			
Fire					
Other					

The classification made by Kadioğlu in the context of Natural Disasters only is presented in Table 2. Kadioğlu (2012) classified hydrologic, meteorological and climatologic disasters as hydro-meteorological disasters. According to this, some of the commonly observed natural disasters can be listed as; icing, mudflows, locust infestations, avalanches, desertification, sea and lake water level changes, earthquakes, hail, frost, storm swellings, landslides, whirlwinds, rock falls, droughts, fires (forest, bush and grass), epidemics, floods (overflow, valley, coast and city floods) hot and cold airwaves,

fog and low visibility distance, strong winds, agricultural pests, landslip, storms (dust, sand, rain, snow and winter), tsunami, volcano eruptions, lava flows and ashes, lightning, soil collapse, etc. According to this definition Kadioğlu (2012) describes hydro-meteorological natural events such as floods and storms, whirlwinds, forest fires, hot airwaves, avalanches, sea and lake water level rises, lightning, drought, hail and frost events as “natural destructions”.

Table 2: Classification of Natural Disasters (Kadioğlu, 2012)

NATURAL DISASTERS				
BIOLOGIC	GEOLOGIC	HYDRO- METEOROLOGICAL		
		HYDROLOGIC	METEOROLOGICAL	CLIMATOLOGIC
<ul style="list-style-type: none"> ▪ Epidemic ▪ Viral infection epidemic ▪ Bacterial infection epidemic ▪ Parasitic infection epidemic ▪ Pest infestation ▪ Mass animal deaths 	<ul style="list-style-type: none"> ▪ Earthquake ▪ Volcano ▪ Mass Movements (Dry) ▪ Rockfall ▪ Landslide ▪ Avalanche ▪ Collapse 	<ul style="list-style-type: none"> ▪ Flood ▪ General flood ▪ Sudden flood ▪ Storm wave /Coast flood ▪ Mass Movements (wet) ▪ Rockfall ▪ Landslide ▪ Avalanche ▪ Collapse 	<ul style="list-style-type: none"> ▪ Storm ▪ Tropical Cyclone ▪ Extra Tropical Cyclone ▪ Local storms 	<ul style="list-style-type: none"> ▪ Extreme Temperatures ▪ Hot Wave ▪ Cold Wave ▪ Extreme winter conditions ▪ Drought ▪ Fire ▪ Forest fire

The number of affected persons by different disaster types is given in Table 3 with a comparison of the total of 2000-2017 as given in the last report prepared by EM-DAT in 2019 and the data pertaining to 2018. According to this, a significant change is seen in some disasters types in the

average of 17 years. Storm and flood disasters were the disaster types that affected the population the most in 2018. In the total of 17 years, flood, drought and storm disasters had the highest effect regarding area (UNDRR, 2019).

Table 3: Number of Affected Persons by Disaster Types (Total of Years 2018 and 2000-2017)⁸ (UNDRR, 2019)

Disaster Type	2018	2000-2017 Total
Drought	9,368,345	58,734,128
Earthquake	1,517,138	6,783,729
Extreme temperatures	396,798	6,368,470
Flood	35,385,178	86,696,923
Landslide	54,908	263,831
Mass movements (dry)	0	286
Storm	12,884,845	34,083,106
Volcanic activities	1,908,770	169,308
Fire	256,635	19,243
Total	61,772,617	193,312,310

In 2018, the distribution of deaths by disaster types is seen as the highest earthquake, flood and storm, respectively (Table 4). In the period between 2000-2017 the disaster that caused most life losses were listed as earthquake, storm, extreme temperatures and flood.

⁸ See. <https://www.emdat.be/index.php>



Table 4: Deaths Caused by Disasters (UNDRR, 2019)

Disaster Type	2018	2000-2017 Total
Drought	0	1,361
Earthquake	4,321	46,173
Extreme temperatures	536	10,414
Flood	2,859	5,424
Landslide	282	929
Mass movement (dry)	17	20
Storm	1,593	12,722
Volcanic activities	878	31
Fire	247	71
Total	10,733	77,144

In the first press bulletin published in 2019 by the UN using EM-DAT data assessments were made regarding the average of long years and natural disasters that occurred in 2018 and shared on the internet site (Table 5). According to this, India was the country that was affected the most by natural disasters with an affected population of over 24

million. The Philippines was the second and China was the third. However, considering the total population of Philippines (105.466.000 according to 2019 data) it is clearly seen that it sustained far more damage from the effects of the natural disasters than India and China, which have the leading populations of the world (UNDRR, 2019).

Table 5: Distribution of Countries by Number of Persons Affected by Natural Disasters (2018)⁹ (UNDRR, 2018; UNDRR, 2019)

Country	Number of Persons
India	23,900,348
Philippines	6,490,216
China	6,415,024
Nigeria	3,938,204
Guatemala	3,291,359
Kenya	3,211,188
Afghanistan	2,206,750
USA	1,762,103
Japan	1,599,497
Madagascar	1,472,190

⁹ See. <https://www.emdat.be/index.php>

1.4. Natural Disasters Caused by Climate Change

In the context of this study, hydro-meteorological and climatologic disasters, which occur as a consequence of climate change, are discussed and explained in general; earthquake and other disasters are left out of the scope. However, even though disasters of geologic origin such as earthquake are left out of the scope, whether climate change has any effect on disasters of geologic origin such as earthquake constitutes the area of interest of the researchers in the recent period. Starting from the point that human activities have harmful effects on climate and cause the temperature rise that makes the large glacier layers at the poles to melt, researchers are looking for an answer to the question *“do such changes in the atmosphere triggers geologic disasters such as volcanic eruptions and earthquakes?”*

For example, Dr Christian Brandes and his team from the Institute of Geology Leibniz Universität-Hannover are conducting some studies in this field. The team is trying to establish a correlation between earthquakes and climate change (melting at the poles and rise in water levels)(Brandes, 2018). At the same time, Dr Adven Masih from Ural Federal University (Yekaterinburg, Russia) stated that global warming should not be seen just a fraction of increase in temperatures, if drought, rise of seawater level and temperature rise continues, geologic disasters such as earthquakes could be triggered in addition to natural disasters such as flood (Masih, 2018). United States of America (USA) Arctic Research Commission stated in its reports that permanent rise in temperatures due to climate change caused concerns in Alaska and Arctic. It was emphasized by the commission that the melting of the glaciers and permafrost due to the warming of air and surface caused loss of balance of the surface and changes in the ecosystem (USARC, 2003).

Sujib Kar conceded that seismic activities increased because of global warming (Kar, 2013). According to Kar, this correlation will be easily understood when the number of earthquakes of a magnitude of 5 and higher from 2001 to 2005 is examined. Because these periods are when there were exceptionally high rises in global warming. It has been shown that while the number of earthquakes recorded over the world at a magnitude of 5 or higher at Richter scale was only 157 in 2001 in total, in 2015 the total number was 10 times higher (1556). Sujib Kar claims that temperature rise together with global warming may have contributed to the rapidly increasing cumulative earthquake frequency in Alaska in recent years (Kar, 2013).

Prof. Bill McGuire, geophysics and disasters expert in University of College London, reiterates in his book *“Awakening of the Giant”* that temperature and sea level will rise continuously with the effect of climate change and as the earth continues to warm up some of the unlimited numbers of faults under the ground will not be able to respond to this new global water distribution (McGuire, 2018). However, for these new theories that are only recently discussed in the literature to be proven in the international arena, accepted and reflected into the policies they need to be investigated in more detail. Eventually, all present risks must be defined and determined for the management of the risks caused by climate change. Therefore, there is a need to deal with the natural disasters that increased as a result of climate change in a holistic manner; if they have any correlation with geologic and/or geophysical disasters, more detailed studies must be made for also our country and findings must be presented.

In this context, the scope of the study has been limited to the definitions related with a flood, mass movements (rockfall, landslide-landslip, avalanche, collapse), storm, extremely hot and extremely cold waves, drought, desertification and fire, which are the natural disasters that climate change caused to increase continuously.

1.4.1. Mass Movement (Rock Fall-Landslide-Landslip-Mud Flow-Avalanche-Collapse) Disasters and Their Consequences

Mass movement is defined as the displacement of soil or rock masses from slopes downwards en masse slowly or rapidly with the effect of gravity (AFAD, 2014). Mass movements include rock falls, landslides, avalanche and collapse disasters (AFAD, 2014).

Landslide is defined as “the situation where rocks, soil or pieces of a landslide or move downwards at a noticeable level with the effect of gravity or as a result of external effects such as earthquakes or extreme precipitation; landslip” (AFAD, 2014).

Avalanche is defined as “flowing movement of large masses of snow that had accumulated on sloped surfaces such as mountainsides suddenly and at a high speed spontaneously or as a result of triggering effect in the direction of the mountainside slope” (AFAD, 2014).

Avalanche warning “making announcements through various communication means to the public, mountaineers, skiers and duty personnel about the avalanche hazard and risk where the occurrence of avalanche is high” (AFAD, 2014).

Avalanche management is “risk management process that has a legal regulation, makes hazard and risk maps, prevents construction of tourism facilities, buildings, traffic infrastructure at locations where there is avalanche hazard or takes measures accordingly, which requires control and structural measures, early warning and monitoring in areas where avalanche occurred before” (AFAD, 2014).

Rockfall “movement of pieces of rock or soil, deteriorated or shattered by physical or chemical effects, downwards rapidly, spontaneously or with

the effect of gravity or as a result of external effects such as earthquakes or extreme precipitation” (AFAD, 2014).

Collapse is “the situation of the cover material extending over the underground void displacing in a vertical direction downwards and collapsing of part of the earth’s crust” (AFAD, 2014).

Even though it is observed that the losses of 1 to 5 billion dollars of losses as a result of life and property losses in developed countries such as USA, France, Italy, and Switzerland are quite high compared to other countries, they do not affect the economies of developed countries significantly. Contrary to this, these types of disasters cause stagnation and recession in the economies of developing countries and affect these countries significantly. Geographical, geologic and meteorological conditions of the countries are influential in the occurrence of mass movements, especially landslides. While mass movements occur independently, sometimes they happen as a result of extreme rains and/or massive earthquakes and cause loss of life and property. For example, 115 persons lost their lives because of a landslide in Elm Quarry of Switzerland that occurred as a result of sliding of 10 million m³ of rubbles. In 1914, Panama Canal construction was delayed 2 years because of 7 large landslides that occurred during the construction. While the calculated excavation volume was 70 million m³, the total excavation volume became 175 million m³ due to the landslides and caused large economic losses. In the earthquake that occurred in 1920 in Kansu region of China more than 200 thousand people lost their lives; as a result of the investigations, it was determined that the reason for the death of more than 100,000 persons was large landslides that happened because of the earthquake (AFAD, 2015). In the worldwide study conducted by Munich Reassurance on natural disasters that occurred in 2017, three of the five major disasters that caused

most deaths were due to landslide. In Sierra Leone 500 life losses occurred due to landslide, in Colombia 329 life losses occurred due to landslide, at the south of Asia 2700 life losses occurred due to floods and landslides caused by heavy monsoon rains. The countries where avalanche disaster occurs the most are Pakistan, Himalayas, India, Afghanistan and European Alps. In this context, avalanche disasters in Pakistan and especially in Afghanistan caused life and property losses in 2017. Authorities stated that a village was destroyed entirely because of avalanche caused by heavy snow precipitation, 300 houses were ruined, and 156 life losses occurred, most of them children and women (MGM, 2018).

1.4.2. Drought Disaster and Its Consequences

Drought "natural events that cause the land and resource production systems to be affected adversely due to hydrologic balance being lost as a result of precipitation decreasing below normal levels significantly" (T.R. Ministry of Forestry and Water Works, 2015). Drought is also the name given to disaster of natural origin that causes the air temperature to rise much higher than seasonal normals and annual precipitation to fall much lower than seasonal normals (AFAD, 2014).

- *Meteorologically: Temporary periods when precipitation falls 80% below seasonal average values*
- *Hydrologically: Temporary periods when water levels of dams, lakes, reservoirs and underground waterfall below an average of long years*
- *Regarding agricultural use: Periods when water and humidity are not available in the required quantity as needed by humans and other living creatures (AFAD, 2014).*

Drought index "Table that shows periods of extreme precipitation and drought in months or years based

on long term meteorological observations and records" (AFAD, 2014). Especially slowly progressing disasters such as drought affect communities, small and medium scale enterprises and the sustained losses constitute quite a high percentage in the total losses. Death rate and economic losses caused by the disaster in developing countries are much higher compared to developed countries. These countries face unexpected cost increases and difficulties from a financial point of view and regarding fulfilling responsibilities (UNDRR, 2005; UNDRR, 2015).

1.4.3. Desertification Disaster and Its Consequences

Desertification means "desert region which spreads due to the combination of climate change and effects of humans on lands". Consequences of desertification cause increasing of drought, permanent changes in atmospheric circulation patterns and famine (Ackerman & Knox, 2015). Desertification is also land deterioration in arid, semi-arid and sub-arid humid soils caused by various factors including climate change and human activities. Desertification is the last stage of land deterioration; permanent loss occurs in the biologic and economic yield of desertified lands. It is defined as the process of land deterioration and decrease of ecologic productivity especially in arid, semi-arid, mildly arid, semi-humid and somewhat humid areas and areas in Mediterranean climate regions regardless of arid/humid characteristics a result of climate change and physical, biologic, political, social-economic, cultural factors and interactions between them (T.R. Ministry of Forestry and Water Works, 2015).

Problems encountered in relation with desertification are steadily increasing together with drought and famine especially in desert regions. For example, the fringes at the southern half of the Sahara Desert are defenceless against

desertification. While in 1960's meadows for grazing grounds were quite large with abundant rain, with the increasing of herds and population together with the decreasing of rains since 1980's drought became prevailing in this area and meadows turned into a desert. The Sahara Desert progressed towards the south and the famine caused by it led to more than 100,000 deaths and affected more than 2 million people (Ackerman & Knox, 2015).

Desertification around the Aral Sea in Central Asia is the most distinctive example of human-caused desertification. While it was a lake of 68.000 km² surface area in 1960, the surface area measured in 2007 was only 10% of this figure. In the Soviet Union era, directions of the rivers feeding the lake were changed to provide water for cotton agriculture; consequently, Aral Lake became increasingly smaller, because its water resources were cut off. Evaporation left behind minerals, the former boundaries of the lake turned into a dusty coast and sea bottom. As Aral Lake shrank, the climate and culture of the region were also affected adversely. The sand layer left behind by evaporated water caused a new formation called Aral Black Sand Desert; the dust caused health problems for the people of the region in cold winters and hot summers. Shortening of local climate growing season, higher water demand of local agriculture and vanishing of fishing are important problem areas (Ackerman & Knox, 2015).

1.4.4. Flood/Waterflood Disaster and Its Consequences

Flood is *"the event of water flowing along the valley rising and overflowing from its bed as the floods coming from side creeks reaching the main creek in a short time"*. One of the main differences between flood and waterflood is that flood has the characteristic of being a water overflow that carries small-sized suspended sediment. When these waters return to the bed, the soil will be seen to be

covered with a thin sediment layer that increases its fertility. At the same time, it is the name given to the event whereby a river forms a flow magnitude to interrupt the socio-economic life in its field of effect by overflowing its bed for various reasons and causing harm to the lands around it, settlements, infrastructure facilities and living creatures.

Flooding area: *"Flood bed near the source of a flood that is left under the water frequently because of repeated floods. Also, the areas where floods of 100 years are seen are also called flood area or flood bed. **Flooding alarm level** means "the water level that has reached or approached the point considered dangerous regarding flood and requires warning actions be taken". **Flood warning** is "action of informing in advance that a flood may occur in the near future at a certain station or a certain river basin". **Flood control**, "the work of building structures such as berms, canals, dykes and dams to prevent or minimize the damage caused by flood and related activities" (AFAD, 2014).*

Waterflood is *"the event whereby a river forms a flow magnitude to interrupt the socio-economic life in its field of effect by overflowing its bed for various reasons and causing harm to the lands around it, settlements, infrastructure facilities and living creatures"*. In other words, it is a large body of water that comes suddenly from side creeks after heavy rains at upper basins and contains a large amount of solid material (T.R. Ministry of Forestry and Water Works, 2015).

Flood is the event whereby waters cover generally dry surfaces by rising or coming from another place. Floods are classified according to their speed of formation as slowly forming floods, rapidly forming floods and flash floods. Generally, the floods that form in one week or longer period of time are called slow floods that form in one or two days are called slow floods and those form in an hour are called flash floods. Based on the place of formation, floods are called coastal floods, city floods, dry creek floods,

dam/reservoir floods and stream (creek and river) floods. **Flood control** is “the process of controlling the water sources for the purpose of preventing floods by building dams, reservoirs, dykes, cutwaters, berms and similar engineering structures”. **Flood risk** is “assessment of flood probability together with its adverse effects on human health, environment, cultural heritage and economic activities”. **Flood insurance**, “insurance type that covers the damages to the goods under insurance that may occur because of overflowing of sea, lakes, rivers, creeks or channels or become flooded due to extreme precipitation (AFAD, 2014).

Today, although flood risk should be managed with possible measures such as land-use planning, continuing industrial, commercial and residential development in flood lands caused floods to turn into water floods with climate change and made the floods a very dynamic risk. Measures against floods, investments made in countries such as Japan and Netherlands in the field of flood protection provide protection against losses. On the other hand, regions under the risk of flood in low-income countries reflect the inadequacy of making an investment for flood protection. For example, as Chao Phraya River Flood in Thailand in 2011 showed, floods caused large losses at rates almost close to those caused by disaster destructions due to earthquakes or tropical cyclones. According to a survey conducted by Swiss Reassurance in 2012, when countries are evaluated regarding flood risk, China, Brazil, Russia and India are placed at the top ranks. Myanmar, Lao People Democratic Republic and Cambodia in Southeast Asia are among the countries that sustained most damage from river floods. Floods also cause large losses in high-income countries. For example, average economic damage in the floods that occurred in the United Kingdom was around 250 million dollars; the highest damage caused by floods in 2012 reached approximately 1.8 billion dollars. It is estimated that approximately half of the flood loss in England is

caused by large river floods, the remainder by a small river and creek floods. Government of England predicts that approximately 2.4 million properties are under the risk of a river or coastal flood in any year (UNDRR, 2015a).

