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MODULE 2

Training for the Institutional Capacity Building on Climate Change Adaptation

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT
AND URBANISATION

Environment and Climate Action
Sector Operational Programme

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ABBREVIATION

ABPRS	Address Based Population Registration System
ACRI +	Advancing Climate Risk Insurance
ADAPT	European Climate Adaptation Platform
ADB	Asian Development Bank
ADP	Working Group on Durban Platform for Strengthened Action
AER	Approved Emission Reductions
AF	Cohesion Fund
AfD	French Development Agency
AfDB	African Development Bank
AIDS	Acquired Immunodeficiency Syndrome
AP	Adaptation Policy
ASAP	Adaptation Program for Small-Scale Agriculture
BAU	Reference Scenario
BEPA	Biomass Energy Potential Atlas
BMZ	German Federal Ministry of Economic Cooperation and Development
BOTAŞ	Petroleum Transport by Pipelines Joint Stock Company
C40	40 Cities Taking Climate Action for Sustainable Development
CAP	Common Agricultural Policy
CARICOM	Caribbean Community and Common Market
CBA	Cost-Benefit Analysis
CCAP	Climate Change Action Plan
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDM	Clean Development Mechanism
CEA	Cost Efficiency Analysis
CF	Consistency Fund
CFC	Chlorofluorocarbonone
CFP	Common Fishing Policy
CGE	Computable Overall Balance
CH4	Methane
CIF	Climate Investment Funds
CLA	Collaboration, Learning and Adaptation
CO	Carbon monoxide
CO_2	Carbon dioxide
COP	Conference of the Parties

COP	Conference of the Parties
CRD	Carbon Dioxide Removal
CRED	Disaster Research and Epidemiology Center
CRPP	Climate Resilience Pilot Program
CSP	Concentrated Solar Energy
DAC	Development Assistance Committee
DALE	Disability Adjusted Life Expectancy
DALY	Disability Adjusted Life Years
DC	Developing Country
DC	Developed country
DDT	Dichloro Diphenyl Trichloroethane
DEMA	Disaster and Emergency Management Authority
DFI	Development Finance Institution
DFLY	Disability Free Life Years
DSI	State Hydraulic Works
EAFRD	European Agricultural Fund for Rural Development
EbA	Ecosystem Based Adaptation
EbM	Ecosystem Based Mitigation
EBRD	European Bank for Reconstruction and Development
EC	European Community
ECA	The Economics of Climate Adaptation
ECDC	European Center for Disease Prevention Control
ECDPC	European Center for Disease Control and Prevention
Eco-DRR	Eco-Disaster Risk Reduction
Eco-DRR	Eco-Disaster Risk Reduction
ECONOADAPT	Economics of adaptation to climate change
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMFF	European Marine and Fisheries Fund
EMRA	Turkish Energy Market Regulatory Authority
ENPV	Expected Net Present Value
ERDF	European Regional Development Fund
ERU	Emission Reduction Units
ES	Expected Shortage
ESF	European Social Fund
ET	Emissions Trading
ETF	Enhanced Transparency Framework

ETKB	Republic of Turkey Ministry of Energy and Natural Resources
EU	European Union
EÜAŞ	Electricity Generation Joint Stock Company
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility
FAO	United Nations Food and Agriculture Organization
FAPRI	Food and Agricultural Policy Research Institute
FCCC	Framework Convention on Climate Change
FDI	Foreign Direct Investment
FDI	Foreign Direct Investment
FIES	Food Insecurity Experience Scale
GCF	Green Climate Fund
GDP	Gross domestic product
GHG	Greenhouse Gas Emission
GI	Green infrastructure
GIS	Geographic Information Systems
GIZ	German International Cooperation Agency
GlobalABC	Global Buildings and Construction Alliance
GNP	Gross national product
HALE	Healthy Life Hope
HC	Hydrocarbon
HeALY	Healthy Life Year
HEPP	Hydroelectric Power Plant
HFC	Hydrofluorocarbon
HIV	Human Immunodeficiency Virus
I&FF	Investment and Financial Flow
IBB	Istanbul Metropolitan Municipality
ICF	UK International Climate Finance
ICRM	Integrated Climate Risk Management
ICT	Information and Communication Technologies
ICT	Information and communication technologies
IDB	Inter-American Development Bank
IDFC	International Development Finance Club
IEA	International Energy Agency
IED	Industrial Emissions Directive
IER	Initial Evaluation Report
IFAD	International Fund for Agricultural Development
IFI	International Finance Corporation

IGBC	India Green Building Council
IHL	International Health Legislation
ILO	International Labor Organization
IMF	International Monetary Fund
INC	Intergovernmental Negotiation Committee
INDC	Nationally Determined Intentions to Contribute
IP	Intellectual property
IPCC	Intergovernmental Panel on Climate Change
IRM	Iterative Risk Management
IUCN	International Union for Conservation of Nature
JE	Joint Execution
JICA	Japan International Cooperation Agency
KfW	German Development Bank
KP	Kyoto Protocol
LDC	Least Developed Countries
LDCF	Least Developed Countries Fund
LEED	Leadership in Energy and Environmental Design
LT-LEDS	Strategies to Develop Long-Term 'Low' Greenhouse Gas Emissions
MBI	Market Based Instruments
MCA	Multi-Criteria Analysis
MCII	Munich Climate Insurance Initiative
MDB	Funding Monitoring Common Principles
MDG	Millennium Development Goal
MEU	Ministry of Environment and Urbanization
MGM	General Directorate of Meteorology
Mt	Billion tons
MTA	General Directorate of Mining Exploration and Research
$MtCO_2e$	Billion tons of carbon dioxide equivalent
Mtep	Ton equivalent oil
N2O	Dinitrogen monoxide
NAP	National Adaptation Plan
NAPA	National Adaptation Programs
NASA	US National Aeronautics and Space Administration
NCP	National Climate Program
NCS	Natural climate solutions
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organizations

NHS	National Health System
NOAA	US National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxide
NPP	Nuclear Power Plants
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PA	Portfolio Analysis
PES	Environmental Services
PFC	Perfluorocarbon
pH	Power of Hydrogen
PM	Particulate Matter
PPCR	Climate Resilience Pilot Program
PRC	People's Republic of China
QALY	Quality Adjusted Life Years
R&D	Research & Development
RCP	Representative Concentration Paths
RDM	Robust Decision Making
RERA	Renewable Energy Resource Areas
RF	Russian Federation
ROA	Real Options Analysis
SARS	Severe Acute Respiratory Syndrome
SBB	Strategy and Budget Department
SBI	Subsidiary Body for Implementation
SBSTA	Scientific and Technological Advice Subsidiary Body
SCCF	Special Climate Change Fund
SCP	Sustainable Consumption and Production
SDG	Sustainable Development Goals
SDG	Sustainable Development Goals
SEEP	Sustainable Energy Action Plans
SEPA	Solar Energy Potential Atlas
SF_6	Sulfur hexafluoride
SPO	State Planning Organization
SREP	Renewable Energy Scaling Program
SSCB	Union of Soviet Socialist Republics
TAAN	Tool for Assessment Adaptation
TAR	Third Evaluation Report
TBMM	Grand National Assembly of Turkey