1.4.5. Storm Disaster and Its Consequences

According to the Disaster Terms Dictionary prepared by AFAD; **Storm** is defined as “Wind with a speed of 23 to 26 m/s that cause harm to nature and humans”. As the speed and force of the wind increase, the damage it causes on nature and humans also increases. When used by itself, it means windstorm. **Wind** is defined as horizontal movement of air with respect to ground, whose direction, speed and force can be measured, in other words as “gale”. Wind is named according to cardinal and intercardinal points such as east, northeast, northwest, etc. and they have corresponding names. Also, the southwesterly wind causes storms and heater poisoning. Wind speed is known with the Knot unit by sailors and aviators in line with international rules. Its unit is miles/hour. Due to the fact that they bring rain, snow, hail, sand, etc. elements with them, they are known as a snowstorm, sand storm and dust storm (AFAD, 2014).

Storm surge is “wave that may cause widespread water flooding as a result of rising sea level due to storms”. **Storm tide** is “the event of rising or falling of seawater level caused by strong storms”. **Storm motion path** is “the name given to the path that a storm follows depending on atmospheric conditions”. Propagation speed and possible paths of storms can be determined with satellite observations and meteorological measurements and early warning messages are given. **Storm scale** is “the table prepared based on speeds of the storms and damages caused by them”. At the international level, *Bofor Wind Scale* is used for wind speed, and *Fujita Whirlwind Table* is used for whirlwind damage (AFAD, 2014).

Meteorology General Directorate (MGM) defines storm, which is one of the most encountered strong meteorological events, as the situation where wind speed reaches a value higher than 17.1 m/sec. Even though there are different classifications and definitions blowing of the wind at a speed of 10.8-17.1 m/s (39-61 km/h) is called **strong wind** at a speed of 17.2-20.7 m/s (62-74 km/h) **storm** at a speed of 20.8-24.4 m/s (7588 km/h) **strong storm** at a speed of 24.5-28.4 m/s (89-102 km/h) **full storm** over 28.5 m/s (103 km/h) is called **hurricane** (MGM, 2004; Büyükbaş et al., 2018).

Typhoon (Cyclone) *“strong tropical cyclone that forms in the low-pressure areas in the atmosphere, revolves around itself at a high speed in a counterclockwise direction in the northern hemisphere and in a clockwise direction in the southern hemisphere, has winds and heavy rains like floods, sometimes accompanied by thunderstorms”*. There is a tropical storm strength scale that evaluates these from 1 to 5 under the name of “category” regarding their size and damage they may cause (AFAD, 2014). In the definitions made by MGM the concept of hurricane is used; in the Disaster Terms Dictionary prepared by AFAD reference is made to the concept of typhoon instead of hurricane. There is not a separate definition for hurricane.

In recent years, there is an increase in the number of meteorological, climatologic and hydrologic disasters, especially storm, typhoon and tropical cyclone disasters with the effect of climate change. For example, among the natural disasters that occurred in the Caribbean and North America in 2017, hurricane Irma caused 128 life losses in North America, hurricane Harvey caused 88 life losses in the USA, hurricane Matia caused 27 life losses in the Caribbean, typhoon Hato affected China and Vietnam and caused 22 life losses and cyclone Debbie caused 12 life losses in Australia (MGM, 2018).

1.4.6. Hot-Cold Air Waves and Their Consequences

Natural disasters that occur within the scope of hot and/or cold heat waves are stated as frost, snowstorm, blizzard and hot airwave. The situation of daily maximum temperature being 5°C above the maximum temperature in an average of long years 5 days in a row is called **Hot AirWave**. An important outcome of hot airwaves is firing in forests and bushes (MGM, 2018).

Combination of hot airwave and humidity is fatal for human life. Even though the effects of hot air wave disaster are lower than the average hot air wave disaster in the world, it significantly harms agricultural activities when it affects a certain region for a long time. It also causes indirect problems due to the fact that energy shortage occurs because of the energy used for cooling reaches a maximum level (MGM, 2018).

Cold AirWave occurs when “daily minimum temperature is 5°C below the minimum temperature in an average of long years 5 days in a row”. When assessed as a disaster, even though cold airwave is less fatal compared to hot airwave, it still affects agricultural, commercial, industrial and social life adversely. If cold airwave brings snow and frost with it, it causes animal, plants, even humans to freeze to death. Adverse effects of cold airwave on agriculture bring about food shortage, even famine (MGM, 2018).

Heavy snowfall is defined as “frozen precipitation made of ice crystals in the form of bright, white, solid and generally hexagonal shape. Snowfall of 1-5 cm in a period of 12 hours is classified as light snowfall, 5-20 cm is classified as strong snowfall and over 20 cm is classified as heavy snowfall (MGM, 2017c).

Frost is “the name given to ice layer or crystals that form as a result of condensation of water vapour in the air when the air temperature on or near the ground is lower than the freezing temperature”. **Fog** is “the situation of very small water droplets being

suspended in the air due to meteorological conditions". It affects life by limiting the visibility distance or even reducing it to zero. **Hail** is *"small ice particle formed by freezing of raindrops"*. **Hailstorm** is *"the event of spherical or irregular ice particles of 5 to 50 mm, in some cases even greater, diameter (hailstones) falling together with strong wind"* (AFAD, 2014).

Hot-cold airwaves, winter storms, frost events cause significant damage to agricultural production patterns and economies of countries. For example, cold airwaves and winter storms that occurred in 2017 in Poland, Czech Republic, Austria and USA, late spring frosts in about 20 countries in Europe (Spain, France, Germany, Italy, Slovenia, Czech Republic, Croatia, Poland, Austria, Belgium, Netherlands, Switzerland, etc.) caused significant economic losses (MGM, 2018). Another adverse effect of hot airwaves is the rise in energy demand due to long periods of air conditioner use and its effects on the economy. Energy interruptions may occur due to excessive demand; road and rail transport may become difficult because of extremely high temperatures. Also, agricultural and animal production may be significantly hindered. Similarly, cold airwaves of long durations cause energy demand to rise for heating, and continuity of social life and agricultural and animal production to be interrupted (Ackerman & Knox, 2015).

1.4.7. Fire Disaster and Its Consequences

Fire is *"the event of material being combined with sufficient heat and oxygen (air) and changing its chemical structure"*. In order for fire to start combustible material, high heat and oxygen are needed. **Fire hazard** is *"the hazard that may start in residences, facilities, and transportation vehicles and forests for various reasons, that makes materials and utensils unusable with its burning effect and that kills living creatures with its suffocating effect"* (AFAD, 2014).

Biomass fires that affect many vegetation areas in the world are the foremost disasters that are of interest for all countries due to their regional characteristics. Forest fires, which are an important fire type, affect a couple of hundred millions of hectares of vegetation and forest areas of the world every year and causes life and property losses and intervention costs. Growing population increases the pressure on the forests and cause forests to disappear rapidly. Destruction of the forests and deforestation, in turn, causes the loss of soil through erosion, destruction of flora, fauna and its genetic potential, changes in climate system (greenhouse effect, global warming), atmospheric pollution (SO₂, NO₂, CO and particle effect), desertification as a result of disrupted water regime, flood, landslide, mudflow, avalanche, drought and similar disasters (MGM, 2019).

An important reason for the occurrence of many types of disasters described above is the reduction of forest areas and destruction of the cover over the soil because of deforestation. Global forest area is decreasing because of population growth. World forest areas were approximately 8 billion hectares in 2000 BC, but they started to decrease at an alarming rate and fell to the level of 3.2 billion hectares according to the latest data. Fire potential in a forest area is strongly related to the climatic conditions of that region. This relation forms the basis of all fire behaviour models. Climate and weather conditions change the physical characteristics and chemical features of fuels and affect their combustibility (MGM, 2019). Forest fires that occurred in 2017 in the USA, Portugal, Spain, Chile, Argentina and South Africa (MGM, 2018) caused significant economic losses in addition to the adverse effects they made on the ecosystem. Forest fires that started in November 2018 in the USA and threatened settlement areas including California caused the deaths of 42 persons, reporting of 228 persons as missing and burning of thousands of houses (BBC Turkish, 2018).



2. EFFECTS OF DISASTERS CAUSED BY CLIMATE CHANGE IN THE WORLD

As indicated in “Sendai Framework for Disaster Risk Reduction” prepared by the United Nations (2015-2030); because of the disasters that occurred between years 2005-2015 over the world, more than 700,000 people lost their lives, more than 1.4 million people got injured and approximately 23 million people became homeless. In general, 1.5 billion people were affected by disasters. Women and children sustained more damage as disadvantaged groups. The total economic loss was greater than 1.3 trillion US dollars. Also, 144 million people were forced to emigrate from their places of living because of disasters between the years of 2008-2012. Due to the disasters that get even worse because of climate change and whose frequency and intensity increase, the income gap between the developed and developing countries widened even more and countries’ capability to reach their sustainable development goals were significantly hindered (UNDDR, 2015a). Within the scope of this section, the effects of the disasters caused by climate change are described and policies employed in the

management of disasters caused by climate change and disaster risks are discussed.

2.1. The Situation of Natural Disasters in the World

Increasing of vulnerability to disasters in countries rapidly, therefore the emergence of new risks and increasing of disaster losses continuously, the emergence of significant economic, social, medical, cultural and environmental effects in short, medium and long term were emphasized frequently in United Nations Reports (UNDRR, 2001; UNDRR, 2002). The countries in the first 1% and 10% of the countries that face the most risks in the world are given in Table 6 together with the risk factors they are affected. According to this, India is the country that is affected by earthquake risk with death rate; Japan and USA %1 are in the first 1% in the sense of affected economic structure. Indonesia is listed with the death rate from volcano disaster risk, China and Congo with the death rate from landslide; Bangladesh with affected population from flood, USA with affected GDP and USA and Bangladesh from storm waves (Akay, 2018 from Shi et al., 2014).

Table 6: Countries in the first 1% and first 10% in Natural Disaster Risk Ranking (Akay, 2018 from Shi et al., 2014).

Hazard	Risk	Countries in the first 1%	Countries in the first 10%	Evaluated Countries
Earthquake	Death rate	India	India, Indonesia, Pakistan, Bangladesh, China, Philippines, Birmania, Iran, Afghanistan, Uzbekistan, Nepal, Ethiopia	115
	Affected economic – social wealth	Japan, USA	Japan, USA, China, Turkey, Italy, Mexico, Chile, Canada, Indonesia, Venezuela, Iran, Philippines	122
Volcano	Death rate	Indonesia	Indonesia, Japan, Chile, Philippines, Papua New Guinea	54
Landslide	Death rate	China, Congo	China, Congo, Brazil, Iran, Uganda, Philippines, Indonesia, India, Nepal, Paraguay, Bolivia, Burundi, Colombia	126
Flood	Affected population	Bangladesh	Bangladesh, China, India, Cambodia, Pakistan, Brazil, Nepal, Netherlands, Indonesia, USA, Vietnam, Birmania, Thailand, Nigeria, Japan	154

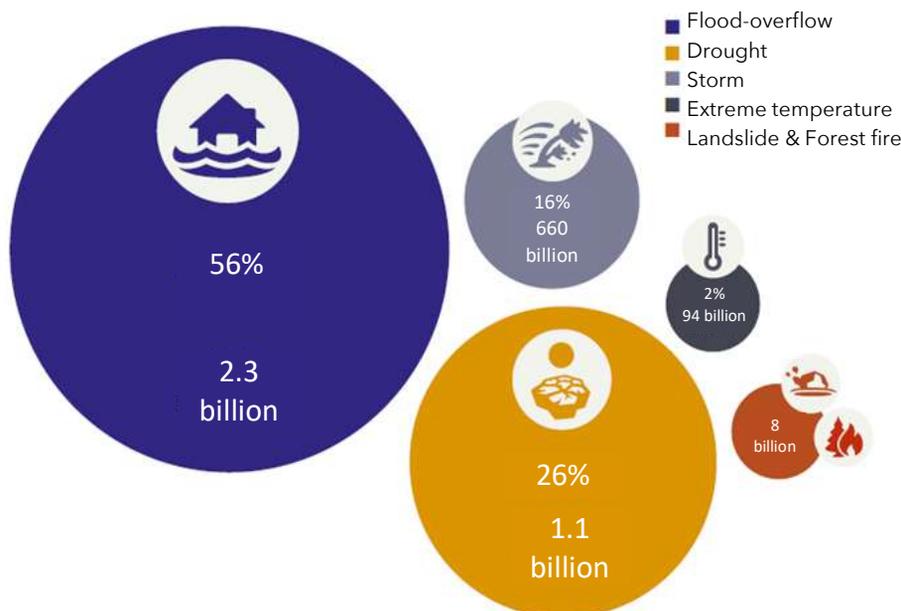
Hazard	Risk	Countries in the first 1%	Countries in the first 10%	Evaluated Countries
	Affected GDP	United States of America	USA, China, Japan, Netherlands, India, Germany, France, Argentina, Bangladesh, Brazil, United Kingdom, Thailand, Myanmar, Cambodia, Canada	150
Storm waves	Affected population	Bangladesh	Bangladesh, India, China, Vietnam, USA, Sri Lanka	57
	Affected GDP	USA	USA, China, Japan, Australia, Ireland, Bangladesh	57
Tropical whirlwind	Affected population	China	China, Philippines, Japan, USA, Vietnam, South Korea, India, Cuba	83
Sand-dust - storm	Affected population	Pakistan	Pakistan, Georgia, Burkina Faso, Yemen, India, Tunisia, Azerbaijan, Ghana Ethiopia, Ecuador, Eritrea	106
	Affected GDP	Kuwait	Kuwait, Georgia, Israel, USA, Spain, Slovakia, Pakistan, Colombia, Saudi Arabia, Greece, Syria	106
	Animal husbandry	Pakistan	Pakistan, Burkina Faso, Syria, Mali, Sudan, India, Jordan, Azerbaijan, Mongolia, Afghanistan, Georgia	109
Hot air wave	Death rate	India	India, Pakistan, USA, Iraq, Russia, Ukraine, Spain, China, Germany, Turkey, France, Iran, Poland	129
Cold Wave	Affected population	China, India	China, India, USA, Russia, Pakistan, Bangladesh, Brazil, Mexico, Germany, Egypt, Japan, South Korea, Iran, United Kingdom, Turkey, Ukraine	161
Drought	Yield loss (corn)	USA	USA, China, Russia, Brazil, Spain, Afghanistan, Kenya, Argentina, Mexico, Turkey, Ukraine, Kazakhstan, South Africa, Tanzania, Iraq, Australia	146
	Yield loss (wheat)	China	China, Russia, USA, Kazakhstan, Canada, Kenya, Mongolia, Pakistan, Mexico, Chile, South Africa, Afghanistan	119
	Yield loss (rice)	Afghanistan	Afghanistan, China, Spain, Pakistan, India, Tanzania, Brazil, Russia, Burkina Faso, Australia, Kazakhstan	109
Difficult to extinguish fire	Burnt forest area	Russia	Russia, Canada, Angola, Brazil, Congo Democratic Republic, USA, Argentina, Birmania, Bolivia, China, Australia	113
	Meadow loss	Brazil, USA	Brazil, USA, Australia, Russia, Kazakhstan, Mozambique, Madagascar, China, Tanzania, Canada, Angola, South Africa, Venezuela, Argentina, Nigeria, Sudan, Colombia, Mexico, Zimbabwe, Zambia	194

Figure 2 shows the population affected by natural disasters caused by climate-weather between years 1995-2015. Flood disaster ranks the first with 56%, drought second with 26%, storm third with 16 % and extreme temperatures fourth with 2% as the events by which population is affected the most. Economic

losses caused by these disasters are; 2.3 billion dollars for flood disaster, 660 billion dollars for a storm, 1.1 billion dollars for drought, 94 billion dollars for extreme temperatures, 8 billion dollars for landslide and forest fires (MGM, 2018).

Figure 2: Population Affected by Disasters Caused by Climate and Weather in the World (MGM, 2018)

Number of persons affected by disasters caused by climate and weather (1995-2015)



Disaster risk management consists of effective planning activities conducted for reliable early warning systems and risk areas to prevent people from getting harmed and to make timely evacuation before the disasters and compensating with insurance and other financing instruments after the disasters (UNDRR, 2015a). Disaster risk is considered as a function of the number of people exposed to hazard, the severity of hazard assets is exposed to and vulnerability. Some great disasters similar to the Indian Ocean Tsunami Disaster occur, which is known with its capacity to cause extensive damage, although it is of low frequency. When generating the risk profile of a country, a series of indicators must be taken into consideration. However, in many aspects, disaster is considered as of exterior origin, protection plans are made against disaster, rather than preparation for it. This perception, which is influential on disaster risk policies, creates an

obstacle for establishing an efficient risk policy (UNDRR, 2003).

Many countries have revised their disaster management policies after the occurrence of big disasters. For example, in the processes of the change Colombia made in the legislation for risk reduction and the new organization, assistance was received from stakeholders at national and regional level. In Nicaragua, after the disaster related with devastating Mitch hurricane in 1998, new legal regulations were put in place in 2000 aimed at risk reduction. India made new legal arrangements after Orissa whirlwind and Gujarat earthquake in 1999; Sri Lanka and Indonesia prepared some draft laws related with risk reduction legislation after the Indian Ocean earthquake and tsunami in 2004. Also, regional organizations such as CEPREDENAC¹⁰, CDERA¹¹, SOPAC¹² and SAARC¹³ disaster management center, technical centers such as

¹⁰ CEPREDANAC - Central American Integration System for Natural Disaster Prevention, Mitigation and Response - Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama are members.

¹¹ CDERA - Caribbean Disaster Emergency Response Agency (CDERA)

¹² SOPAC - Secretary of The Pacific Islands Applied Geoscience Commission

¹³ SAARC - South Asian Association for Regional Cooperation

ADPC¹⁴ were founded and periodic regional investments were made such as PREDECAN¹⁵. Multi-national organizations such as European Commission (ECHO¹⁶), United Nations Development Program and World Bank began to work on issues such as emergency state management, building process after disaster and risk reduction factors (UNDRR, 2015).

2.2. Climate Change Risks in the World and Their Consequences

Natural climate change and human-induced climate change affect the frequency, intensity, spatial coverage and duration of some extreme weather and climate events. It enters into interaction with these events to determine the vulnerability of affected human community and ecosystems, fragility, probability of effects and disasters (IPCC, 2012). In addition to natural hazards, differentiations may emerge in the process of being exposed to climate change (for example, rising of sea level and climate refugees as a consequence of drought) (Table 7) (UNDRR, 2017).

While climate change causes relatively low losses, it is expected that changing hazard patterns and high fragility levels due to climate change to increase general losses even more in some regions of the world. For example, these losses are expected to occur significantly in Caribbean. IPCC stated that the data obtained from long term observations (that is, 40 years or longer) on intensity, frequency and duration of tropical cyclone activity may not be sufficient at the present due to the increasing effects of climate change. It is predicted that the risk foreseen with long term observations related with tropical cyclone winds in Caribbean will have higher effects by using climate change scenarios projected for the process until 2055 (UNDRR, 2017).

¹⁴ ADPC - Asian Disaster Preparedness Center

¹⁵ PREDECAN - Andean Community Disaster Prevention Project - Bolivia,

Ecuador, Peru and Colombia are members.

¹⁶ European Civil Protection and Humanitarian Aid Operations

Table 8: Major Climate Change Risks and Effects (AFAD, 2017b)

Climate Indicator	Climate Change Risk	Physical Effects
Change of Humidity in Atmosphere	<ul style="list-style-type: none"> ▪ Flood (sea, river) ▪ Heavy rain ▪ Changes in water table levels ▪ Changes in soil chemistry ▪ Changes in underground waters ▪ Changes in humidity cycles ▪ Prolongation of wetness period ▪ Sea water chlorides 	<ul style="list-style-type: none"> ▪ Eutrophication ▪ Damages due to defective or inadequate water disposal systems; old rain water systems that do not have the capacity to cope with heavy rain ▪ Erosion of organic and inorganic matters due to flood waters ▪ Biologic attack on organic materials by invasive species such as insects, mold, fungi, termite ▪ Instability of subsoil, swelling and collapsing of soil ▪ Relative humidity cycles / disintegration, scaling and dusting of material and surfaces to cause shock ▪ Other effects (for example, humidity rise due to fertilizer and insecticide use)
Temperature Change	<ul style="list-style-type: none"> ▪ Daily, seasonal extreme events (temperature waves, snow loading) ▪ Change in freezing-melting times, ice storms and increase in wet frost 	<ul style="list-style-type: none"> ▪ Biochemical deterioration of infrastructure ▪ Changes in some unsuitable structures that may cause adverse effects on "suitability for purpose" (insulation for very old buildings) ▪ Unsuitable adaptation that allows structures to remain in use
Sea Level Rise	<ul style="list-style-type: none"> ▪ Coastal flood ▪ Sea water flood 	<ul style="list-style-type: none"> ▪ Coast erosion / loss ▪ Submerging areas lower than sea level permanently ▪ Population emigration ▪ Division of communities ▪ Loss of rituals and collapsing of social interaction
Wind	<ul style="list-style-type: none"> ▪ Wind-induced rain ▪ Wind-borne salt ▪ Wind-borne sand ▪ Wind, storm and direction changes 	<ul style="list-style-type: none"> ▪ Static and dynamic overloading of old structures ▪ Structural damage and collapse ▪ Deterioration due to erosion
Desertification	<ul style="list-style-type: none"> ▪ Drought hot waves ▪ Drop in water table 	<ul style="list-style-type: none"> ▪ Erosion ▪ Salinity ▪ Demographic effects, emigration ▪ Abandoning and collapse ▪ Cultural memory loss



2.3. Disasters Caused By Climate Change and Disaster Risk Management

Vulnerability to climate change, in general sense, is a community or system being affected by climate change stress and pressure from ecologic or socioeconomic aspects related with physical geography. Adaptation to climate change, on the other hand, covers the adaptation arrangements made in advance to become prepared for the expected climate change and climatic variability in order to mitigate the harmful effects of climate change and benefit from useful opportunities (Türkeş, 2018).

It is a fact demonstrated by many studies that the most important effect of climate change is the increase observed in number of natural disasters. In Natural Disasters of Meteorological Character 2016 Evaluation Report prepared by MGM Research Department Meteorological Disasters Branch it was stated that in 2016 global disaster evaluation made by German Munich RE (Reassurance) Company it was indicated that 750 large scale disasters occurred

in that year and 9,200 persons lost their lives because of these disasters (MGM, 2017b).

Climate change is one of the underlying reasons for disaster risks and it affect slowly starting events such as rising of sea level, increasing temperatures, ocean acidification, recession of glaciers, salinization soil and forest deterioration, loss of biologic diversity, desertification and extreme weather events. At this point floods, cyclones or extreme temperatures can be given as examples. Some disaster risks are directly related with increasing of magnitudes in climate components (temperature and precipitation) and high extremities and low capacity for adaptation (Table 8).

Especially, climate change adaptation and disaster risk management policies and investments should be fully prepared to make use of measures that facilitate efficient and consistent use of resources. For this reason, it is very important that policies aimed at reducing the national disaster risk cover effects of climate change on related hazards and risks (Kadioğlu, 2012; Kadioğlu, 2018).

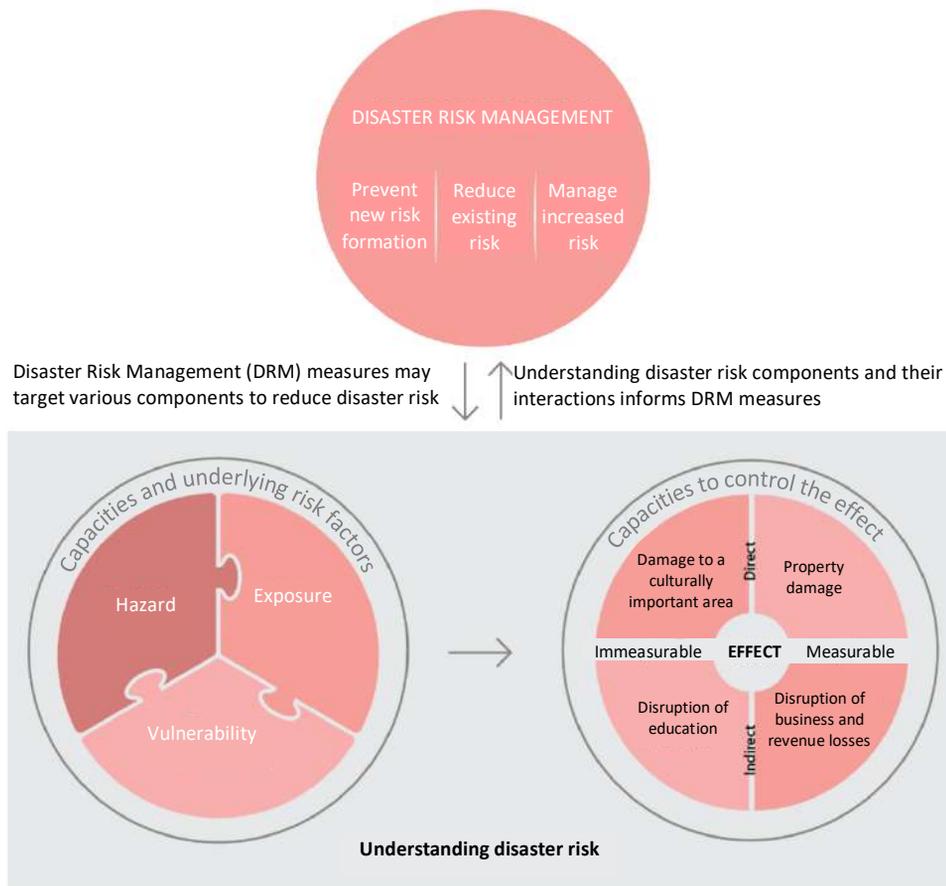
Table 8: Correlation between the Disasters Caused by Climate Change and Adaptation to Climate Change and Mitigation of Disaster Risks (Kadioğlu, 2012)



Relation of climate change adaptation and disaster risk management at national level is closely related with national entities and common stakeholders, financial and implementation mechanisms, information, capacity, data and analysis processes. For example, government of Laos established recently Disaster Management and Climate Change Department under the Ministry of Natural Resources and Environment to manage the effects of climate change and disaster risk and coordinate resources and processes effectively. Even though climate change is clear for countries, there are uncertainties on how and how much it will change exactly in the future. Changes expected to take

place in climate components depend on the level of greenhouse gases in the atmosphere and the response of global-local average surface temperatures to the increase in greenhouse gases. One way of dealing with the future uncertainties is to use climate change scenarios and projection models to define the possible changes in climate components and to define risk levels for different climate change scenarios (Figure 3). This will strengthen the decisions in the design of policies and investments to ensure that the present infrastructure is resilient against future extreme climate events (UNDRR, 2017).

Figure 3: Holistic Understanding of Disaster Risk and Comprehensive Disaster Risk Management (UNDRR, 2017)



2.4. Disasters Caused By Climate Change in International Policy and Strategy Documents

In many international policy and strategy documents related with disasters caused by climate change terms and actions are determined. Countries made commitments by signing these documents. In this context, priorities and actions in relation with climate change disasters determined in important policy documents, especially of United Nations, for reducing climate change disaster risks are covered in this study.

2.4.1. United Nations - European Forum for Disaster Risk Reduction (EFDRR)

Hyogo Framework for Action (HFA) facilitates and encourages data and information exchange between national, regional/sub-regional partners for reduction of disaster risks. United Nations established European Forum for Disaster Risk Reduction Governance and Accountability Working Group (EFDRR) on 11-13 November 2009 in London. EFDRR facilitates progress and discussions for reduction of disaster risks at regional level. EFDRR has three working groups related with three major topics. They are; adaptation to climate change and reduction of disaster risks, HFA practices at local level and accountability working groups (AFAD, 2015a).

2.4.2. Hyogo Framework Action Plan for Mitigation of Disaster Risks (2005-2015)

HFA (2005-2015) provided guidance for disaster risk reduction efforts and contributed to the implementation of United Nations Millennium

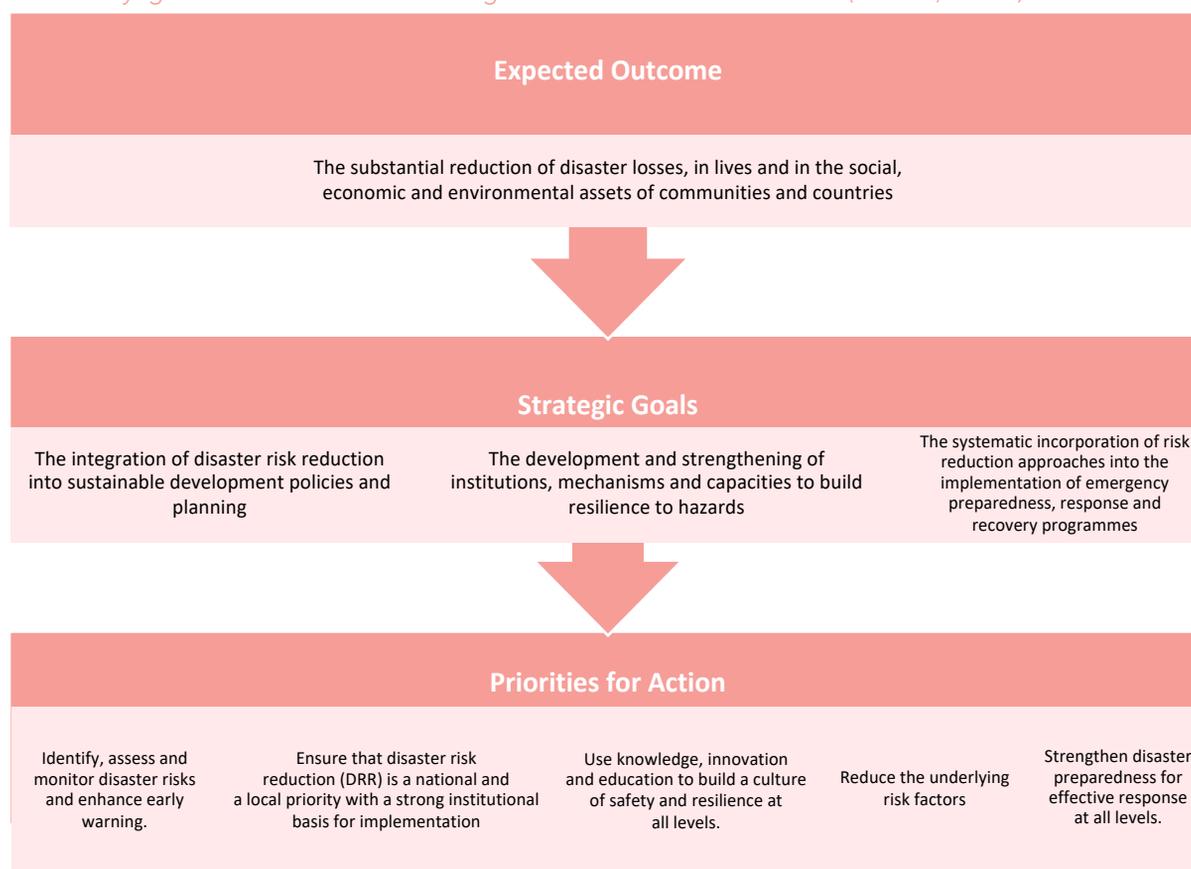
Development Goals. However, it became apparent in the process and during the implementation of the plan that it was necessary to encourage resilience against disaster at all levels, namely local, regional and national levels, in the assessment of elements constituting the disaster risks and implementation of the action priorities given below¹⁷, and difficulties arose in the development implementation tools. It was stated that in order to complete these missing elements all stakeholders should present disaster risks as a whole and action-oriented plans are needed to establish a resilience culture (AFAD, 2015b).

Action decisions were taken by United Nations for the reduction of disaster risks and HFA was accepted in 2005 to facilitate resilience against natural disasters. HFA helps states and communities to become more resilient against hazards that threaten their efforts for sustainable development. World Disaster Risks Reduction Conference, convened with the resolution on UN General Assembly, resulted in the acceptance of HFA that includes 5 main goals, 3 strategies targets and 22 progress indicators for the common goal of disaster risk reduction. Continuity of progress towards the goals of HFA and "Framework for Post-2015 Disaster Risk Reduction" depends on the capacity of countries to make investments in fields related with disaster risk reduction. In European Countries Status Reports, resource inadequacy is cited as an important obstacle in each of the 22 indicators for progress in HFA (Table 9). Especially, in economic austerity periods of the countries, it is very difficult to give priority for disaster risk reduction in the use of resources. Many countries do not attach the same importance to preparation activities for disaster risk reduction as the humanitarian aid and improvement works after the occurrence of disasters (UNDRR, 2015a).

¹⁷ Priority areas designated in Hyogo Framework for Action (2005-2015) are as follows: 1.Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation. 2.Identify, assess and monitor disaster risks and enhance early warning.

3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels. 4. Reduce the underlying risk factors. 5. Strengthen disaster preparedness for effective response at all levels.

Table 9: Hyogo Framework for Action Strategic Goals and Priorities for Action (UNDRR, 2015a)



Hyogo Framework for Action Plan’s three strategic goals reflect the logic of disaster management cycle. Two main goals, strengthening the organizations and making administrative arrangements, make contribution to the achievement of two other auxiliary goals. There are processes for making risk mitigation plans part of sustainable development projects and understanding and responding to emergency situations effectively before, during and after the emergency (UNDRR, 2015a)

2.4.3. United Nations Sustainable Development Conference (2012)

UN Sustainable Development Conference’s (2012) final declaration title *The Future We Want*, a call was made to consider disaster risk reduction and increase of resilience against disasters with a new approach of urgency in the context of sustainable development and elimination of poverty and to integrate this approach at all levels appropriately (UN, 2012).



2.4.4. Sendai Framework Document for Mitigation of Disaster Risks (2015-2030)

Sendai Framework Document for reduction of disaster risks, which was prepared by UN and signed by countries, was accepted in Disaster Risk Reduction Third World Conference held on 14-18 March 2015 in Japan's Miyagi Prefecture Sendai city. The strategy document contains actions, priorities and policies for the reduction of disaster risks after 2015. The elements that were preliminarily accepted were included in the document basically as follows:

- *To complete the assessment and review of the implementation of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters,*
- *To consider the experience gained through the regional and national strategies/ institutions and plans for disaster risk reduction and their recommendations, as well as relevant regional agreements for the implementation of the Hyogo Framework for Action*
- *To identify modalities of cooperation based on commitments to implement a post 2015 framework for disaster risk reduction,*
- *To determine modalities for the periodic review of the implementation of a post 2015 framework for disaster risk reduction (UNDRR, 2015a).*

As pointed out by UN, countries' policies for post-2015 development agenda and financing are implemented through intergovernmental negotiations related with climate change and disaster reduction policies. It is obvious that these efforts are useful for achieving global goals for forming resilience against disasters and eradication of poverty. Within the scope of Sendai Framework document, 4 basic priority areas were determined.

Details of elements that must be included under these priority areas at national and regional levels are given.¹⁸ According to this;

Priority 1: Understanding Disaster Risk

National and regional level priorities under this priority can be summarized as follows:

- *To promote the collection, analysis, management and use of relevant data and practical information and ensure its dissemination*
- *To encourage the use of and strengthening of baselines and periodically assess disaster risks, vulnerability, capacity, exposure, hazard characteristics and their possible sequential effects at the relevant social and spatial scale on ecosystems*
- *To systematically evaluate, record, share and publicly account for disaster losses and understand the economic, social, health, education, environmental and cultural heritage impacts*
- *Capacity of using information related with disaster through information technologies*
- *Training works for understanding disaster risks, presence of necessary investments that must be made by Non-Government Organization (NGO), university, citizen, public and private cooperation,*
- *Establishing a strategy for awareness*
- *Integration of risk data into risk reduction policies (UNDRR, 2015a).*

Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

National and regional level priorities under this priority are as follows:

¹⁸ Priorities are summarized by going over the Turkish translation of UN Sendai Framework Document's original English Text, translated by AFAD.