TCFD	Task Force for Climate Financial Disclosure
TDB	Trade and Development Bank
TDRP	Turkey Disaster Response Plan
TEDAŞ	Turkish Electricity Distribution Corporation
TEİAŞ	Turkish Electricity Transmission Joint Stock Company
TKI	Turkish Coal Enterprises
TRIPS	Trade Related Intellectual Property Agreement
TTK	Turkish Hard Coal Authority
TÜBİTAK MAM	Turkish Scientific and Technological Research Council Marmara Research Center
TÜİK	Turkish Statistical Institute
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organization
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
UV	Ultraviolet
VR	Value at Risk
WGB	World Bank
WHO	World Health Organization
WMO	World Meteorological Organization
WorldGBC	World Green Building Council
WTTC	World Travel and Tourism Council
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

1. International Climate Agreements: The United Nations Framework Convention on Climate Change and Kyoto Protocol

Prof. Dr. Murat Türkeş

The Earth's climate is warming, and climate models show that significant climate changes will occur for the next century. This will create negative consequences for societies and create a major obstacle to progress and sustainable development. For this reason, the international community and individual countries face an important task to prevent the threat and risk of climate change associated with the increase in human-induced greenhouse gas emissions (Greenhouse Gas Emissions (GHGs)). The most important way to minimize the predicted climate changes and the possible adverse effects of these changes on natural and human systems is to reduce the human-induced greenhouse gas emissions and increase the sinks. For today, the most important and only intergovernmental effort that can ensure to stop the atmospheric accumulation of greenhouse gases at a level that will minimize the adverse effects of humans on the climate system is the United Nations (UN) Framework Convention on Climate Change (FCCC); United Nations Framework Convention on Climate Change (UNFCCC). Unfortunately, what was expected from the UNFCCC Kyoto Protocol (KP) was realized at a very weak level. The current (latest) climate regime that is expected to reduce / control greenhouse gas emissions and continue the climate change combat in the post-Kyoto period is the Paris Agreement adopted in December 2015. Even though the Paris Agreement entered into force in a very short time like a year, the implementation rules of this agreement, which included very weak targets and 'obligations' at the beginning, and vital financial mechanisms such as the Green Climate Fund could not be put into practice. The global COVID-19 pandemic has further weakened the hardly standing (not progressing) Paris climate regime despite all climate diplomacy initiatives and efforts. The Conference of the Parties (COP), which is planned to be held in December 2020, has been postponed to December 2021, which in turn caused the postponement of nationally determined contributions (NDCs), in other words, optional-voluntary declarations of intent foreseen to be made every 5 years, the revision of other related issues or the submission of new national plans and targets for a year, thereby creating a serious loss and weakness in the process of combating the climate change.

2. Paris Agreement

Prof. Dr. Murat Türkeş

The Paris Agreement, which was adopted on 12 December 2015 by 196 Party countries at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) on 30 November-13 December held in Paris and came into force in a very short time, on 4 November 2016, is a legally binding international agreement that stipulates combating climate change, limiting global warming and all developed and developing countries making contribution to this combat under the UNFCCC.

The Paris Agreement does not impose numerically binding obligations on the subjects of "reducing or stopping the dangerous human-induced impact on the global climate system" and "reducing or limiting the emissions of greenhouse gases that cause climate change" on the Parties to limit, stop or reduce the emissions of greenhouse gases in a certain period according to a specific reference year. On the other hand, the most important output of the Paris Agreement in this context is the regulation of "voluntary, optional or intended" actions and obligations to limit climate change below dangerous levels (below 2 °C or 1,5 °C). For example, it is seen as a turning point in terms of ending the "everything is as it is today" approach in the energy sector and industries. In this context, their future investments must be competitive in terms of "zero or very low carbon world".

The Paris Agreement constitutes a sustainable legal and open regime in which all Parties can have 'voluntary, optional or intended' obligations aimed at reducing greenhouse gas emissions and managing the effects of climate change. In this context, there are circles who believe with an optimistic point of view that they can shape their climate actions and obligations that may last for decades in the future. It is considered that it brings together these long-term climate actions and obligations on a legal intergovernmental and international platform.

Although the Republic of Turkey signed the Paris Agreement in Paris in December 2015, it has not yet passed a confirmation from Parliament of an Approval/ Ratification/ Acceptance certificate to date and has not become a party legally to the UNFCCC Paris Agreement. On the other hand, as it has not yet ratified the Paris Agreement even though it may exhibit such a view of not giving enough support to the global transformation that has achieved acceleration with the Paris Agreement, Turkey is reviewing its policies in almost every area of combating climate change by adhering to sustainable development principles and is progressing on the way to improve its legal, institutional and economic system the context of new climate economy in recent years.

3. United Nations 2030 Agenda and Sustainable Development Tools

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

At the United Nations Sustainable Development Summit held in 2015, in the light of the experiences gained from the sustainable development process initiated with the Millennium Development Goals, it was pointed out that it was necessary to determine inclusive and sustainable development goals that will provide solutions to the current problems of our world and "2030 Agenda for Sustainable Development" has been accepted with the signature of 193 member countries. The Sustainable Development Goals (SDG 2030), consisting of 17 goals and 169 targets, have been defined in the 2030 Agenda document. This new global agenda requires the shaping of the development plans and policies of countries with an understanding that emphasizes the principle of human rights for all by 2030.

Sustainable Development Goals are aimed to promote combating poverty at the global scale, ensuring food and water security, meeting many social needs such as education, health, social protection and unemployment, using reliable and sustainable energy resources, making cities and human settlements safe and durable, creating durable infrastructures, protecting natural resources and ecosystems, reducing the loss of biological diversity, providing economic growth, reducing inequality, preventing income inequality, ensuring social peace and ensuring global partnership and a road map is being defined for all countries to achieve these global goals. This document addresses the Sustainable Development Goals, targets and indicators, and endeavors to explain the relationship between climate change and SDG.