- *Prevention of settlement in areas under disaster risk/ development of public policies for evacuation*
- *Legally determining duties and responsibilities of public and private sector in the disaster risk reduction process*
- *Preparation, implementation and auditing of national and local disaster reduction strategies and plans*
- *Management of risks determined at national and local level; technical, financial and administrative evaluation*
- *Conducting studies related with standards of land use on sectoral basis, urban planning, building safety legislation, environment and resource management, health and safety*
- *Facilitating the sharing of duties and responsibilities among different community sections within the scope of the legislation related with risk management*
- *Establishing coordination mechanisms with the attendance of different stakeholders at national and local level*
- *Authorizing local administrations with proper regulatory and financial instruments to facilitate cooperation with NGO's and local communities*
- *Development of quality standards such as certification and rewarding mechanisms with the participation of private sector, civil society, professional and scientific organizations (UNDRR, 2015a).*
- *Constructing new buildings that are resilient and resistant to disasters in schools, hospitals and physical infrastructures and/or strengthening existing buildings, developing construction standards*
- *Establishing protective maintenance concept for structures*
- *Conducting economic, social, structural, technological and environmental impact assessments*
- *Taking measures for the protection of historical and cultural assets, museums and religious prayer places*
- *Increasing resilience of workplaces against disaster risks*
- *Implementing land use policies (urban planning, land loss assessment, illegal constructions, temporary settlement activities) with focus on disaster risk reduction*
- *Designating safe areas for settlements and conducting disaster risk assessment for the protection of ecosystem*
- *Disaster risk mapping and management*
- *Taking disaster risks into consideration in urban development planning, prevention of floods and drought*
- *To encourage the revision of existing or the development of new building codes and standards and rehabilitation and reconstruction practices at the national or local levels,*
- *To enhance the resilience of national health systems, including by integrating disaster risk management into primary, secondary and tertiary health care, especially at the local level; developing the capacity of health workers in understanding disaster risk and applying and implementing disaster risk reduction approaches in health work; promoting and enhancing the training capacities in the field of disaster medicine;*
- *In order to mitigate the social harms of the disasters by improving social welfare services; developing social security mechanisms,*

Priority 3: Investing in Disaster Risk Reduction for Resilience

National and regional level priorities that must be taken into consideration are as follows:

- *Providing financial resource and logistic support for developing and implementing legal and administrative arrangements*
- *Developing disaster risk transfer mechanisms (insurance, fund, other financial protection mechanisms)*
- *In order to mitigate the social harms of the disasters by improving social welfare services; developing social security mechanisms,*

removing obstacles for access to basic health services, food safety, shelter and education services due to poverty in advance

- *Taking into consideration the needs of disadvantaged groups in risk reduction policies and documents*
- *Implementing policies and programs to increase the resilience of people and host communities that are affected by disaster because of the emigrations caused by disaster*
- *Facilitating the protection of operational resilience of whole supply chain, means of livelihood and productive assets*
- *Encouraging disaster risk management approaches in tourism industry (UNDRR, 2015a).*

Priority 4: Enhancing Disaster Preparedness for Effective Response and to “Build Back Better” in Recovery, Rehabilitation and Reconstruction

- *Preparation of (1) policies, plans and programs (2) climate change scenarios related with disaster readiness and emergency situation with a participative mechanism*
- *Making investments for the purpose of reducing disaster risks, developing human-centered, multi-hazard and multi-sector prediction and early warning systems*
- *Establishing disaster risk and emergency communication mechanisms, social technologies and telecommunication systems that can make hazard observation*
- *Developing dissemination channels for early warning information about natural disasters*
- *In order to make critical infrastructure resilient, conducting works primarily related with water, transportation, telecommunication, schools and hospitals*
- *Establishing community centers where materials are stored to conduct rescue and aid activities for increasing social awareness*

- *Developing public policy and action for the purpose of making plans and preparations for recovery and re-building after the disaster*
- *Strengthening technical and logistic capacity for public education on intervention to disaster and for better intervention*
- *Ensuring the continuity of work including social and economic recovery and continuity of basic services after the disaster*
- *Conducting regular exercises for disaster preparedness, intervention and recovery*
- *Facilitating rapid and effective intervention to disaster and evacuation in line with local requirements*
- *Ensuring the participation of stakeholder in re-building after disaster*
- *Incorporating disaster risk management in recovery and re-building processes after disaster*
- *Integration of affected areas in economic and social sustainable development after disaster, implementing it for settlement of people who emigrated because of disaster*
- *Re-building of public facilities and infrastructure outside risk areas*
- *Strengthening the capacities of local administrations for the purpose of evacuating people living in areas exposed to disaster*
- *Developing recovery plans to provide psycho-social support and mental health*
- *Conducting international disaster aid and preliminary improvement support works (UNDRR, 2015a).*

3. EFFECTS OF DISASTERS CAUSED BY CLIMATE CHANGE IN TURKEY

When the natural events prevailing in the world affect the life of humans significantly they are called natural disasters or disasters of natural origin. As a consequence of natural disasters life and property losses occur, furthermore people are forced to leave their land, emigrate and go to safer places. Turkey has a large geographical area and different climate regions. Due to its geographical location and atmospheric conditions meteorological and hydrologic disasters, especially storms, floods, drought, hail and heavy snowfall, occur quite frequently and these disasters cause significant life and property losses (MGM, 2017a).

3.1. Situation of Natural Disasters Caused by Climate Change in Turkey

Under the present climatic conditions approximately 70% of Turkey's surface area consists of semi-arid, arid meadow, humid and semi-humid lands that have different amount of annual water deficit. In approximately half of Turkey's land variability between years is observed frequently; subtropical summers associated with weather and climate extremities such as drought, extreme rain, hail, flood and water flood and dry-very hot Mediterranean climate prevail. According to the results of many climate models made at the present it is foreseen that there will be significant climatic changes in Turkey and there will be meteorological disasters due to these changes. The most important problems when entering the 21st century are climate change, overuse and/or misuse of water resources and inadequate management. The most significant effects of the climate change on the society will be the effects on water resources and agriculture (Türkeş, 2018).

As a result of global climate change, Turkey has to cope with problems such as desertification, hydro-meteorological disasters that keep increasing their intensity and frequency and rising of sea level. There is a Climate Change Coordination Board consisting of 13 ministries, AFAD and other public and private organizations coordinated by Republic of Turkey, Ministry of Environment and Urbanisation. There are various working groups that deal with certain aspects of the necessary work such as reduction of climate change effects and adaptation to climate change, mitigation of loss and damage, inventory, finance, technology development and transfer, capacity building and air management. Works are performed within the framework of National Climate Change Strategy Document (2010-2020) and National Climate Change Action Plan (2011-2023). Adaptation works were planned about water resource management, agriculture policy, disaster management, forest policy, public health, capacity building activities, awareness efforts, effect and safety assessments. There is a "Strategy and Action Plan for Combating Agricultural Drought" implemented by rescinded T.R. Food Agriculture and Animal Husbandry Ministry; renamed today as T.R. Ministry of Agriculture and Forestry. In the combat against drought conducted within the scope of the plan, various meteorological data is used as basis for early warning. This Action Plan, which is being implemented according to climate change strategy is being reported annually for United Nations Framework Convention on Climate Change (UNFCCC) (AFAD, 2017a).

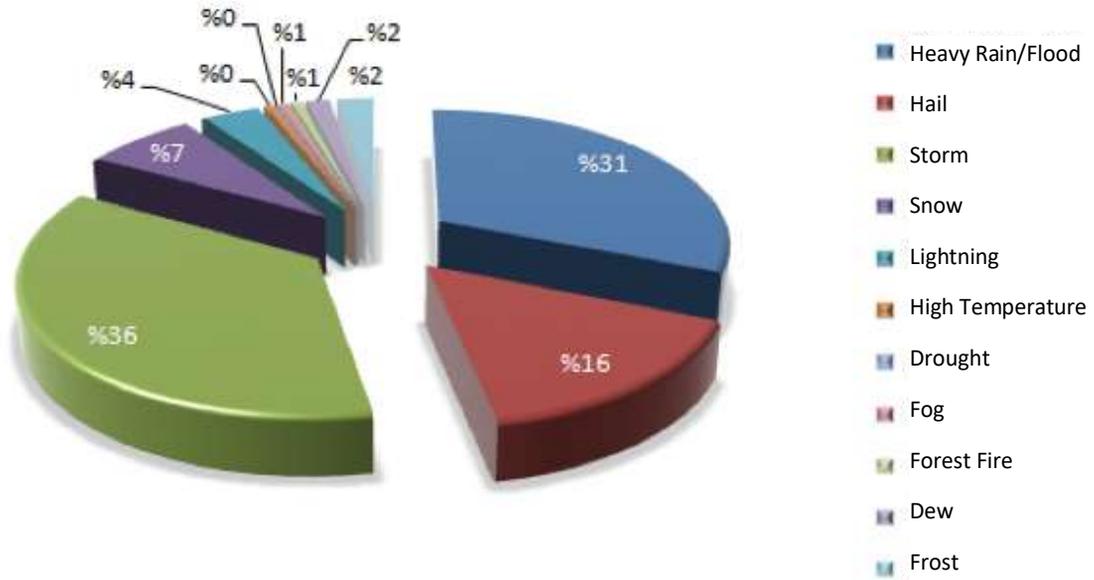
Assessment of meteorological disasters that occur in Turkey is made regularly every year in the bulletins published by MGM and shared with the public. Considering the assessments made in the scope of long years, it is seen that the most frequent disasters that occur in Turkey are storms, floods, drought and forest fires (TMMOB, 2018). These disasters cause life losses as well as significant economic, social and

environmental losses and result in a direct economic loss of 3% of Turkey's GDP every year. However, when indirect economic losses are taken into consideration such as market loss, production loss, unemployment, work force loss in addition to direct economic losses, total loss on annual basis approaches to 4-5% of the GDP (T.R. Ministry of Development, 2012).

As is the case across the world, natural disasters of meteorological character affected different parts of Turkey in varying dimensions in 2017. In Turkey, a total of 598 natural disasters of meteorological character were reported in 2017. Among the natural disasters of meteorological character observed in 2017 the first three disasters at the top of the list are storm (36%), heavy rain/flood (31%) and hail (%16) disasters (Figure 4).

Figure 4: General Distribution of Meteorological Disasters in 2017 (MGM, 2018)

DISTRIBUTION OF METEOROLOGICAL DISASTERS 2017

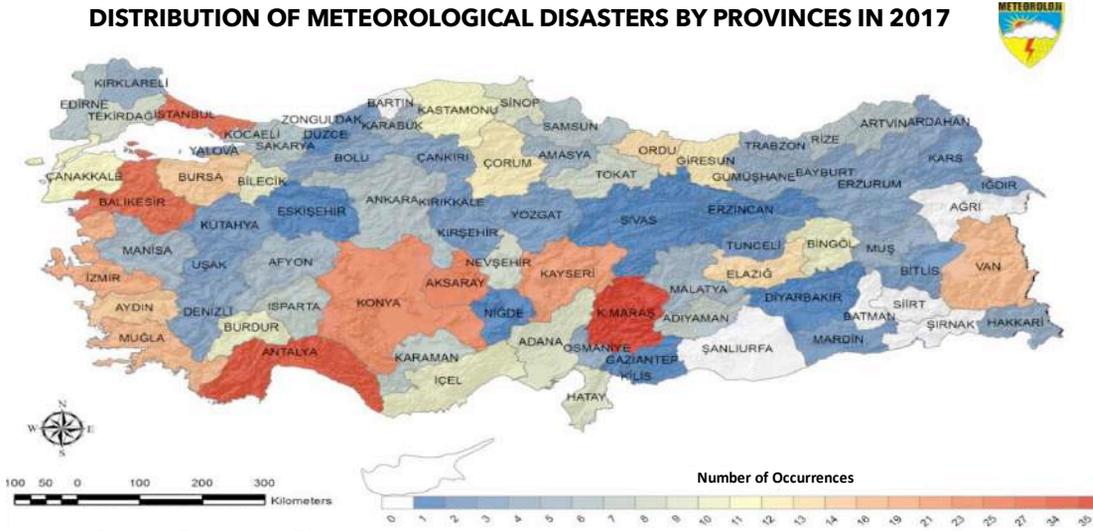


Considering the distribution of long years, total number of disasters that occurred in 2017 became the third highest value. There is the effect of changing climate conditions on this situation, as in the rest of the world. In 2017, the regions where natural disasters of meteorological character occurred the most were Marmara Region, Aegean Region, Mediterranean Region and inner and

northern parts of Turkey (Figure 5). The provinces where the most number of disasters occurred in 2017 were Kahramanmaraş, Antalya, İstanbul and Balıkesir, respectively. Number of disasters is quite high in Aksaray, Konya, Kayseri and İzmir provinces, too (MGM, 2018).



Figure 5: Distribution of Meteorological Disasters by Provinces in 2017 (MGM, 2018)



A general assessment regarding the disasters of storm, strong wind, flood, hail and drought that Turkey suffered the most in 2017 were made based on the Annual Assessment Report and Year 2017 Temperature and Precipitation Assessment Report prepared by MGM.

In 2017 average temperature in Turkey increased 1.5 degrees with respect to 1970 and became 14.2 degrees. MGM reports that there is continuous rise in average temperatures of Turkey since 1998 (except for 2011) (MGM, 2017a).

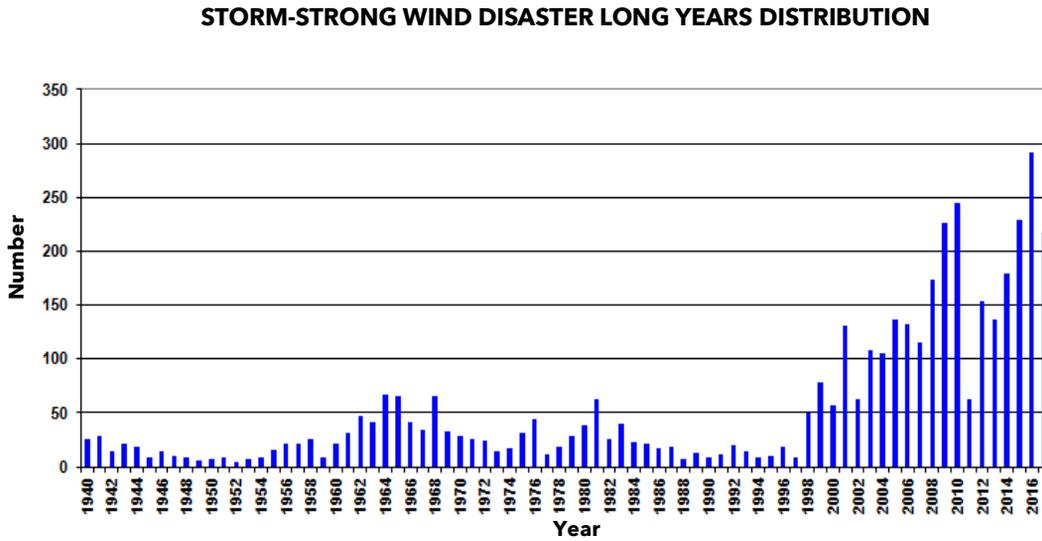
According to MGM data on amount and frequency of precipitation year 2017 was (574 mm) 12% below

the normal of 1981-2010 with total precipitation of 506.6 mm. According to 2017 Temperature and Precipitation Assessment Report prepared by MGM there is a tendency of decrease since 1990 up to today, in 2017 the third decrease occurred since 1990 up to today (MGM, 2017a).

Storm - Strong Wind - Whirlwind

Looking at the averages considered in long periods of time, it is seen that storm/strong wind disaster started a significant rise in Turkey as of year 2000 (Figure 6). Number of storms that occurred in the last three years is over 200. In year 2016, it reached the highest number in history with the effect of climate change.

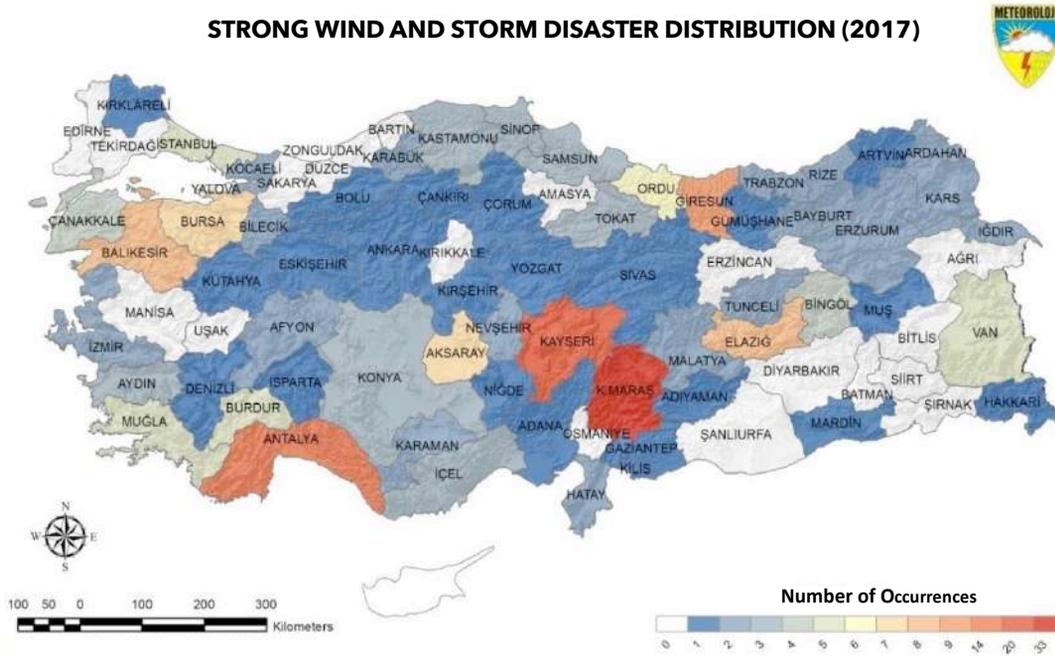
Figure 6: Number of Storm Occurrences in Long Years (1940-2017) (MGM, 2018)



In 2017 a total of 217 storm and strong wind disasters occurred (Figure 5). Kahramanmaraş is the province where storm is seen the most with 33 storms. Following it are Kayseri (20), Antalya (14),

Giresun (9), Balıkesir and Elazığ (8) respectively. Turkey encountered storm - strong wind disaster almost in every province in 2017 as shown in Figure 6 with the effect of climate (MGM, 2018).

Figure 7: Storm and Wind Disaster by Provinces (MGM, 2018)



Storm and whirlwind events that occur repeatedly especially in winter months are not disaster types that we are accustomed to and faced with in historical process. Turkey needs to reduce these risks and take necessary structural measures and the citizens must be informed about the measures they need to take. For example, the storm that occurred in the city of Antalya demonstrated the importance of early warning. Meteorology 4th Regional Directorate gave the warning that on 26.01.2019 there will be heavy snowfall in high parts of Antalya's east townships, heavy rain and storm in city center and west townships; wind will blow from south at 70 to 100 kilometers per hour; after this warning a

whirlwind event occurred that, even though did not cause any life losses, blew away roofs and caused a bus to topple down (Milliyet, 2019).

In storm events that occurred in many cities in recent years roofs were blown away, vehicles and city furniture were damaged. Another example of this situation is the whirlwind disaster that occurred in Mardin Kızıltepe in 2016. Whirlwind combined with the ash and smoke from the burnt stubbles made a different effect (Figure 8); the environmental pollution it caused became even more serious (TRTHaber, 2016).

Figure 8: Whirlwind Disaster that Occurred in Antalya (Left) and Mardin Kızıltepe (Right) (Sabah, 2019; Trthaber, 2019)

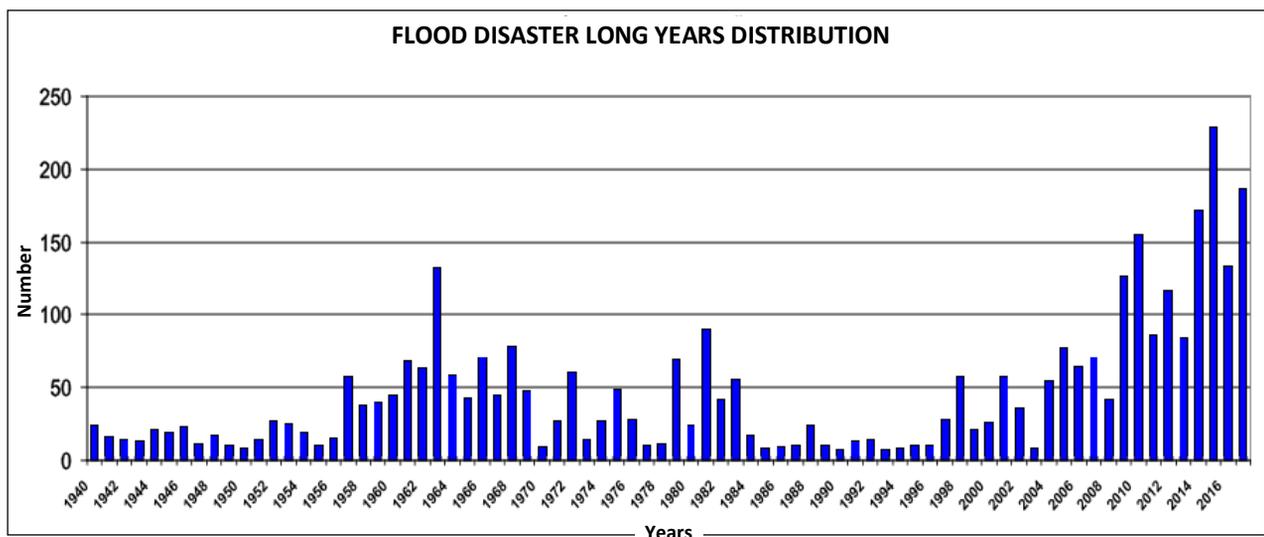


Floods and Water Floods

Flood disaster is a type of disaster that caused significant life and property losses for Turkey in historical process. Furthermore, its frequency and intensity became even more destructive especially in the last 10 years (Figure 9). Turkey's northern parts receive precipitation almost in every season. At the same time, slope rains that occur in Black Sea region cause sudden heavy rains and floods and turn into

disasters with life and property losses. In spring and summer seasons, floods and overflows occur due to snow melting, especially in Black Sea region. 187 flood events were reported only in 2017. In the context of flood events, 2015 was the second highest year after 2017. After year 2000, 50 or more floods occurred every year.

Figure 9: Number of Flood Occurrences in Long Years (1940-2017) (MGM, 2018)



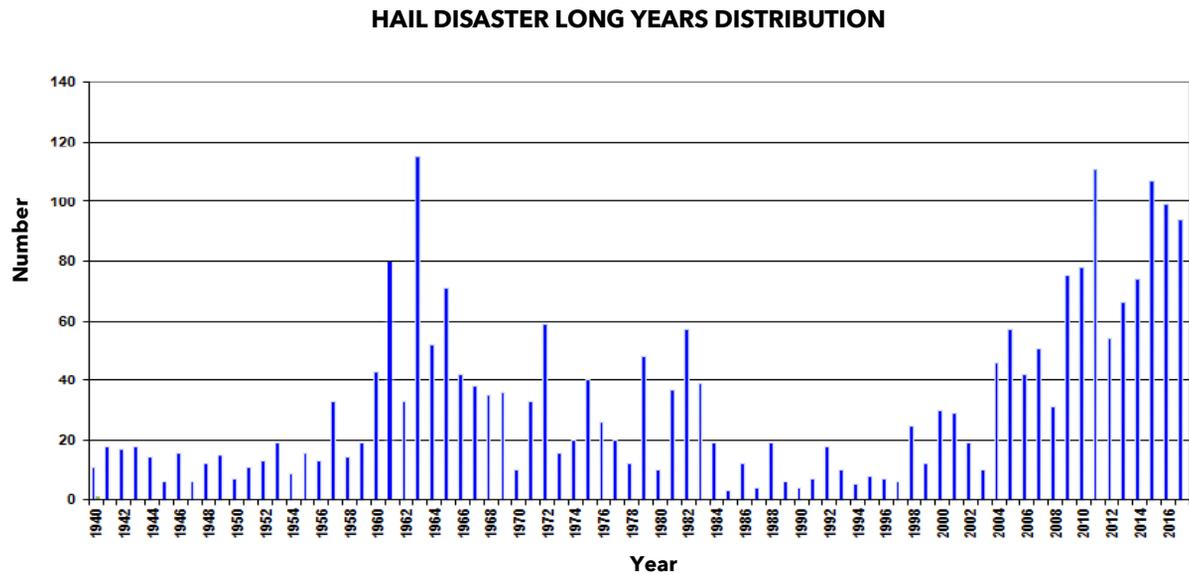
Considering the regional distribution of flood disaster, it is seen that 49 flood events occurred in Marmara Region. As for the other regions, numbers of flood events recorded are 31 in Aegean Region, 38 in Mediterranean Region, 30 in Black Sea Region, 24 in Central Anatolian Region. 9 flood events occurred in Eastern Anatolian Region and 6 flood events in South Eastern Anatolian Region (MGM, 2018).

Hail and Heavy Snowfall Disaster

Hail disaster became a frequently encountered disaster in recent times. It caused damages in many sectors, especially agricultural and transportation sectors. Hail occurrence frequency increased significantly in Turkey, as shown in Figure 10. A total of 94 hail disasters occurred in 2017. Hail affected Konya, İstanbul and Antalya the most. Heavy snowfall disaster was seen 43 times in the entire year and it constitutes 7% of natural disasters of meteorological character (MGM, 2018).



Figure 10: Number of Hail Occurrences in Long Years (1940-2017) (MGM, 2018)



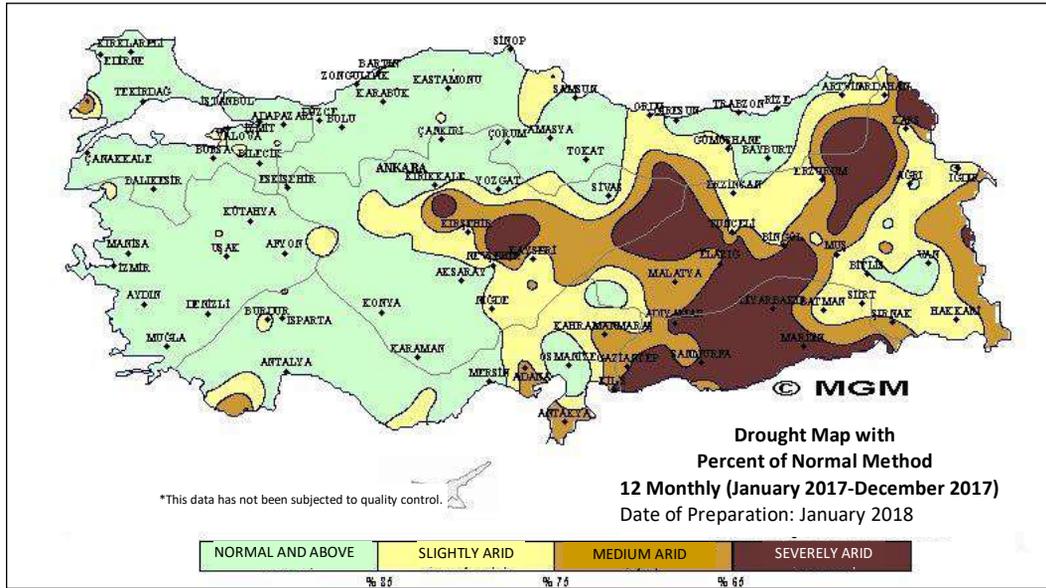
Drought Disaster

Drought is disaster that is seen frequently in Turkey. Because the location and temporal distribution of precipitations in Turkey are irregular, existing water resources of the cities are inadequate to meet the requirements of population growth and industry. Because of traditional irrigation methods, water consumption is high in agricultural production and water quality drops due to environmental pollution. Furthermore, Turkey will feel the drought disaster much more with the climate change. With the increase in drought, unfortunately our country will face more problems in national and international arena in sharing and management of waters within the borders and beyond the borders (Kadioğlu, 2012).

Many studies are being conducted by MGM for drought using different indices and projections.

In this context, the drought map made according to index of normal method for Turkey for year 2017 is given in Figure 11 just as an example. Atmospheric conditions that affect drought in Turkey are physical geography factors and climate conditions. Majority of Turkey is under the effect of semi-arid climate conditions. Amount of arid and semi-arid land area is 51 million hectares; this is an indication of 37.3% of Turkey's surface area being under semi-arid climate conditions. Because of water resources and dry agriculture indexed on rain, changes in quantity and distribution of precipitation affect drought. In the period between 1981-2010 annual spatial average precipitation in Turkey is 574 mm. Drought may be encountered in any part of Turkey; it may be more effective in some parts due to irregular precipitation distribution (Kadioğlu, 2012).

Figure 11: 2017 Drought Map of Turkey's According to Index of Normal (MGM, 2018)



According to Figure 11 in drought analysis of 2017 according to index of normal method drought of varying intensity occurred in central and eastern parts of Central Anatolian Region, east of Mediterranean Region, entire Eastern and South Eastern Anatolian Regions except south of Lake Van and around İpsala, Kaş, Anamur, Geyve, Ordu, Merzifon, Bafra, Burdur, Edremit, Suşehri and Emirdağ. Driest settlement centers are Maden, Genç, Horasan, Arpaçay, Avanos, Ceylanpınar and Şanlıurfa. Increasing need for drinking water in large cities is foreseen to have severe affects especially in İstanbul, Ankara, Aydın, Nevşehir and Bursa. Drops in river flow rates, floods, forest fires and decrease in agricultural productivity were classified as effects of medium intensity (MGM, 2018).

Forest Fires

Forest fires is a disaster type which is closely associated with drought; especially meteorological factors that decrease humidity and increase temperature are effective on fire potential and hazard. They not only cause the fire to start, but also make it difficult to take the fire under control. For

Turkey, it was found out through studies that 92% of forest fires are caused by human activities such as negligence, intention, cigarette, train, harvesting machine, dumping ground, stubble, land clearing and shepherd fire. Fires caused by natural causes are only 8-10%. They are mostly lightning and power transmission lines due to storm. In general, forest fires start between the hours of 11.00 - 20.00 when temperature rise is maximum depending on hours of sunshine, relative humidity is minimum and human activities are at the highest level. It is seen that as a result of 30417 forest fires that occurred between 2005-2017 a total of 111592 hectares of forest burnt down. 27% of the burnt areas in this period happened in 2008. In 2008, as a result of 2135 forest fires, 19 of which are large forest fires, 29749 hectares of forest area was damaged. 2008 was a dry year and this had a significant influence on this. Among the fire statistics, the largest forest fire is the one that occurred in 2008 in Antalya-Taşağil that destroyed 10299 hectares of forest. Area of forest that we lost in 2411 fires in 2017 is 11992 hectares. Forest that occurred in that year corresponds to 8% of the number of fires that occurred in 12 years and 11% of the lost forest area (MGM, 2018).

Protection and improvement of forest ecosystems have a distinct importance in combating climate change because they have very important functions and they are the major carbon sinks. Many works are being performed in Turkey to protect these values and repair the disturbed forest ecosystem by various organizations, especially T.R. Ministry of Forestry and Water Works. Also, in the context of effects of climate change, many joint activities are being conducted for the purpose of coordinated work among related bodies and organizations up to intervention in early warning and alarm systems.

Avalanche Disaster

Meteorological factors, topography and field conditions are influential in the occurrence of avalanche disaster. Most important factors are snow, rain, rain intensity, wind condition, present temperature, atmospheric pressure and cloudiness. As regards to topography, avalanche event occurs especially mountainous regions of our country; they do not turn into disasters because their level of affecting settlement areas is low. Number of reported events is also low, as long as they do not cause life and property losses. A total of 9 avalanche

events occurred in Turkey in 2017, especially in the provinces of Van, Hakkari and Bingöl; highways and people were affected from these events the most. Snow masses falling down from mountains because of avalanche, especially in Eastern Anatolian Region, close the highways; when combined with heavy snowfall and blizzard many vehicles and persons get stranded. In this context, avalanche tunnels are built on highways to reduce the avalanche risks (MGM, 2018).

General Evaluation

When the situation of meteorological disasters is evaluated in general for Turkey, it is clearly seen that our country is under significant risk for the disasters caused by climate change. Reflection of adverse conditions caused by climate change on regions and general economic activities in Turkey on sectoral basis according to Climate Change National Action Plan (2012) prepared by Republic of Turkey, Ministry of Environment and Urbanisation is shown in Table 10. In this context, the highest priority is to conduct the activities to reduce the risk by related bodies and organizations and implement the policies and strategies.

Table 10: Effect of Climate Change on Regions and Sectoral Activities in Turkey (Republic of Turkey, Ministry of Environment and Urbanisation, 2012)

Effect	Strength	Regions	Sectors / Themes
Change in river/basin regimes	Low	All regions	Ecosystem services and biologic diversity
Decreasing river flow rates	Medium	Western Anatolia	Agriculture, water supply infrastructure
Increasing scarcity of grid water	High	İstanbul, Ankara, Aydın, Nevşehir and Bursa	Settlement areas
	Medium	Afyon, Kayseri, İzmir, Muğla and Manisa	Agriculture, industry, energy
Floods	Medium	Black Sea and South Eastern Anatolian Regions	Farmers, public health

Effect	Strength	Regions	Sectors / Themes
Soil loss/salinity	Low	Mediterranean, Black Sea, Aegean and South Eastern Anatolian Regions	Tourism, ecosystem services, biologic diversity and loss of sea products
Coastal erosion	Low	Black Sea Region	Fishing, unemployment
Deterioration of sea ecosystem	Low	Mediterranean, Black Sea and Aegean Regions	Ecosystem services and biologic diversity loss
Forest fires	Medium	Western Anatolia	Tourism, Agriculture
Permanent emigration of species	Low	Mediterranean Region	Tourism, Agriculture
Decreasing agricultural yield	Medium	Mediterranean and Aegean coasts	Agriculture (employment), food supply safety
Decreasing hydro - energy potential	Low	Mediterranean region	Energy, industry
Decreasing sea product production	Low	Mediterranean region	Agriculture, food supply safety, water supply

3.2. Natural Disasters Caused by Climate Change in Turkey's Policy and Strategy Documents

Turkey made certain commitments in relation with the disasters caused by climate change in many international documents, especially in UNFCCC signed in 2004 and Kyoto Protocol in 2009, of which it is a party. In addition to these, it made regulations in many different areas and sectors in relation with disasters caused by climate change, especially in national policy and strategy documents and development plans. In this context, effects of climate change are discussed under sub-headings by going over the documents prepared in national field.

3.2.1. Urbanisation Council and Climate Change

Within the scope of the activities conducted in Urbanisation Council organized by Republic of Turkey, Ministry of Environment and Urbanisation in 2009, Climate Change, Natural Resources, Ecologic Balance, Energy Efficiency and Urbanisation

Commission was established. In this context, urbanisation processes and climate change in Turkey was examined by a separate commission and activities were formed accordingly. Commission's findings on the structures of cities Turkey are as follows:

- Global risks and threats are increasing day by day and threaten our cities,
- In addition to high disaster risk of our country, considering the deficiencies in the urbanisation process and nondurable structure stock, there are problems in raising the quality of life
- There are difficulties in the protection of natural and cultural assets
- In the prevention of illegal housing
- City-oriented renewal, transformation, in the construction of technical and social infrastructure in a healthy manner, establishing good governance, facilitating city-oriented development and development of the area (T.R. Ministry of Public Works and Settlement, 2009).

The commission stated that due to the fact that 10-15 million more will emigrate to cities in future years in our country, globalization process will affect every part of the society, climate change and energy efficiency will be the most important agenda item, center-local relation will be transformed and local's project-based development efforts will be seen under the guidance of the central administration. When the subject is the measures to be taken against climate change and that the cities are turned into pollution centers, what needs to be done with priority is structuring the sustainable cities by taking climate change into consideration, and secondly eliminating environmental pollution. Focal point of global warming in the world is cities. The reason is that majority of greenhouse gases that cause global warming are produced in cities. Share of the cities in the production of greenhouse gases is 70% in Turkey and 80% in Europe. It was indicated by the commission that energy producing cities should be transformed into nature friendly cities and should have dominantly sun architecture. Also, the necessity for the environment law to be passed was emphasized and it was foreseen to establish a fund and provide financing for project to cover the carbon law (T.R. Ministry of Public Works and Settlement, 2009).