4. EU Adaptation Strategy and Information Sources for Adaptation to Climate Change

Prof. Dr. Ayşe Gül Tanık

Adapting to the effects of climate change is described as ensuring that the people's livelihoods, economies and natural systems are affected less by the changes due to climate and in some cases benefit from adaptation. Climate change adaptation is the actions and measures taken to help societies and ecosystems cope with the changing climate conditions. In other words, adaptation to climate change is the process of strengthening, developing and implementing strategies to combat the effects of climate events (risks), gain benefits from them and manage their effects. The main purpose of all documents prepared by the European Commission is to ensure that the regions of Europe that will be affected by climate change are prepared for it and to determine the priorities for the first and basic actions at the society level. In this context, various documents have been published and adaptation has been planned.

The aim of the EU adaptation strategy is to create a basic framework to minimize the effects of climate change and to ensure that the EU countries act together within this framework. In November 2013, the European Parliament and the European Council set the targets to be achieved by 2020. The action program consists of nine priority goals that are required by the EU and desired to be achieved by 2020. The 6 steps of the adaptation support tool are given on the Climate-ADAPT web page. They are; (i) Preparing the region for adaptation, (ii) Making risk and sensitivity evaluation for the climate change, (iii) Determining adaptation options, (iv) Evaluating adaptation options, (v) Implementation, (vi) Monitoring and development. Information and actions to be taken about Human, Animal, and Plant Adaptation, Forest Adaptation, Infrastructure Adaptation, Marine Adaptation are also conveyed.

5. Climate Change Adaptation

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

In adaptation to climate change, it is aimed to determine the adaptation options that can transform the effects of climate change into opportunities by taking appropriate measures in ecological, social and economic terms in order to anticipate the negative effects of climate change, to prevent or reduce the damage caused by these effects and to strengthen the climate resilience. Adaptation actions are of vital importance to address the consequences of climate change in terms of vulnerabilities before and after the disasters. Adaptation and mitigation actions are not alternatives to each other, but they are complementary elements. Adaptation often includes solutions produced at a local scale to climate change.

This document defines the general framework for adaptation to climate change. Adaptation to climate change has an inclusive and multi-component structure that includes all sectors and thematic areas. In this integrated approach, it is important to create a setup that works in integration with each other. Adaptation to climate change is a learning process by application. In order to achieve results from joint efforts on climate adaptation, it is required to make the adaptation strategies priority targets, to develop them by constantly taking into account current conditions, and obtain support from all segments of the society. Regular monitoring and evaluation of the effectiveness of adaptation actions, making changes when necessary, sharing experiences and increasing the widespread effect are very important for the success of the adaptation process.

6. Climate Change Adaptation Planning Matrix For Adaptation Planning

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

Solutions specific to local circumstances are developed in climate adaptation planning. There are different matrices developed for adaptation planning. Adaptation planning includes identification of impacts and damages, analysis of risks and vulnerabilities (determination of climate resilience and adaptation capacity), identification of adaptation actions (research of options), evaluation of adaptation actions (determination of priorities) and preparation of adaptation plan, implementation of the plan (taking action) and monitoring and evaluation stages. Climate adaptation planning is a learning process; it must have the flexibility to allow feedback and changes to be made depending on time and conditions. In this booklet, adaptation planning process and the matrices used in planning are explained within the scope of the vulnerability to climate change of natural and cultural assets in a city sector.

7. Local Climate Change Adaptation for Municipalities Public Vision of Climate Resistant

Prof. Dr. Elif Çolakoğlu

Today, in the face of natural disasters and crises caused by the changing climate, not only the people themselves, but also the infrastructure such as the transportation networks, energy, water and sewage transmission lines and food distribution systems in the cities that constitute their living spaces can directly sustain damage. Although the level of intensity may be the same, the strong and resilient urban infrastructures of countries struggling with the changing climate enable them to struggle against similar situations more strongly and control these disasters as much as possible. In order to keep the greenhouse gases that cause climate change at a level that will allow the climate system to function properly in residential areas, the cities of today make the inventories of greenhouse gases and plan energy, agriculture and water resources in line with the determined reduction targets and manage their living spaces accordingly. As examples of good practice, the managers of successful cities can protect their cities from the hazards of climate change as much as possible by increasing the resilience of their living spaces with their plans and infrastructure investments that include standards regarding prevention, preparedness and response, and thus they can defend against an overheated or overcooled world. These cities, on the one hand, improve the quality of their life by increasing the quality of the services they offer to the citizens every day, and on the other hand, they can ensure the continuity of their growing economies by protecting their environmental values. While doing this, cities are aware of the fact that it is very difficult for them to achieve complete success in tackling this global problem on their own at the local level, and they become more effective by showing a coordinated approach and action at the global, regional and national level.

This study describes the struggle of these climate change-resilient and low-carbon cities and their administrations in urban planning actions and strategies in general. It is discussed in this context how cities incorporate their climate policies into their sustainable development strategies and policies in sectors such as energy, transport and agriculture with less emissions.

9. Sector-Specific Adaptation Strategies: Tourism

Prof. Dr. Mehmet Somuncu

The tourism sector is the main source of foreign currency for most developing countries and is critical for their economies due to reasons such as the rapid increase in its share in the economy of countries, the high employment opportunities it provides, directly and indirectly, its interaction with many sectors and its multiplier effect on these sectors. According to the data provided by the United Nations World Tourism Organization (UNWTO), despite the occurrence of negativities that may affect tourism from time to time such as wars, economic problems, epidemics and political problems between countries, the number of people participating in international tourism and expenditures and investments increased continuously since 1950. Consequently, the tourism industry has developed significantly.

It is known that climate change has widespread consequences for tourism businesses and destinations. At the destination level, the magnitude of the impact of climate change depends on the importance of tourism in the regional economy, the characteristics of climate change and its impact on the natural environment, the adaptation response of the tourism sector and how it interacts with other long-term factors affecting the effects of climate change in the tourism sector such as globalization and economic fluctuations, fuel prices, aging in industrialized countries' populations, increased travel safety and health concerns, increased environmental and cultural awareness, advances in information and transportation technology, and environmental constraints. It should not be assumed for any destination not to be affected by climate change (UNWTO and UNEP, 2008). Considering that the direct and indirect impacts of climate change on the tourism goals are largely negative, it is in the industry's interest to actively contribute to both adaptation and mitigation. Since the existence of the tourism sector is based on nature, and especially climate, it is exposed to the effects of climate change more than other sectors. Therefore, adaptation holds vital importance for the tourism industry. IPCC (2007) states that the need for adaptation to climate change is inevitable for societies around the world and economic sectors such as tourism.