3.2.2. Natural Disasters and Climate Change in World Humanitarian Summit

In World Humanitarian Summit held on 23-24 May 2016 in İstanbul in the meeting on the subject *Natural Disasters and Climate Change: Managing Risks and Crises Differently* Turkey gave its support to all 5 basic commitments designated by UN. Also,

11 national commitments were made in relation with these basic commitments.¹⁹ Prominent elements in the designated basic commitments are facilitating the reduction of risks related with climate change, strengthening the capacity in risk management, being prepared and establishing early warning systems. It undertakes to reduce disaster risk, strengthen national and local leadership in the management of disaster and risks related with climate through arrangements for intervention to disaster and improvement and to be prepared for risks related with climate.

Turkey undertakes to fulfill the obligations of Sendai Natural Disaster Risk Reduction 2015-2030 Framework, 2030 Sustainable Development Agenda and Climate Change Paris Agreement, UN Convention to Combat Desertification in other commitments in additional commitments presented at national level. It undertakes to implement the works for balancing the land destruction by 2030 and obligations of *Ankara Initiative*²⁰. It declared that it will conduct works in the scope of land deterioration, erosion, drought, social instability and emigration, to organize training programs and to support establishing and developing early warning systems in sensitive countries. Furthermore, entities and organizations responsible for these actions were determined and work distribution was made.

3.2.3. Turkey Climate Change Action Plan and National Declarations

Turkey became a party to UNFCCC, which forms the focal point of international disaster policies and signed for climate change, in 2004. In the context of

¹⁹ See. <http://www.dizturkiye.org/tr>

²⁰ United Nations Convention to Combat Desertification 12th Conference of Parties was held in Ankara on 12-23 October 2015 hosted by Turkey and chairmanship of the Conference was transferred to Turkey for 2 years. Within the scope of this activity, Turkey started Ankara Initiative to support the implementation of COP decisions as Turkey's contribution to Sustainable Development Goals (SDG) accepted in September 2015 in New York. Ankara Initiative requires making contribution to global

development agenda with existing experience on sustainable land use. Desertification/land deterioration is one of the greatest obstacles in reaching sustainable development goals. Ankara Initiative was developed basically to strengthen the efforts made by the Secretariat and convey Turkey's experiences on the subject.

its obligations in this framework it submitted Climate Change First National Declaration in 2007, Climate Change Fifth National Declaration in 2013 where Second, Third, Fourth and Fifth Declarations were submitted together, and Climate Change Sixth National Declaration in 2016 to United Nations Climate Change Secretariat (Republic of Turkey, Ministry of Environment and Urbanisation, 2016). Furthermore, 2011-2013 Turkey Climate Change National Action Plan was prepared by Republic of Turkey, Ministry of Environment and Urbanisation and put into effect for the purpose of fulfilling Turkey's obligations (Republic of Turkey, Ministry of Environment and Urbanisation, 2012). It was emphasized in the plan that climate change will cause adverse effects in Turkey such as decreasing of water resources, occurrence of floods, forest fires, drought and desertification, and ecologic deteriorations because of these. It was states that with distinct rises in temperatures foreseen for Turkey will trigger sectors, settlement areas and climate-borne natural disasters and precipitation regime will change. Climate change policies included in the plan focus on five important areas as water resources management, agriculture and food safety, ecosystem services, biologic diversity and forestry, natural disaster risk management and human health.

Turkey's Climate Change Seventh National Declaration was submitted in 2018 in a very broad perspective covering the evaluation of the works foreseen in the Sixth Declaration and subjects such as communication, institutional, legal and policy related with climate change. In the declaration, there are the measures taken by Turkey for the purpose of accelerating the efforts at national level for responding to climate change, measures for sectoral climate change and policies developed to encourage greenhouse gas emissions and increase resilience against climate. In the declaration, which is a very comprehensive document that show the situation of our country in the field of climate change,

there are assessments related with disasters that we encounter as a consequence of climate change. It has been emphasized that in this process aimed at climate change in our country, addition to what has been done, the steps that need to be taken will be realized by means of the young population we have and the dynamism of public entities and organizations and the private sector (Republic of Turkey, Ministry of Environment and Urbanisation, 2018).

There is an increase in the frequency, intensity and spatial distribution over the country of nature-borne disasters sensitive to water cycle such as flood and drought because of climate change. For example, increasing of quantity of water that began to flow on the surface in winter months will require new measures to be taken and improvement of the existing infrastructure. Similarly, there are regions where it is foreseen that rains will increase in intensity. Therefore, there will be a risk of flood both in rural and urban areas in these types of regions or existing flood risk will increase. According to IPCC the effects of climate change on Turkey are related with increasing of frequency, area of impact and duration of forest fires depending on the increase in the length and intensity of hot and dry periods. This is seen as a hazard in Mediterranean Basin, especially in southern regions, all around the year and it is foreseen that this increase in forest fires will cause the spreading of invasive species, therefore spreading of forest fires to wider areas (Republic of Turkey, Ministry of Environment and Urbanisation, 2012; Akay, 2017).

Climate Change Adaptation Department, which is organized under Republic of Turkey, Ministry of Environment and Urbanisation Environmental Management General Directorate, is carrying out climate change national and local adaptation policies and sectoral effect and fragility analyses on regional and provincial bases in 2019 (Republic of

Turkey, Ministry of Environment and Urbanisation, 2019)

MGM supports efforts for adaptation to effects of climate change and it developed various policies for adaptation to climate change such as making early warnings before natural disasters of meteorological character, developing meteorological early warning system, developing avalanche prediction system, increasing product diversity and monitoring global warming and climate change (MGM, 2014).

The communiqué sent by Republic of Turkey, Ministry of Environment and Urbanisation on 22 January 2019 to governorships and municipalities titled "*Climate Change and Disaster Measures*" is of importance regarding implementation of climate change policies and strengthening related legislation. With this communiqué, it is stated that there is an increase in the number and intensity of natural disasters, especially floods and overflows, in recent years because of global climate change, local administration that have the capability and responsibility to make intervention are instructed to implement the measures appropriately and with priority. In recent past legal arrangements were made for the related entities to make improvement works in this field with the communiqué of T.R. Prime Ministry dated 9 September 2006 titled *Creek Beds and Floods to prevent flood and overflow events and Improvement of River and Creek Beds* dated 20 February 2010. It is quite important for facilitating Turkey's adaptation to climate change rapidly that the entities and organizations that have the duty, authority and responsibility implement the necessary measures and improvement works urgently.

3.2.4. Elements Related with Disasters Caused by Climate Change in Development Plans

Turkey is taking serious measures for the reduction of disaster risks in development, medium and

annual, disaster and emergency, sectoral and strategic plans. However, in case multiple hazards occur at the same time or on a close date, it is considered that developed risk reduction and risk transfer mechanisms will be inadequate. In this framework, it is required to integrate the activities conducted for prevention, reduction, preparedness and vulnerability with sustainable development policies, plans and programs in a more effective manner (AFAD, 2015b).

Disaster policies implemented in development plans in Turkey are generally based on compensation of the affected persons' losses by public. Policies aimed at risk reduction and preparedness were not included sufficiently in the first four development plan periods. Especially with shanty housing remissions, effective policies were not implemented sufficiently by local administrations in combating illegal buildings without obtaining construction permits and without complying with laws and regulations. This situation caused thousands of unlicensed and unsupervised building stock, especially in large cities. At the present most of our cities are under disaster risk and management of these risks is getting increasingly difficult (Akay, 2015).

In Turkey, annual investment programs and medium term programs that follow five-year development plans since 1963 (only the Ninth Development Plan was made for 7 years) determine the development strategy of the country as a whole. When the historical progress of disaster in Turkey is investigated, it is seen that it is dominantly earthquake in character and rural in location. When reviewed for this point of view, it is seen that in the policies reflected into development plans disaster damages are listed to earthquakes and practices are restricted to rural areas. In five-year development plans disasters, implemented policies and measures are not described under a separate heading. Information about disasters in given in settlement

and urbanisation policies, housing, environment and research and development sections of the plans (Akay, 2016).

There is not any action designated on the issue of natural disasters related with climate change in the 1st (1963-1967) and 2nd (1968-1972) Five-Year Development Plans (DPT, 1963; DPT, 1968). Even though there is no action on disaster management in the 3rd Five-Year Development Plan (1973-1977), it is seen that natural disasters were taken into consideration only in relation with housing needs. In principles and measures section of the plan it was recommended to revise the present laws for resettlement of the people and, by drawing attention to risk transfer, develop a system to lessen the burden on the government (DPT, 1973; DPT, 1979; Akay, 2016).

In 4th Five-Year Development Plan (1979-1983) disaster damages were discussed specifically for earthquake and supervision of settlement and structuring was emphasized (DPT, 1979).

In the scope of 5th Five-Year Development Plan (1985-1989) a change was made in the principles and policies related to environmental problems and it was stated that problems encountered because of disasters and environmental pollution cannot be solved by preventing pollution, but in line with the sustainable development goals included in international policy (DPT, 1985; Akay, 2016).

Regarding disasters caused by climate change and meteorological disasters, for the first time in the 6th Five-Year Development Plan (1990-1994) period within the scope of Sectoral Development Goals and Forestry, it was emphasized that for restoring the effects of disasters such as deforestation, desertification and soil erosion priority must be given to works of protection, forestation, rejuvenation, erosion control and meadow improvement. Importance of forestation activities

was mentioned, and necessity of forest protection works was stated (DPT, 1990).

In 7th Five-Year Development Plan (1996-2000) there are arrangements related with the policy and measures that need to be taken to lessen the problems caused by earthquake and other natural disasters (DPT, 1996). The 8th Five-Year Development Plan (2001-2006), which was prepared after the destructive earthquakes in 1999 is the plan that contains most detailed settlement, urbanisation and disaster policies among development plans. Protective and preventive measures before the disasters were included on reducing disaster risks (DPT, 2000a). In the preparation process of the plan *Natural Disasters Special Expertise Commission and Climate Change Special Expertise Commission* were established for the first time. Works conducted in both commissions provided guidance in developing policies about disaster and climate change in the preparation process of the plan (DPT, 2000b; Akay, 2016).

The 9th Development Plan was prepared for a period of seven years, different than the other development plans, and covers the period of 2007-2013. Plan does not contain assessments and activities about disaster policies at sufficient degree; it consists of various thematic-sectoral and large-scale decisions in a way different than the other development plans (DPT, 2006).

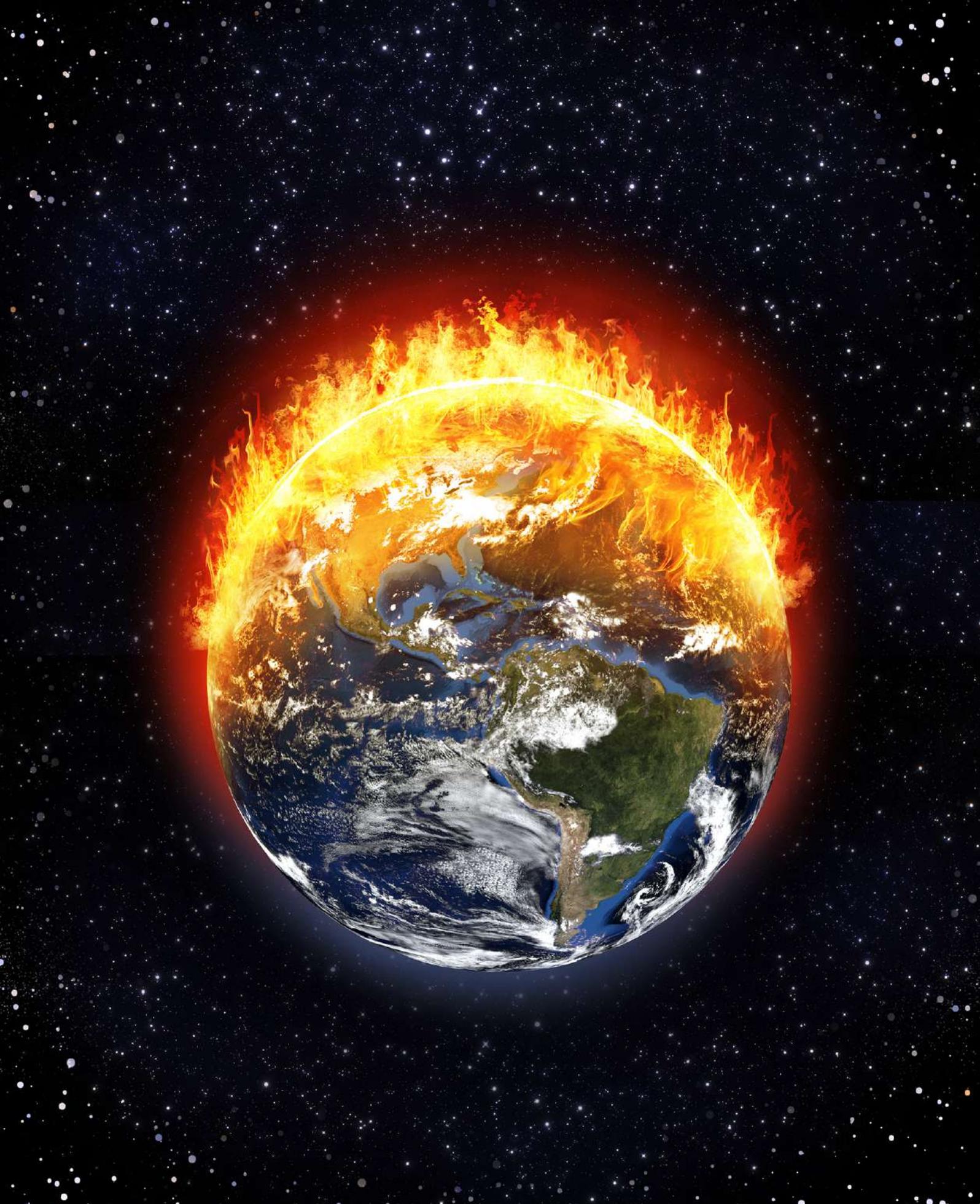
10th Development Plan (2014-2018) was given a direction with the preliminary works conducted by *Effectiveness in Disaster Management Special Expertise Commission* within the scope of preparation activities. Disaster management was discussed under a separate heading in a development plan for the first time and it was formulated in line with international developments about disaster and HFA, strategic goals and action priorities (T.R. Ministry of Development, 2013).

Also for the first time, *Climate Change and Environment* was included as a separate heading, climate change was considered as a risk in *Effective Use of Food, Water and Natural Resources* and it was stated that “frequency of disasters increased as a result of climate change and their effects reached serious dimensions” (T.R. Ministry of Development, 2013).

Turkey’s Eleventh Development Plan (2019-2023) was published in the Official Gazette dated 23 July 2019 and dated 30840 1st Double and was made effective. Climate change was included in the plan in many different areas. It was especially discussed under a separate heading as “Climate Change, Food Safety and Effective Use of Water” in the 2nd Section titled Global Developments and Trends. In this context, emphasize was made on the increase of climate change at global level and it was stated that the commitments of developed-developing countries in the scope of Paris Agreement were not adequate to implement the designated global goals. It was mentioned that increasing food demand applies pressure on climate change, urbanisation, soil and water resources, agricultural products and producers and growing plants and animals suitable for the changing climate gains more importance. It was stated that Turkey is geographically among the countries that will be most affected from climate change; increasing sudden rains, floods and drought disasters occurred. It was emphasized that Turkey continues with efforts for reduction of emissions and adaptation to climate change presently with its position as a developing country, it should be given access to climate financing for this purpose and emission reduction opportunities at lowest marginal cost should be taken (Republic of Turkey, Presidency Strategy and Budget Department, 2019).

As assessed on the basis sectors, the Plan foresees that activities must be made to build underground water basins and dams for the purpose of preventing

water losses caused by evaporation by taking into consideration the effects of climate change in the policies and measures related with agriculture; action plans must be prepared about combating invasive species and agricultural pathogens and to make agricultural product pattern change scenarios in the context of adaptation. It was also foreseen to conduct studies for determining the effects of climate change on tourism sector in the policies and measures related with tourism, to raise the quality of life and to increase the amount of green areas with Gardens of Nation within the scope of green city vision in the policies and measures related with urbanisation. It was stated within the scope of the Eleventh Development Plan that climate change action plans must be prepared for 7 regions, especially Black Sea Region, for adaptation to climate change and taking necessary measures; disaster hazard and risk maps must be prepared by taking into consideration the scenarios about the effects on climate change in Turkey in general in the policies and measures related with disaster management (T.R. Presidency Strategy and Budget Department, 2019).



3.3. Social and Economic Effects of Disasters Caused by Climate Change

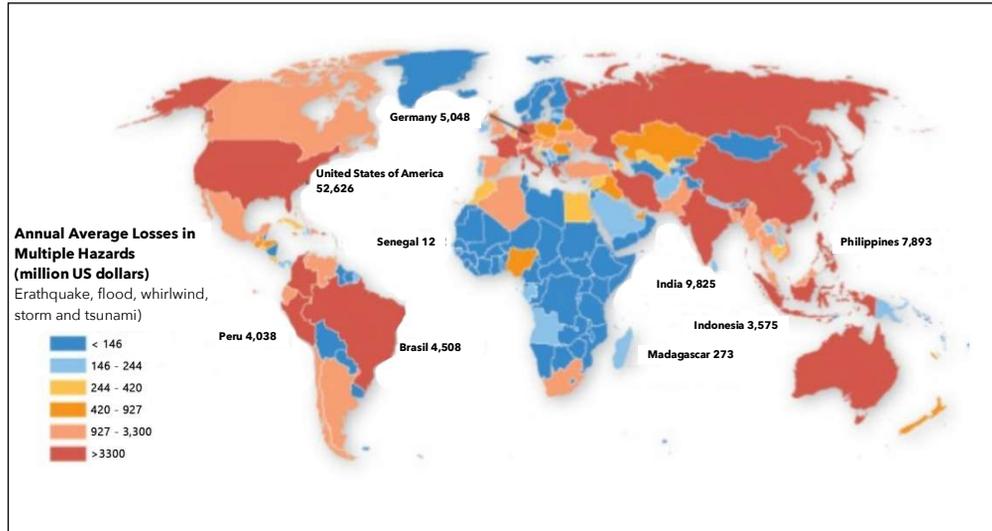
The goal of reducing disaster risks is to prevent the hazards before they turn into disasters and to eliminate the risks at the source. In the face of increasing frequency and (both life loss and damages) intensity of disasters, countries are making researches for methods about the reduction of disasters in addition to traditional mechanisms for help after the disaster. UN emphasizes that in order to reduce the losses caused by disasters and the effects they have on people's quality of life; disaster risk reduction policies must have a significant place in national development plans. Integration of natural disaster risk management and risk reduction policies must be included in development policies. As this approach is a multi-disciplinary concept combining different fields, it requires the participation of all related sectors such as infrastructure, construction, energy, finance, transportation, agriculture, education and health. Difficulty of developing financial analyses to support the reduction of disaster risks becomes more complicated with the need to determine suitable budgets put in place to support disaster risks reduction programs. This type of programs is generally included in the total of national strategies, each of which is under the responsibility of a different entity or ministry and among which there is coordination at different levels. According to UN GAR (Global Assessment Report on Reduction of Disaster Risks) "in the present situation, national financial systems of countries do not measure the disaster effects adequately. On the contrary, their financial systems generally report the restructuring and aid expenditures and add these to Gross Domestic Product (GDP) figures. In order to provide welfare at national level in the future, disaster risks should be

calculated in risk management and financial strategies (UNDRR, 2015b).