Climate change adaptation should be considered as a part of studies and efforts at the national level. In this respect, the national climate change adaptation strategy documents and the action of bringing the targets of these documents into action are important in terms of contributing to the coordination of the adaptation activities.

10. Sector Spesific Climate Change Adaptation Strategies: Energy

Prof. Dr. Levent Aydın

In dealing with climate change adaptation strategies in the energy sector, the conceptual framework of adaptation to climate change and reduction of greenhouse gases is drawn and the basic differences between these two concepts are revealed. The reason for this is that, although the energy sector is a key sector for mitigation, it must be a structural component of adaptation plans and strategies. After explaining the effects of climate change and the necessity of adaptation in energy services that became vulnerable, the effects of extraordinary weather conditions on energy production, distribution, transmission and consumption are explained. The potential vulnerabilities of nuclear, thermal and hydraulic power plants to each climate change impact and the adaptation options that can reduce or eliminate this vulnerability are presented as examples. Finally, the main factors that should be included in the creation of the adaptation plan and strategy in the energy sector are explained.

11. Economic Cost Analysis and Financing of Adaptation To Climate Change

Prof. Dr. Levent Aydın

Economic analysis of adaptation to climate change and financing of adaptation and financial resources are discussed in two separate sections. After discussing how to support climate change adaptation decision-making in the economy and the content of this support, the basic steps in the economic analysis of climate change adaptation are discussed. Each step is explained in detail with the help of diagrams. Then, micro and macroeconomic evaluations of some selected sectoral and regional sample projects are made. In the second section, an overview of the most suitable financing resources is displayed by evaluating the state of the financing environment of adaptation. The ways to develop strategies for accessing adaptation funding are also described.

12. Sector-Specific Adaptation Strategies: Industry

Prof. Dr. Erdem Görgün

Industrialization has saved millions of people around the world from poverty and created employment; it has increased social welfare by using advanced technology. In addition to the fact that the limited resources of the world are being used to a great extent with the increase in industrialization, the increase in industry-based emissions also have serious effects on the environment; the most effective of these effects on humanity is the climate change. Energy efficiency is one of the strategies for adaptation to climate change in the industry sector, which is the largest sector in terms of energy consumption.

Adaptation in the industrial sector is achieved by taking measures against factors that are expected to rise due to climate change and that directly affect production and competitiveness adversely. In this context, the most important methods that will accelerate the adaptation process in the industry are the application of Best Available Techniques (BAT), the adoption of cleaner production methods, and industrial symbiosis. In order to make the climate change adaptation strategies widespread more effectively, governments need to encourage integrated adaptation planning and adopt intersectoral planning.

13. Tools And Methods For Adaptation Decision-Making Mechanisms Processes

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

Climate change adaptation is a risk management strategy that is affected by many factors. Since it is not technically and economically possible to implement adaptation actions for all climate impacts and risks at the same time, adaptation actions should be prioritized according to their importance and requirements. Determining adaptation options enables the evaluation of adaptation options that take into account risks and opportunities in key issues.

Various assessment tools and methods including measurable parameters are used to find the most appropriate solution for climate risks in adaptation to climate change. The parameters used in the classification of adaptation options vary according to the subject to be evaluated, the indicators and the characteristics of the data that can be used. Metrics are used to determine adaptation requirements in the adaptation process, as well as to evaluate the effectiveness of adaptation actions and to test whether adaptation goals are achieved.

In this booklet, the methods used in the adaptation decision-making process and the tools for evaluating the effectiveness of adaptation are explained in the example of vulnerability analysis (determination of exposure, sensitivity and adaptative capacity) for determining coastal vulnerabilities in a coastal city.

14. Sector Specific Adaptation Strategies: Health

Prof. Dr. E. Didem Evci Kiraz

In order to ensure the adaptation of the health sector to the impacts of climate change, the adaptation and perspective of public health must be changed. In public health, which is a science and art branch; it is necessary to reduce the expected health impacts, to be prepared for the unexpected, to make flexible, short and long term goals, strategies and action plans, to make planning focused on determinants of health, and to blend research perspectives, scientific and institutional approaches that can change at the same pace with the changing of the climate. In public health, a decision cannot be reached without measuring and the health system cannot be managed without measuring. In addition to measurement systems, complementary elements such as conducting scientific studies and increasing the knowledge and awareness of the individual should be developed.

In the adaptation mechanisms of the health risks of climate change, infrastructure studies take the first place, while adaptation studies take the second place. The most common adaptation studies in countries are capacity building, knowledge generation, management, planning and policymaking, warning or observation system, implementation and behavior. Considering the progress made by the countries of the world in terms of climate change and health adaptation studies, it is considered that it would be appropriate to group the countries as "those with and without public health adaptation plans" in classifying them as "countries that have gained not gained resilience to climate". It can be said that the way to increase the resilience to the climate in the health sector is a public health perspective.

15. Sector Specific Climate Change Adaptation Strategies: Transportation

Prof. Dr. Cem Soruşbay

The transportation sector is a sector that must be designed in accordance with local weather conditions and climate; it has a high vulnerability to changing climatic conditions and it is also under the influence of some other sectors. Although transportation systems are generally designed based on information based on past experiences and data on the subject by taking into account extreme weather conditions, data obtained in the past may lose their validity as a result of the climate change. For this reason, various scenarios related to climate change should be developed, and the best, worst and average situation projections should be made and action plans should be prepared for each situation.

Measures to be taken against climate change are carried out, in the general sense, within the scope of interrelated mitigation and adaptation studies. Regarding the transportation sector, the issues that come to the forefront in the climate change adaptation actions and policies are; making the society and institutions more conscious and more prepared against the risks arising from climate change, appropriate development of tool/equipment technologies, improvement of infrastructure investments, realization of planning in accordance with the climate and similar considerations. In this process, in determining the strategies, the costs of adaptation studies should be taken into account and dynamic processes should be defined. It is of great importance to developing action plans for the transportation sector, especially in coastal areas and areas prone to extreme climatic conditions.

16. Sector-Specific Adaptation Strategies: Construction and Infrastructure

Prof. Dr. Erdem GÖRGÜN

Rapidly developing economies bring along more use of the resources. As a result of the increase in production and consumption as a result of changing consumption habits, human beings are more and more exposed to "climate change" and its effects. Extreme climatic events that are the results of climate change cause major economic and social impacts. The infrastructure (buildings, transportation, energy and water supply) sector is also affected by climate change in this context and this situation poses a separate threat to densely populated locations.