Global Assessment Report presents scenarios that expose the effect of disaster risk reduction measures on economic growth for countries. However, in countries exposed to meteorological disasters, in the context of inadequacy of measures for reducing disaster risks, it is not clear whether disasters' effect on economic growth is as big as foreseen or not (UNDRR, 2015b).

Annual average economic losses caused by multiple hazards (earthquakes, floods, cyclones, tsunamis, etc.) are given by UN in Figure 12 in millions of dollars. According to this USA is at the top of the list with 52,626 million dollars (UNDRR, 2018).

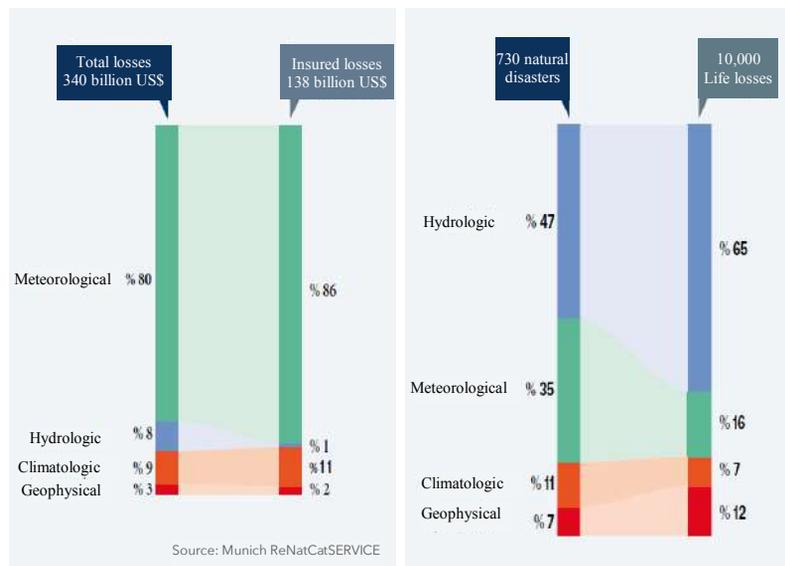
Figure 12: Annual Average Economic Losses in Multiple Hazards (million dollars) (UNISDR, 2017)



As a result of the findings of Munich Reassurance, 2017 has been among the costliest years regarding the material losses caused by weather-climate borne disasters in the world. Total losses were 340 billion US dollars and insured losses were 138 billion US dollars. 80% of these losses were caused by

meteorological disasters, 8% hydrologic, 9% climatologic and 3% geophysical disasters (Figure 13). In total 730 natural disasters occurred, and these disasters caused 10,000 life losses. 47% of the disasters were hydrologic, 35% meteorological, 11% climatologic and 7% geophysical.

Figure 13: Distribution of Economic Losses of Disasters that Occurred in 2017 in the World (MGM, 2018)



To provide social support for disaster risk reduction investments, it is very important to develop financial and social returns of this type of investments. In addition to encouraging resource accumulation, this type of analyses present information for better distribution of the existing resources by providing opinion on where the highest social and economic returns are obtained among many disaster risks reduction activities. Especially natural protection mechanisms such as protection and restoration of ecosystem services (wetlands, forests, etc.) exist in many countries in Europe. Global warming caused by environmental deterioration due to rapid urbanisation, population growth, industrialization and climate change increase the disaster risks. Effective environmental management is an important factor in disaster risk reduction. Establishing environmental management by countries will make contribution to risk reduction in this direction. In addition, the following are the other activities that must be performed with priority;

- *Prevention of lack of coordination among institutions,*
- *Definition of areas of authorization clearly,*
- *Establishing institutional structures for central management of disaster risk reduction actions*
- *Definition of information and management systems in disaster management plans*
- *Establishing effective data base management system for disasters using information technologies*
- *Integration of early warning systems with disaster management systems (UNDRR, 2015a).*

Katrina and Rita Hurricanes (2005) that occurred in USA, which are important indicators of climate change in recent periods and which made impressions across the world caused the failure to protect settlement areas from floods, to transform data obtained from disaster early warning system to information and to make an effective crisis management. In addition to life and property losses

in the society, they also caused social and economic problems and even security gaps to occur. In the process following Hurricane Katrina, in the restructuring process including the construction sector, problems appeared in unemployment and quality of life as a result of inequality and social defenselessness. Six years after the hurricane, average salary in New Orleans is 6% lower than the USA average at the present. While the poverty indicator across the country is 15.9%, this indicator became 29% for New Orleans. It is seen that New Orleans ranks second in inequality in the country. Average household income fell by 9% between years 1990-2011; income inequality went up by 50%. While Hurricane Katrina was a strong and destructive hurricane, this type of disaster occurred many times in the history, not for the first time. This is not the first hurricane in the history of USA, and it will not be the last. However, what turned it into disaster is the defenselessness of those left behind and lack of effective measures in risk and crisis management that must have been taken. 46% of the deaths that are caused by the damage inflicted by category 3 hurricanes that have the property to affect similar number of persons are getting intensified due to vulnerability and defenselessness of people. This shows that reducing the social and economic vulnerability and increasing resilience will lower the damages significantly. The reason for the disaster that occurred in New Orleans is not natural processes or bad stars, with the habits coming from antic ages, but failure of the managers to reduce the risks and coordinate them (UNDRR, 2015a).

As mentioned before, in the face of the difficulty in developing financial analyses to support reduction of disaster risks, countries developed different practices. For example, *Costs of Natural Hazards - ConHaz Project* financed by European Commission is an application that provides basis for developing financial assessments for reduction of disaster risks.

ConHaz²¹ makes a synthesis of assessment methods for damages, measures and intervention to natural disasters activities and produces data to support the decisions in natural disaster management and climate change adaptation planning fields and for policy development processes. ConHaz's method determines the cost of multiple hazards (famine, flood, hazards in coastal and mountainous regions) and of the affected sectors. Outputs of ConHaz research also include costs of intangible effects and costs reducing the defined hazards. This way, in addition to cost forecasts for reducing the existing hazards, evaluation of intangible effects is made (UNDRR, 2015a).

Even though the measures taken by countries against climate change will not result in definite solutions in the short term, it is expected that the investments to be made in the next 10-20 years in this field will give birth to effective results in the second half of the century and in the next century. In this context, in the report prepared by EU and International Relations Unit of Turkey Insurance and Reassurance Companies Association (2007) the importance of European insurance sector's taking risk and loss reduction measures and the importance of private- public sector cooperation in the reduction of social and economic effects of natural disasters is emphasized. European insurance sector supports private- public sector cooperation on subjects such as especially risk assessment, risk transfer, funding, harmonization, mitigation and prevention measures. Priority areas on this subject are determined as follows:

- Enhancing the risk awareness
- Space and land use planning, mapping and zoning of risks and pricing of risks
- Implementing disaster risk prevention measures
- Providing effective risk measures, loss reduction measures and public support

- Sharing the financial burdens with private-public sector cooperation (TSB, 2007).

In this context, it will be very helpful to define-analyze the risk that the insurance sector has, to encourage new financial products by utilizing the financial solution formulating experience that will improve the effects of climate change and to make R&D studies and multi-stakeholder activities with the participation of private sector, public and universities.

3.4. Risk Reduction Approach in Disasters Caused by Climate Change in Turkey and Roles of Stakeholders

Important gains have been made for Turkey in relation with transfer of authority and resources to local administrations, participation of local communities and facilitating decentralization, which are of importance priority in the process of reducing disaster risks. There are some studies, although limited, about the legal responsibility of local administrations for reducing disaster risks and regular/systematic budget allocation. Metropolitan municipalities arrange for the people's participation in environment order planning and settlement planning processes and other municipalities in settlement planning processes; this way they are trying to reflect the disaster risk reduction practices to the plans they make. Local administrations also make activities for combating poverty, climate change and reduction of natural and human-caused disasters. On the other hand, since a separate code is not assigned to disaster risk reduction in budgeting system, reliable information cannot be obtained about how much allocation is made for this type of activities and how much is spent (AFAD, 2015b).

²¹ For more information, see www.conhaz.org



Turkey has started Capacity Development Projects for public entities and institutions with IPA (Instrument for Pre-Accession Assistance) funds. Activities of Building Resilience against Disasters in Western Balkans and Turkey Project are being conducted, which is executed by UNISDR (United Nations International Strategy for Disaster Reduction) and WMO (World Meteorological Organisation) in the context of HFA for the purpose of decreasing the vulnerability of the beneficiary countries of IPA against disasters and resilience against climate change. Also, Turkey has other activities considering the regional cooperation in reducing the disaster risks and taking into account regional and beyond the border's risks of national and local risk assessments. For example AFAD works in coordination with many international organizations, especially UN organizations such as UNISDR (United Nations International Strategy for Disaster Reduction), UNICEF (United Nations International Children's Emergency Fund), UNHCR (United Nations High Commissioner for Refugees), UNFPA (United Nations United Nations Population Fund), WB (World Bank), WHO (World Health Organization), UN OCHA (United Nations Office for the Coordination of Humanitarian Affairs), UNDP (United Nations Development Program), WFP (World Food Program), IOM (International Organization for Migration) and UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific) (AFAD, 2015b).

Regarding land use, management of natural resources and adaptation to climate change being complementary goals of environmental policies and plans, Turkey needs to combat desertification, hydro-meteorological disasters and rising of sea level problems because of global climate change (AFAD, 2015b). activities are in progress related with climate change within the framework of Turkey Climate Change National Action Plan (2011-2023), prepared to be compatible with National Climate Change Strategy Document (2010-2020) with the contributions of UNDP. These activities are reported every year through National Declarations within the

scope of UNFCCC (Republic of Turkey, Ministry of Environment and Urbanisation, 2016).

Desertification issue is being handled within the framework of Combating Desertification Turkey National Action Plan, which was prepared pursuant to UN United Nations Convention to Combat Desertification. Road Map Document for Climate Change and Related Disasters (2014-2023) was accepted by AFAD for the purpose of reducing hydro-meteorological disaster risks. Integrated coast area plans are being made by Republic of Turkey, Ministry of Environment and Urbanisation covering areas including all areas which are in interaction with coastal areas. In addition, arrangements were made within the framework of alignment with EU acquis in relation with environment and nature protection areas (AFAD, 2015b).

Boundaries of areas that are left under the water or that may be subject to water floods that will be caused by overflowing of rivers which will form important problem areas with the effects of climate change are determined with the Resolutions of Board of Ministers in Turkey and they are not allowed to be opened for settlement. In risky areas agricultural lands and natural values are protected and locations under disaster risk are not allowed to be opened for settlement through disaster hazard and risk maps. As combating climate change is a relatively new policy area compared to other disasters, there is a requirement to reassess the existing incitements for this purpose. In this context, Republic of Turkey, Ministry of Environment and Urbanisation is conducting on *Ecologic Settlement Unit* standard. With this standard, it is intended to make settlement areas resilient against disasters and reduce the carbon emissions and environmental impacts. Planning and managing residences in relation with disasters of meteorological cause involves elements such as disaster risk reduction including supervision of implementation of settlement laws. There are laws and regulations in force in Turkey to prevent floods in regions that have

tendency for flood. Also, T.R. Ministry of Agriculture and Forestry Water Management General Directorate and General Directorate of Water Works are authorized institutions in Turkey for water management. In this framework, basin protection action and management plans are being made for water basins including coastal and transition waters of Turkey; water quality standards on basin basis, monitoring system for control of water quality, database for water, flood and drought management plans on basin basis and flood risk and damage maps are also being made. Further, climate change scenarios are being developed to determine the effects of climate change of water resources. T.R. Forestry General Directorate is conducting fire and natural disaster risk assessments for activities such as forestation for city forests and recreation areas, soil plowing and forest road opening works. Possible risk scenarios are being developed by taking into consideration climate change forecasts and readiness plans are updated based on future risk

scenarios. Emphasis was made on determination of regional and climatic features and determining priorities according to disaster types and effects in the reduction of disaster risks. *Disaster and Emergency Situation Intervention Services Regulation* was placed in force in 2013 and *Turkey Disaster Intervention Plan* (TDIP) in 2014. TDIP includes elements for reducing disaster risks and covers ministries, entities and institutions, private organizations, NGO's and real persons (AFAD, 2015b).

Policies developed for preventing the adverse effects of climate change is directly related with the entire disaster risk management process, especially disaster risk reduction policy. The stages prioritized by UNDP for the reduction or prevention of losses caused by disasters related with climate in the process management are given in Table 11 for guidance in the management of this process by Turkey.

Table 11: General Steps of Climate Risk Management Approach (Kadioğlu, 2012; Kadioğlu, 2018)

1. CLIMATE ANALYSIS:
Determining locally the present climate characteristics, climate variability and trends, climate prediction studies in different time periods and scenarios such as how the climate may change
2. DETERMINING RISKS AND EFFECTS: Determining present possible climate change effects;
<ul style="list-style-type: none"> • Present change (according to long term observation information) • In the medium term (according to present situation and trends in observations) • In the long term (according to projections and predictions).
3. DECISION ANALYSIS AND SUPPORT:
<ul style="list-style-type: none"> • Supporting the decision of national and local decision makers for projects and programs they will initiate or support with scientific findings related with climate variability and climate change • In decision analysis, it covers institutional policies and capacity analyses, determining priority sectors and geographical regions in climate risk management.
4. INSTITUTIONAL AND POLICY RESEARCH:
<ul style="list-style-type: none"> • Determining adaptation and prevention responsibilities between public entities and sectors for administrative and governance aspects of climate risk management policies with stakeholder analyses and stakeholder-oriented studies.
5. CAPACITY DEVELOPMENT:
<ul style="list-style-type: none"> • Institutional and legal efforts for capacity building aimed at solving the difficulties and problems that are determined according to the assessed risks, development and progress priorities.

The stages indicated in this context will provide guidance in the process management of the projects to be implemented in the context of risks related with climate change. Even though meteorological disasters are at the top of the list, the activities to be conducted in this field will help to minimize the life and property losses caused by other types of disasters (Republic of Turkey, Ministry of Environment and Urbanisation, 2012).

There are elements that need to be developed for the Turkey's capacity in relation with the reduction of disaster risks. In addition to existing capacity, resilience of Turkey against climate risks must be enhanced in the context of the measures that need to be taken for the effects of climate change at global and regional levels for understanding the disaster risk caused by climate change as incorporated in Sendai. For this purpose, it is possible to list the measured that must be taken at global and regional level as adapted for Turkey in general outlines as follows:

- It is required to strengthen the early warning systems based on disaster risk modeling, assessment, mapping, monitoring and multiple hazards by recording the disaster loss that occur in Turkey.
- It must be incentivized to conduct studies on multiple disaster hazards and risks caused by climate change in our country and to make regional disaster risk assessments and mapping including climate change scenarios
- Use of information based on up to date and real data and information technologies, access to satellite and space technologies and related services must be provided in fields that prioritize international cooperation
- It is required to maintain and enhance the earth and climate observations through on-site and remote sensing and to share with the public the best practices implemented by central and

local administrations in our country (adapted from UNDDR, 2015a).

When we assess the issues that are of importance at national and local levels in relation with the effects of climate change for preparedness, development, improvement, rehabilitation and **Building Better than Previous** in restructuring for effective intervention, it is required;

- To take into consideration, prepare and continuously update the policies, plans and programs related with preparedness for disaster and emergency situations, climate change scenarios and their effects on disaster risks with the participation of all stakeholders, especially public-local administrations, private sector and universities in our country,
- To strengthen the international cooperation in line with our national interests, priorities and requirements and to establish genuine and strong partnerships at regional and international levels (adapted from UNDDR, 2015a).

These priorities that are designated by UN need to be prioritized in the national and international context in the activities to be conducted in Turkey by local administrations as well as the central government. In addition the activities to be performed at national level, it is necessary for on the one hand Turkey to share its knowledge and experience with developing or less developed countries, to transfer its experience and to provide guidance and on the other hand to make technology transfer from UN and form the countries that made great progress in the field and to make use of it through sharing of experience for reducing the risks associated with climate change and building a society and future that are resilient against disasters that cone out as a consequence of climate change.

CONCLUSION

Activities for climate change are included and priorities are determined for reducing the disaster risks caused by climate change in many national and international strategy and policy documents and reports prepared in recent times in Turkey. Development of potential risk scenarios based on climate change predictions by both the central government and the local administrations will provide guidance on this issue. Turkey made great progress in combating poverty in the last thirty years. However, it is having an intensive mass emigration reception experience due to the political instability in its neighbors, civil wars and also being located on intercontinental passage point in geographical sense.

At the present, increase in the number of refugees over millions coming to Turkey cause Turkey to produce new policies in many aspects, especially in economic aspect. Increasing of disasters caused by climate change will lead to increasing of these emigration waves from every direction in the future. Especially **“Climate Refugees”** movement will increase the activities that our country as well as other countries will make on the issue.

In this respect, managing the works aimed at eliminating the risks and hazards threatening the environmental values, ecosystems, economic resources and activity fields, historical and cultural values, community and emigrants together with stakeholders in a participative manner is the most important way to be successful in disaster management. It is necessary to develop adaptation mechanisms for the living conditions varying from individual to the whole society and climate change programs, that is, to transform climate change combat to a life style, to develop environmental- and climate-friendly technologies and adopt new combating techniques against climate change.