Adaptation can be defined as adjustments aimed at reducing the level of vulnerability in natural systems or human systems to actual or predicted climate change and variability or taking advantage of the opportunities. Buildings can be vulnerable to climate change. In the future, more extreme climatic events could lead to consequences such as collapse/ruin, flooding, deterioration of indoor climate and shortening of building a life and significant risk of loss of life and value. Adaptation measures need to be taken to increase climate resilience in the construction and infrastructure sector. Green Building and Green Infrastructure applications can be given as examples of these measures. These types of buildings are structures that provide environmental, economic and social benefits and aim to slow down the effects of climate change.

Combatting climate change at the local level is at an early stage in Turkey, where the construction sector has an important place in the economy. Even though the issue of reduction receives relatively limited interest within the scope of this combat, it is required to accelerate the works on climate change adaptation in Turkey.

17. The Relationship Between Climate Change Adaptation and Development

Prof. Dr. Mehmet Somuncu

Development is a structural improvement and a local and social balanced improvement process, which can be implemented under the economic, social, cultural and environmental conditions of countries, regions and communities. Unlike the phenomenon of economic growth, development can be expressed as a process of change that can be measured and monitored with indicators related to changes in the composition of production elements and quality of life, as well as increases in the production elements and therefore in production. In this sense, the concept of development encompasses the meaning of the progressive improvement of the economy and the society and the primary goal of development is the fulfillment of needs and expectations of humanity (WCED, 1987).

Scientific evidence suggests that climate change is a serious global threat and requires urgent global intervention. It is also a fact that the benefits of acting vigorously and early in the fight against climate change and the benefits of these actions far outweigh their economic costs. Climate change currently affects fundamental aspects of life for people around the world, and as the magnitude of the impact of climate change increases, the adversities to be experienced will also increase, especially in developing countries and countries that are more exposed to climate change. There will be difficulties in accessing other natural resources, particularly water, and difficulties will be experienced in food production and supply. Consequently, health conditions as well as other environmental conditions will deteriorate. As the earth continues to warm, hundreds of millions of people may suffer famine, water shortages and floods. Countries that are already facing various difficulties in terms of development will be affected with all of these risks more severely.

Based on evaluations conducted with results from official economic models, it is estimated that the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year forever if the necessary action is not taken. Considering a wider range of risks and impacts, the estimates show that the damage can rise up to 20 % or more of GDP (Stern, 2007). Therefore, it can be safely said that there is a direct relationship between adaptation to climate change and development. For instance, actions such as reducing greenhouse gas emissions to avoid the most severe effects of climate change are likely to limit costs to around 1% of global GDP each year.

The problems and/or opportunities regarding development and climate change are intertwined and they need be addressed together. For example, water availability, agricultural and industrial production, and employment affect means of livelihood that are dependent on natural resources and overall quality of life. With this perspective, it is required to consider sustainable development in the most general framework and climate change in particular in development approaches (plans and strategies). Climate change vulnerability depends not only on climate change, but also on the chosen development approach and the ability to adapt to changes faced.

18. Scope, Types and Methods of Adaptation to Climate Change

Assoc. Prof. Dr.. Çiğdem Coşkun Hepcan

Climate adaptation ensures that ecosystems, natural resources, cultural assets, society and individuals are protected, the economy becomes resilient and the potential opportunities caused by climate change are exploited by managing the risks arising from the effects of the climate change.

In adaptation to climate change, it is aimed to avoid exposure to climate risks, to accept the impact, to overcome the losses caused or to be caused by the risks, to balance the risks by sharing, to produce solutions by using new approaches, to develop approaches that will turn changing climate conditions into opportunities and to increase climate resilience. Adaptation includes solutions developed based on a climate impact that has already occurred (effective adaptation) or on forecasts for a potentially climate effect that has not occurred yet (preventive adaptation). Adaptation types and methods are determined specifically for the area for which solutions are to be produced, taking into account the climate risks and the needs arising from the vulnerabilities against these risks. Adaptation is basically classified as hard adaptation (structural adaptation) and soft adaptation (social and institutional adaptation). Structural adaptation includes engineering-based and nature-based solutions. Soft adaptation defines the non-structural adaptation actions developed against the effects of climate change and includes the political, legal, social, administrative and economic measures taken to improve adaptation capacity and increase resilience.

In this document, adaptation types in various scales and details developed for different climate effects are discussed in terms of their scope and content, and their activities are explained with examples. In addition, nature-based solutions focusing on the purpose of adapting to the climate by gaining ecological, social and economic benefits to increase climate resilience in cities are emphasized.

INTERNATIONAL CLIMATE AGREEMENTS: THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE AND KYOTO PROTOCOL

Prof. Dr. Murat Türkeş

1. INTRODUCTION

The most important consequence of the greenhouse effect that got stronger due to the accumulation of the main greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and dinitrogen monoxide (N_2O) in the atmosphere, which has rapidly increased since the industrial revolution due to various human activities, is to generate an additional positive radiative forcing on the energy balance and make the world climate warmer and more variable. On the other hand, whether on a global or regional scale, climate change causes significant changes in the frequency, severity, spatial distribution, length and timing of extreme weather and climate events.

The effects of climate change will increasingly reshape our security and peace in the years to come. Our present physical geographical conditions and our physical environment are in a transition phase today and show important indicators of how the future functions of societies will be. This could be reflected in serious social, economic and political impacts for all regions. While countries with varying adaptation capacities can address the effects in different ways, many developing countries and vulnerable states (small island and low-coast countries, arid climate countries, etc.) without effective, experienced and determined institutions are affected more by the climate change. This situation is likely to get stronger in the future.

The urgency and complexity of climate change issues require creativity in diplomatic processes. Within this framework, climate change diplomacy can be defined as a multidisciplinary field based on input from a wide variety of disciplines such as science, technology, political processes, laws, ethics and philosophy. Although climate change is a global issue that goes beyond national boundaries, it should be addressed at all levels ranging from individual to United Nations at local, national, regional and global levels. Furthermore, climate diplomacy needs to be a multilateral and participatory diplomacy. Therefore, although states have to take a leading role in addressing climate change issues, other actors including civil society, business and academia are also essential stakeholders in this process.


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2. A BRIEF HISTORY OF THE FIRST INTERGOVERNMENTAL ATTEMPTS AND CLIMATE DIPLOMACY FOR THE PROTECTION OF THE GLOBAL CLIMATE

In fact, the greenhouse effect, global climate change and the issue of global warming, which began to attract the attention of the society in the last 25-30 years, have been known and studied by scientists for over a century (Türkeş, 1995a). The possibility of climate change due to the change of carbon dioxide (CO_2) accumulation in the atmosphere was first predicted by the Swedish Nobel Prize winner S. Arrhenius in 1896. However, despite the passage of years, the world waited until 1979 to take the first international serious step regarding the adverse effects that the increased CO_2 accumulation (concentration) in the atmosphere may cause.

The importance of the issue was brought to the attention of the countries of the world at the First World Climate Conference held in 1979 under the leadership of the World Meteorological Organization (WMO) and in summary the following was stated: "If society's long-term dependence on fossil fuels as the main energy source and deforestation continue in the future, it seems likely that the accumulation of carbon dioxide in the atmosphere could increase substantially. Our current knowledge, which enables us to understand climate processes, shows that this increase in CO_2 accumulation can lead to significant and possibly long-term changes in the global climate. The removal of CO_2, which is added to the atmosphere by human activities, from the atmosphere by human activities, is a slow developing process and therefore the climatic consequences of increasing CO_2 accumulation are also effective for a long time."

International events following this conference reinforced the need to investigate the effects of increasing CO_2 on the global climate system and regional climates and the carbon cycle within the common atmosphere-ocean-biosphere system and the socioeconomic consequences of these effects. The work meetings (workshops), seminars and symposiums attended by a large number of scientists not only reinforced the thoughts of 1979, but also created a scientific consensus environment that is rarely seen in the world on the threat posed by global warming (Türkeş, 1995b).

Table 1: Important milestones and developments in the process of international and intergovernmental negotiations on climate change in the period 1979-2020 (Updated and rearranged according to Türkeş 1995a, 1995b, 2001a, 2001b, 2006a, 2006b, 2008, 2009, 2010, 2012a, 2012b, 2017, 2021 and, Türkeş and Bilir 2013)

Work / Action / Activity / Process	Major Conferences, Arrangements, Agreements and Developments
Scientific and technical evaluation and information studies	• WMO World First Climate Conference (1979) • Villach Climate Change Conferences (1985 and 1987, Villach) • Toronto Changing Atmosphere Conference (1988, Toronto) • Establishment of WMO / UNEP IPCC (1988) • IPCC 1st Assessment Report (December 1990, Geneva)
Preparation for a legal intergovernmental framework climate regime	• UN Global Climate Protection Resolution (December 1988, New York) • Noordwijk Ministerial Conference (November 1989, Noordwijk) • WMO World Second Climate Conference (October-November 1990, Geneva) • UN Intergovernmental Talks on Climate Change (1991-1992, in various cities around the world, mostly in Geneva)
Action strategies aimed at a framework climate agreement that will form the basis for the legal climate regime	• UN Conference on Environment and Development (June 1992, Rio de Janeiro) • Adoption of the UN Framework Convention on Climate Change (UNFCCC, June 1992, Rio de Janeiro) • UNFCCC enters into force (March 1994, New York) • UNFCCC Berlin Directive (April 1995, Berlin)
Legal liability objectives	• Adoption of UNFCCC Kyoto Protocol (December 1997, Kyoto) • FCCC Buenos Aires Action Plan (November 1998, Buenos Aires)
Legal obligations enforcement activities (Kyoto rules)	• UNFCCC Bonn Political Agreement (July 2001, Bonn) • FCCC Marrakech Accords (November 2001, Marrakech) • UNFCCC Montreal Conference Resolutions (November-December 2005, Montreal)

Work / Action / Activity / Process	Major Conferences, Arrangements, Agreements and Developments
Enforcement of legal greenhouse gas obligations	• UNFCCC Kyoto Protocol enters into force (February 2005, New York)
Establishing a post-Kyoto legal climate regime, Determination of greenhouse gas obligations and Stopping the global warming at 1,5 °C	• UNFCCC Bali Action Plan / Roadmap (December 2007, Bali) • FCCC Bangkok Climate Change Talks (March-April 2008, Bangkok) • UNFCCC Copenhagen Accord (December 2009, Copenhagen) • FCCC Cancun Agreements (December 2010, Cancun) • UNFCCC Durban Agreements (December 2011, Durban) • FNCC CP Doha Corrections (December 2012, Doha) • UNFCCC Warsaw Mechanisms (November 2013, Warsaw) • Adoption of UNFCCC Paris Agreement (December 2015, Paris) • UNFCCC Paris Agreement enters into force (November 4, 2016)

The meetings held in Austria Villach in 1985 and 1987 and in Toronto, Canada in 1988 focused attention on the development of political options in the face of climate change for the first time. The Villach 1985 Meeting was titled "International Conference on the Assessment of the Role and Effects of Carbon Dioxide and Other Greenhouse Gases on Climate Change". At the Toronto Conference on Changing Atmosphere held in 1988, it was proposed as an international target to reduce global CO_2 emissions by 20% by 2005 and to prepare a framework climate agreement to be developed with protocols.

In December 1988, the UN General Assembly adopted resolution 43/53 on "Protection of the Global Climate for the Present and Next Generations of Man" with the initiative of Malta. In the decision, the global climate was described as the common heritage of human beings and climate change as the common problem

In November 1989, a Ministerial Conference was held in Noordwijk, the Netherlands on Atmospheric and Climatic Change. At this meeting, even though most of the countries other than the United States of America (USA), Japan and the former Union of Soviet Socialist Republics (USSR) supported a 20% reduction of CO_2 emissions globally, a specific target or schedule for reducing greenhouse gas emissions could not be set.

The step before the last from the perspective of the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in June 1992, in other words, from the perspective of talks for founding a global climate change agreement or a legal intergovernmental climate regime is the Second World Climate Conference held in Geneva, Switzerland, between 29 October and 7 November 1990. At the Second World Climate Conference, organized under the leadership of the World Meteorological Organization, the Second World Climate Conference Ministerial Declaration, whose main issues are climate change and greenhouse gases, was approved by 137 countries, including Turkey (Türkeş, 1995a). Both the Conference Conclusion Statement and the Ministerial Declaration were of historical significance for the urgent initiation of negotiations on a climate change framework agreement to be opened for signature at UNCED. In these documents, measures to reduce the accumulation of greenhouse gases in the atmosphere are advocated. Moreover, it was emphasized that uncertainties on the subject should not be used to delay the actions required to minimize the adverse effects of the climate change. Regarding the reduction of greenhouse gas emissions, two articles in the Conference Conclusion Statement are remarkable (Türkeş, 1995b):

- “These emissions are expected to change the planet's atmosphere and climate, and there is a definite scientific consensus on the extent to which this change may occur. Net CO_2 emissions must be reduced by 1-2 percent annually, on a global scale, continuously, to stop atmospheric carbon dioxide accumulation at about 50 percent above pre-industrial levels by the mid-21st century. A 15-20 percent reduction in methane emissions will stop the accumulation of this gas in the atmosphere.”
- “This Conference believes that the technical and economic means required to reduce CO_2 emissions are available in all countries. Developed countries, with the potentials they have, can stop CO_2 the emissions from the energy sector and reduce them by at least 20 percent by 2005. Measures should include efficient use of energy and increases in the use of alternative energy sources. Furthermore, carbon capture can be increased by preventing current forest losses. The economic and social costs and benefits of such measures should

be examined urgently by all nations. Joint assessment at the international level should be carried out through the IPCC."