Program to fight poverty, construction of buildings resilient against disasters and building disaster-resilient cities with high quality of life that are among the highest priority activities that are supporters of this process.



REFERENCES

- Ackerman, S.A. & Knox, J.A. (2015). *Meteorology, Understanding the Atmosphere*. [Kadiođlu, M. ve akır, S. (der.)] Üüncü Basımdan eviri, Nobel Yayınları: Ankara.
- Adven, M. (2018). An Enhanced Seismic Activity Observed Due To Climate Change: Preliminary Results from Alaska. 8th International Conference on Environment Science and Engineering (ICESE 2018). IOP Publishing IOP Conference Series: *Earth and Environmental Science*, 167.
- AFAD, (2014). *Afet Terimleri Sözlüğü*. Afet ve Acil Durum Yönetimi Başkanlığı Yayınları: Ankara.
- AFAD, (2015a). *Avrupa Afet Risklerinin Azaltılması Platformu (EFDRR)*, Hyogo ereve Eylem Planı Yönetişim ve Hesapverebilirlik Raporu: Avrupa Perspektifi.
- AFAD, (2015b). BM, Afet Risklerinin Azaltılması Hyogo ereve Eylem Planının Uygulanmasına Yönelik Ulusal İlerleme Raporu (2013-2015), Ankara.
- AFAD, (2015c). Bütünleşik Tehlike Haritalarının Hazırlanması: Heyelan-Kaya Düşmesi Temel Kılavuzu, Ankara.
- AFAD, (2017a). *Akran Değerlendirmesi Türkiye Raporu 2015*. Avrupa Birliği (AB) İle Sivil Koruma ve Afet Risk Yönetimi Alanında İşbirliği erevesinde Akran Değerlendirmesi Programı 2015-2016, Ankara.
- AFAD, (2017b). *Türkiye’de İklim Değişikliğinden Kaynaklanan Afet Risklerinin Belirlenmesi ve Azaltılması için Kapasitenin Artırılması*. Yasal ve Kurumsal Boşluk Analizi Final Raporu, Ankara. 17
- Akay, A. (2016). *Türkiye’de Afet Politikaları*. [Kartal, F. (der.)] Kamu Politikaları. Yayın no: 386, TODAİE Yayınları: Ankara.
- Akay, A. (2017). *Türkiye’de Afet Yönetimi Politikaları*. [Özmen, B. (der.)] Afet Yönetimi II. Yayın no: 3604, Anadolu Üniversitesi Yayınları: Eskişehir.
- Akay, A. (2018). *Afet Risk Azaltma Politika ve Stratejileri*. [Akay, A. & Pekkan, E. (der.)] Afet Risk Azaltma Politikaları. Yayın no: 3727, Anadolu Üniversitesi Yayınları: Eskişehir.
- Akay, A. & Özmen, Ö.T. (2018). *Afet ve Acil Durum Başkanlığı’nın (AFAD) Afet Yönetimindeki Rolü*. [Özmen, B. (der.)] Afet Yönetimi II. Yayın no: 3604, Anadolu Üniversitesi Yayınları: Eskişehir.
- BBC Türke, (Kasım 13, 2018). California Tarihindeki En Ölümcül Yangın: En Az 42 Kişi Hayatını Kaybetti. Accessed from <https://www.bbc.com/turkce/haberler-dunya-46169454>.
- Brandes, C. (2018). Can Climate Change Cause Earthquakes?. *Scientia*, accessed from <https://www.scientia.global/dr-christian-brandes-can-climate-change-cause-earthquakes/>.
- Büyükbaş, E., Ekici, M. ve Yavaş, Ö.M. (2018). *Dođa Kaynaklı Afet Risk Azaltma Stratejileri-II*. [Akay, A. & Pekkan, E. (der.)] Afet Risk Azaltma Politikaları. Yayın no: 3727, Anadolu Üniversitesi Yayınları: Eskişehir.
- DPT, (1963). *Birinci Beş Yıllık Kalkınma Planı 1963-1967*. Accessed from http://www.sbb.gov.tr/wp-content/uploads/2018/10/Birinci_Bes_Yillik_Kalkinma_Plani-1962-1967.pdf
- DPT, (1968). *İkinci Beş Yıllık Kalkınma Planı 1968-1972*. Accessed from <http://www.sbb.gov.tr/wp-content/uploads/2018/11/%C4%B0kinci-Be%C5%9F-Y%C4%B1I%C4%B1k-Kalk%C4%B1nma-Plan%C4%B1-1968-1972%E2%80%8B.pdf>.
- DPT, (1973). *Üüncü Beş Yıllık Kalkınma Planı 1973-1977*. Accessed from <http://www.sbb.gov.tr/wp-content/uploads/2018/11/%C3%9C%C3%A7%C3%BCnc%C3%BC-Be%C5%9F-Y%C4%B1I%C4%B1k->

- Kalkınma-Planı-1973-1977-E2%80%8B.pdf.
- DPT, (1979). *Dördüncü Beş Yıllık Kalkınma Planı 1979-1983*. Accessed from http://www.sbb.gov.tr/wp-content/uploads/2018/10/Dorduncu_Bes_Yillik_Kalkinma_Planı-1979-1983.pdf.
 - DPT, (1985). *Beşinci Beş Yıllık Kalkınma Planı 1985-1989*. Accessed from <http://www.sbb.gov.tr/wp-content/uploads/2018/11/Be%C5%9Finci-Be%C5%9F-Y%C4%B1llık-Kalkınma-Planı-1985-1989.pdf>.
 - DPT, (1990). *Altıncı Beş Yıllık Kalkınma Planı 1990-1994*. Accessed from http://www.sbb.gov.tr/wp-content/uploads/2018/10/Altinci_Bes_Yillik_Kalkinma_Planı-1990-1994.pdf.
 - DPT, (1996). *Yedinci Beş Yıllık Kalkınma Planı 1996-2000*. Accessed from <http://www.sbb.gov.tr/wp-content/uploads/2018/11/Yedinci-Be%C5%9F-Y%C4%B1llık-Kalkınma-Planı-1996-2000-E2%80%8B.pdf>.
 - DPT, (2000a). *Uzun Vadeli Strateji ve Sekizinci Beş Yıllık Kalkınma Planı, 2001-2005*. Accessed from <https://www.goc.gov.tr/files/files/8kalkınma-Planı-2001-2005.pdf>.
 - DPT, (2000b). *Doğal Afetler Özel İhtisas Komisyonu Raporu*. Accessed from <http://www.sbb.gov.tr/ozel-ih-tisas-komisyonu-raporlari/>.
 - DPT, (2007). *Dokuzuncu Kalkınma Planı 2007-2013*. Accessed from <http://www3.kalkinma.gov.tr/DocObjects/Download/3577/oik676.pdf>.
 - Environmental Justice Foundation, (2009). *No Place Like Home: Where Next for Climate Refugees*. London: United Kingdom.
 - Faroqhi, S. (2001). *Tarımsal Değişimin Bir Göstergesi Olarak Doğal Afet: Edirne Bölgesinde Sel, 1100/1688-89*. [Zachariadou, E. (der.)] Osmanlı İmparatorluğu'nda Doğal Afetler. Yayın no: 117, Tarih Vakfı Yurt Yayınları: İstanbul.
 - Hazai, G. (2001). *Osmanlı Tarihinde Doğal Afetlerin Rolü Hakkında Birkaç Görüş*. [Zachariadou, E. (der.)] Osmanlı İmparatorluğu'nda Doğal Afetler. Yayın no: 117, Tarih Vakfı Yurt Yayınları: İstanbul.
 - IPCC, (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. [Field, C.B., Barros, V. ve ark. (der.)] Cambridge University Press: Cambridge, UK ve New York, NY, USA.
 - Jardley, J. (Eylül 5, 2009). Drought Puts Focus on a Side of India Left Out of Progress. *The New York Times*, accessed from <https://archive.nytimes.com/www.nytimes.com/indexes/2009/09/05/todaypaper/index.html>.
 - Kadioğlu, M. (2008). *Sel, Heyelan ve Çığ için Risk Yönetimi*. [Kadioğlu, M. & Özdamar, E. (der.)] Afet Zararlarını Azaltmanın Temel İlkeleri. No: 2, JICA Türkiye Ofisi Yayınları: Ankara.
 - Kadioğlu, M. (2012). *Türkiye'de İklim Değişikliği Risk Yönetimi*. Türkiye'nin İklim Değişikliği II. Ulusal Bildiriminin Hazırlanması Projesi Yayını.
 - Kadioğlu, M. (2018). *Bütünleşik Yaklaşım: İklim Risk Yönetimi*. [Arı, İ. (der.)] İklim Değişikliği ve Kalkınma. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı: Ankara.
 - Kar, S. (2013). Impact of Global Warming on the Probable Earthquake in the Bengal Basin Area with respect to the Global Scenario. *International Journal of Engineering Science Invention*, 2(7): 20-28.
 - MGM, (2016). *2016 Yılı Afet Değerlendirilmesi Bülteni*. Accessed from <https://www.mgm.gov.tr/genel/kutuphane.aspx>.
 - MGM, (2017a). *2017 Yılı Sıcaklık ve Yağış Değerlendirmesi*. Accessed from

- <https://www.mgm.gov.tr/FILES/Haberler/2018/2017SicaklikveYagisDegerlendirmesi.pdf>.
- MGM, (2017b). *Meteorolojik Karakterli Doğal Afetler 2016 Yılı Değerlendirme Raporu*. [Arabacı, A., Kılıç, G., Erhan, A., Çetin S., ve ark. (der.)] Ankara.
 - MGM, (2017c). *Buzlanma ve Don Olayından Korunma*. Accessed from <http://www.mgm.gov.tr/site/yardim2.aspx>.
 - MGM, (2018). *2017 Yılı Afet Değerlendirilmesi*. [Erhan, A., Kılıç, G., Çamalan, G. ve ark. (der.)] Ankara.
 - MGM, (2019). *Meteorolojik Karakterli Doğal Afetler: Orman Yangınları Meteorolojik Erken Uyarı Sistemi (MEUS)*. Accessed from <https://www.mgm.gov.tr/arastirma/dogal-afetler.aspx?s=ormanyangin>.
 - Milliyet, (Mart 8, 2019). Korkunç sır 600 yıl sonra ortaya çıktı!. Accessed from <http://www.milliyet.com.tr/galeri/korkunc-sir-600-yil-sonra-ortaya-cikti-2839036>.
 - Sabah, (Ocak 26, 2019). Son dakika: Antalya'da hortum dehşeti... Fırtına otobüsü devirdi. Zorunlu olmadıkça... . Accessed from <https://www.sabah.com.tr/yasam/2019/01/26/antalyada-hortum-dehseti-firtina-otobusu-devirdi?paging=6>.
 - Shi, P. ve ark. (2014). *Understanding the Spatial Patterns of Global Natural Disaster Risk*. [Peijun S. & Casperson, R. (der.)] World Atlas of Natural Disaster Risk, IHDP/Future Earth Integrated Risk Governance Project Series. Springer Verlag GMBH, Berlin Herdenberg ve Beijing Normal University Press.
 - T.C. Başbakanlık, (2006). *Osmanlı Belgelerinde Kırım Savaşı (1853-1856)*. Yayın no: 84, Başbakanlık Devlet Arşivleri Genel Müdürlüğü, Osmanlı Arşivi Daire Başkanlığı: Ankara.
 - T.C. Bayındırlık ve İskan Bakanlığı, (2009). *Kentleşme Şurası*. Bayındırlık ve İskan Bakanlığı Yayını: Ankara.
 - T.C. Çevre ve Şehircilik Bakanlığı, (2012). *İklim Değişikliği Ulusal Eylem Planı*. Accessed from <http://www.dsi.gov.tr/docs/iklimdegisikligi/ideptr.pdf?sfvrsn=2>.
 - T.C. Çevre ve Şehircilik Bakanlığı, (2018). *Seventh National Communication of Turkey Under the UNFCCC*. Accessed from https://unfccc.int/sites/default/files/resource/496715_Turkey-NC7-1-7th%20National%20Communication%20of%20Turkey.pdf.
 - T.C. Kalkınma Bakanlığı, (2012). *Onuncu Kalkınma Planı. Afet Yönetiminde Etkinlik Özel İhtisas Komisyonu Raporu*, Ankara.
 - T.C. Kalkınma Bakanlığı, (2013). *Onuncu Kalkınma Planı*. Accessed from <http://www.sbb.gov.tr/wp-content/uploads/2018/11/Onuncu-Kalk%C4%B1nma-Plan%C4%B1-2014-2018.pdf>.
 - T.C. Orman ve Su İşleri Bakanlığı, (2015). *Çölleşme, Arazi Bozulumu ve Kuraklıkla Mücadele Terimler Sözlüğü*. ÇEM: Ankara.
 - T.C. Tarım ve Orman Bakanlığı, (2019). *Ankara Girişimi*. Accessed from <http://www.cem.gov.tr/erozyon/AnaSayfa/ankaragirisimi.aspx?sflang=tr>.
 - T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, (2019). *On Birinci Kalkınma Planı (2019-2023)*, Ankara.
 - TMMOB, (1999). *Meteoroloji Kaynaklı Doğal Afetler ve Meteorolojik Önlemler*. Meteoroloji Karakterli Doğal Afetler Raporu, TMMOB Meteoroloji Mühendisleri Odası: Ankara.
 - TMMOB, (2018). *Dünya Çevre Günü Türkiye Raporu*. Çevre Mühendisleri Odası: Ankara.
 - Tokar, B. (2014). *İklim Adaletine Doğru*. Öteki Yayınevi: İstanbul.
 - Türkeş, M. (2018). *İklim Değişikliğinin Etkileri, Türkiye'nin İklim Değişikliği Uyum Gereksinimleri, Etkilenebilirlik ve Risk Değerlendirmeleri*. [Arı, İ. (der.)] İklim Değişikliği ve Kalkınma. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı: Ankara.

- UN, (2012). *Rio+20 Sonuç Bildirgesi*. Accessed from <http://www.cem.gov.tr/erozyon/Files/Rio20SonucBildirgesi.pdf>.
- UN, (2013). *Plan of Action on Disaster Risk Reduction for Resilience*. United Nations System Chief Executives Board for Coordination, New York, USA.
- UNDP, (2010). *Human Development Report*. Palgrave Macmillan: New York, NY. Accessed from http://hdr.undp.org/sites/default/files/reports/270/hdr_2010_en_complete_reprint.pdf.
- UNDRR, (2009). *Global Assessment Report on Disaster Risk Reduction: Risk and Poverty in a Changing Climate*. Accessed from <https://www.unisdr.org/we/inform/publications/9413>.
- UNDRR, (2001). *Report of Working Group 3 to the ISDR Inter Agency Task Force for Disaster Reduction*. UN/ISDR: Geneva.
- UNDRR, (2002). *International Strategy for Disaster Reduction, Mission and Objectives*. UNDP: New York, NY. Accessed from http://www.unisdr.org/eng/about_isdr/isdr-mission-objectives-eng.htm.
- UNDRR, (2003). *World Summit on Sustainable Development: Follow-Up Actions to the Outcome of the Plan of Implementation in Relation to Disaster Reduction*.
- UNDRR, (2004). *Living with Risk: A Global Review of Disaster Reduction Initiatives*. UN/ISDR: Geneva.
- UNDRR, (2005). *World Conference on Disaster Reduction*. Kobe, 18-22 Ocak 2005. Accessed from <http://www.unisdr.org/>.
- UNDRR, (2015a). *Sendai Framework for Disaster Risk Reduction*. Accessed from <https://www.unisdr.org/we/coordinate/sendai-framework>.
- UNDRR, (2015b). *GAR-Global Assessment Report*. Accessed from <https://www.unisdr.org/we/inform/gar>.
- UNDRR, (2016). *Report of The Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction*. Accessed from <https://www.unisdr.org/we/inform/publications/51748>.
- UNDRR, (2017). *Words into Action Guidelines, National Disaster Risk Assessment*. Accessed from <https://www.unisdr.org/we/inform/publications/52828>.
- UNDRR, (2018). *Economic Losses, Poverty & Disasters 1998-2017*. Centre for Research on the Epidemiology of Disasters (CRED), part of the Institute of Health and Society (Université catholique de Louvain).
- UNDRR, (2019). *2018: Extreme Weather Events Affected 60 Million People*. Accessed from <https://www.unisdr.org/archive/63267>.
- USARC, (2003). *Climate Change, Permafrost, and Impacts on Civil Infrastructure - U.S. Arctic Research Commission Permafrost Task Force Report*. Accessed from <https://storage.googleapis.com/arcticgov-static/publications/other/permafrost.pdf>.
- TRTHaber, (Haziran 13, 2016). Kızıltepe'de Hortum Çıktı. Accessed from <https://www.trthaber.com/haber/gundem/kizil-tepede-hortum-cikti-255985.html>.
- TSB, (2007). *İklim Değişikliği ve Doğal Afetlerin Sosyal ve Ekonomik Etkilerinin Azaltılması Raporu*. Türkiye Sigorta ve Reasürans Şirketleri Birliği Avrupa Birliği ve Uluslararası İlişkiler Birimi. Accessed from <https://www.tsb.org.tr/iklim-degisikligi-ve-dogal-afetlerin-sosyal-ve-ekonomik-etkilerinin-azaltilmasi.aspx?pageID=714>.
- Veinstein, G. (2001). *Karadeniz'in Kuzeyinde Büyük 1560 Kuraklığı: Osmanlı Yetkililerinin Durumu Algılayışı ve Gösterdikleri Tepkiler*. [Zachariadou, E. (der.)] Osmanlı İmparatorluğu'nda Doğal Afetler. Yayın no: 117, Tarih Vakfı Yurt Yayınları: İstanbul.

- Waititu, E. (2008). Drought Spurs Resource Wars. *The Independent*, accessed from <https://independent.org/authors/ernest-waititu/>.
- Zachariadou, E. (2001). *Dođal Afetler Fırsat Anları*. [Zachariadou, E. (der.)] Osmanlı İmparatorluđu'nda Dođal Afetler. Yayın no: 117, Tarih Vakfı Yurt Yayınları: İstanbul.

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