To address this new situation, in addition to traditional measures of climate change combat and adaptation, a new profile of climate diplomacy is evolving in a manner to benefit from a full policy mechanism including development cooperation, conflict prevention efforts and humanitarian aid, etc. These new approaches in foreign policy are well beyond the traditional world of climate policy. The transition from risk analysis of climate-related hazards to timely preventive action and management plans requires substantial commitments to integrate climate change concerns into development, foreign policy and security policies. Such a new foreign policy process and approach will also contribute to the execution of the climate agreement (UNFCCC Paris Agreement) concluded in Paris in December 2015. In fact, this approach has begun to play an important role in overcoming the long-term divide or divergence between developed and developing countries.

The first real emergence of intergovernmental 'climate diplomacy' is related with the publication of the first evaluation report of Intergovernmental Panel on Climate Change (IPCC) in 1990 and with the work of the Intergovernmental Negotiating Committee (INC), which was commissioned by the UN to prepare a framework agreement on climate change just after the Second World Climate Conference held in Geneva on 29 October-7 November 1990, which continued until June 1992 in Rio (Table 1). In the INC process, which initially consisted mainly of diplomats at various levels from the foreign ministries of countries, representatives of the environment or relevant ministries, representatives of national meteorological and hydrometeorology organizations of WMO member countries and IPCC delegates, representatives of developed and developing countries found the opportunity, albeit quite weak, to attend in international climate negotiations from the very beginning.

In this period, many developing countries such as the People's Republic of China (PRC) and India etc. have seriously put forward and defended the North-South equality problem and the historical responsibility of developed countries and so on, as in other global treaties such as the depletion of the ozone layer, etc. Developing countries believe from the very beginning of the process, that it is necessary for developed countries to take responsibility for 'human-induced' (anthropogenic) climate change, and therefore to provide financial and technological assistance to developing and underdeveloped countries in order to facilitate climate change mitigation and adaptation.


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3. UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

United Nations Framework Convention On Climate Change (UNFCCC), is the last and most important initiative to keep greenhouse gas emissions at a certain annual level or to reduce them at a desired rate up to a specified year, in terms of the period when action strategies to prevent climate change and legal obligations to reduce greenhouse gas emissions are discussed. As we briefly explained in the previous section, the preliminary preparations of the UNFCCC were carried out by the Intergovernmental Negotiation Committee of the Climate Change Framework Convention (FCCC/INC), which was formed by the UN General Assembly decision dated December 21, 1990 (Table 1). Until June 1993, 166 countries and the European Community (EC) signed the UNFCCC, which was opened for signature at UNCED in June 1992. In accordance with the relevant provisions of the Convention, the ratification or acceptance document of 50 countries must be submitted to the UN for the Convention to enter into force. Until February 1994, more than 50 countries submitted their ratification or acceptance documents to the UN and the Convention entered into force on March 21, 1994. According to the current information shared on the official website, 197 countries have become a party to the UNFCCC, which is considered the most important intergovernmental effort that can reduce human-induced greenhouse gas emissions (CO_2, CH_4, N_2O, etc.) on a global level (https://unfccc.int/about-us/about-the-secretariat; access, 23.02.2021).

In outlines, the UNFCCC regulates general principles, action strategies and obligations to protect the global climate and reduce greenhouse gas emissions (Table 1). The basic obligation of developed countries under the UNFCCC can be summarized as keeping human-induced greenhouse gas emissions at 1990 levels until 2000 (Türkeş et al., 2000). The ultimate goal of the UNFCCC (Article 2) is identified as "To achieve to stop the accumulation of greenhouse gases in the atmosphere at a level that prevents the dangerous effects of human on the climate system" (UNEP/WMO, 1995). Such a level should be reached in a time that allows the ecosystem to naturally adapt to climate change, food production not to be damaged and economic development to continue in a sustainable manner. In fact, these obligations fall behind the targets previously determined by some developed countries on greenhouse gas liabilities. In this form, the UNFCCC has fallen behind the 1990 Luxembourg Agreement, which aims to "keep CO_2 emissions at 1990 level until 2000" by the Toronto Conference and the European Union (EU) countries (Türkeş, 1995b).

According to the UNFCCC Article 3, in addition to other matters, the following will provide guidance to the Parties in their actions to achieve the objective of the Convention and fulfill its provisions (UNEP/WMO, 1995):

1. Parties should protect the climate system on the basis of equality and in accordance with their common but different responsibilities and powers, for the benefit of the present and future generations of human beings. Therefore, developed country Parties should take the lead in combating climate change and its harmful effects.
2. The needs and special circumstances of developing countries, especially those vulnerable to the harmful effects of climate change, and those under excessive or abnormal burden than developing countries under the Convention should be fully taken into account.
3. Parties should take preventive measures to foresee, prevent or minimize the causes of climate change and mitigate its harmful effects. In situations where there is a danger of serious or unavoidable damage, the absence of full scientific certainty should not be used as an excuse to delay these measures, taking into account that policies and measures related to climate change should be as cost-effective and globally beneficial as possible. To achieve this, such policies and measures should take into account different socio-economic contexts, should be comprehensive, should over all relevant greenhouse gas sources, sinks, reservoirs and implementation, and include all economic sectors. Efforts to respond to climate change can be carried out in cooperation with interested Parties.

4. Parties have the right to support sustainable development and they should support it. Policies and measures to protect the climate system against human-induced change should be suitable for the specific circumstances of each of the Parties and should be integrated into national development programs, taking into account that economic development is necessary to take measures to respond to the climate change.

5. The Parties should cooperate to promote an open and supportive international economic system that will lead to sustainable economic growth and development, especially in developing country Parties, so that they can better deal with climate change problems. Measures taken against climate change, including unilateral ones, should not be an arbitrary, unfair, discriminatory or a means of imposing a covert restriction on international trade.

In general, the UNFCCC prescribes three conditions for the objective of stopping greenhouse gas emissions in the atmosphere at a certain level (UNEP/WMO, 1995; Türkeş, 2001a). According to this, the stopping greenhouse gas emissions should be carried out as summarized below:

- Allowing ecosystems to naturally adapt to climate change;
- Ensuring that food production is not threatened;
- Availability of sufficient time to allow economic development to be carried out in a sustainable way.

Some important principles providing guidance for this process are specified in UNFCCC/Article 3. These can be summarized as follows:

- Equality,
- Common but differentiated responsibilities,
- Preventive approach,
- Cost-effective measures,
- The right to sustainable development,

- A transparent international economic system

In the implementation of the obligations in the 4th Article, developed country parties will take full account of what actions are required under the Convention, including the initiatives related to providing financial resources, insurance and technology transfer in order to meet the specific needs and concerns arising from the harmful effects of climate change and / or taking countermeasures for them, in particular (UNEP/WMO, 1995):

- Small island countries;
- Countries with low-lying coastal areas;
- Countries with arid and semi-arid areas, forested areas and areas sensitive to forest degradation;
- Countries with areas open to natural disasters;
- Countries with areas vulnerable to drought and desertification;
- Countries with areas with high urban atmospheric pollution;
- Countries with areas with sensitive ecosystems, including mountainous ecosystems;
- Countries whose economies are largely dependent on income from the production, processing, export and/or consumption of fossil fuels and energy-intensive products associated with fossil fuels; and
- Landlocked and transit countries;

Besides these, Parties will fully take into account the specific needs and situations of the least developed countries in their actions related to technology financing and transfer (UNEP / WMO, 1995). In fulfilling the obligations of the Convention, developed country Parties (Annex II countries) will take into account the situation of developing country Parties, in particular, whose economies are susceptible to the adverse effects of the implementation of measures against climate change. This is especially true for Parties whose economies are heavily dependent on the production, processing, export and/or consumption of energy-intensive products associated with fossil fuels and/or have serious difficulties in converting to other alternatives using fossil fuels.

In summary, the main obligations on reducing human-induced greenhouse gas emissions to 1990 level until 2000, financial resource and technology transfer are left to the Parties listed in Annex I and Annex II (Table 2) of the UNFCCC. Turkey did not become a party to for 10 years, from 1994 when it came to force to 2004, for the reasons that it was included in the developed countries at the annexes of UNFCCC, the criterion for determining these countries was being a member of Economic Cooperation and Development Organization (OECD), this criterion was against the principle of 'common but differentiated responsibility', therefore under the circumstances, it could not fulfill the obligation of stopping its emissions, especially energy-related CO_2 emissions, at the level of 1990 by the year 2000 (Türkeş, 2008, 2017).

4. TURKEY'S UNFCCC ADVENTURE

In this section, Turkey's status has been evaluated within its historical and political development in view of UNFCCC starting before the June 1992 Rio Summit, its approach to UNFCCC, its attempts for removal from the annexes of the Convention in the Intergovernmental Negotiation Committee (INC) process and in the period starting from the Kyoto up to The Hague and the present situation has been presented.

In the preparations for the Rio Summit held in 1991 and 1992 under the coordination of the General Directorate of State Meteorology Affairs (now called the General Directorate of Meteorology - MGM); it has been reported to UNFCCC that Turkey needs to be made a party to the Convention taking into account in its conditions, particularly the development level, development goals, consumption patterns and that the obligations of countries need to be determined according to their development levels, emission levels and responsibilities (Türkeş et al., 1992). In this context, it has been stated that due to the energy policy in force at that time, national resources, especially domestic lignite, were used and when compared with developed countries, energy consumption was insufficient in terms of modern living standards. In addition, it was emphasized that it is necessary to focus on resources that emit less CO_2 and more efficient combustion technologies, and the need to support energy savings by including research and development efforts. All these evaluations and opinions of Turkey revealed that its request to be a party to the UNFCCC among the developing country parties was the right approach.

Table 2: United Nations Framework Convention on Climate Change Annex I and Annex II Countries (Revised per UNEP/WMO 1995).

Annex I Parties	Annex II Parties
Germany	Germany
United States of America	United States of America
European Economic Community	European Economic Community
Australia	Australia
Austria	Austria

Annex I Parties	Annex II Parties
Belgium	Belgium
Belarus*	Denmark
Bulgaria*	Finland
Czechoslovakia*	France
Denmark	Holland
Estonia*	United Kingdom
Finland	Ireland
France	Spain
Holland	Sweden
United Kingdom	Switzerland
Ireland	Italy
Spain	Iceland
Sweden	Japan
Switzerland	Canada
Italy	Luxembourg
Iceland	Norway
Japan	Portugal
Canada	~~Turkey**~~
Latvia*	New Zealand
Lithuania*	Greece
Luxembourg	
Hungary*	
Norway	
Poland*	
Portugal	
Romania*	
Russian Federation*	
Turkey	
Ukraine*	
New Zealand	

(*) Countries in transition to a market economy.

(**) Turkey was removed from Annex II in accordance with an amendment, which entered into force on June 28, 2002 pursuant to decision 26 / CP.7, adopted in CP-7.

However, as a result of the second part negotiations of the 5th meeting of UNFCCC/ INC held in New York in May 1992 before the Rio Summit; Turkey was placed in Appendix I together with the OECD and the transition to market economies in central and Eastern European countries as well as in Appendix II with OECD countries (Table 2) (INC / FCCC, 1992). As a result, as Turkey was considered among the developed countries in the annexes of the UNFCCC, it did not sign the UNFCCC in Rio and did not become a party until 2004, due to the fact that it could not fulfill its obligations under these conditions, especially decreasing energy-related CO_2 and other greenhouse gas emissions to 1990 levels by 2000 and the financial and technological assistance obligations to developing countries etc. This position of Turkey is possible particularly with the evaluation of the energy-related CO_2 emissions and projections that constitute the essence of the convention that are given to developed countries in terms of allowed greenhouse gas emissions reduction commitments (not given here; see: DPT, 2000; TTGV, 2002; Türkeş, 2001a, 2002, 2007, vb.).

Turkey has officially stated in almost all UNFCCC/INC meetings it attended in the 1992-1995 period after Rio and subsequent UNFCCC subsidiary bodies and CP meetings that it is impossible for it to keep especially in energy-related CO_2 and other greenhouse gas emissions at 1990 levels by 2000 and it can only be a party to the Convention if it is removed from the Annexes of the Convention or certain conveniences are granted to it by taking into account its special circumstances as explained in Berlin Conference (CP-1) (Türkeş, 2001a, 2006b, 2008).

In December 1997 in Kyoto, the amendment motions given by Pakistan and Azerbaijan for removal of Turkey from the annexes of the UNFCCC and the amendment have not been accepted by the US and the EU. At that stage, Turkey was expected to accept a voluntary obligation relating to emissions. In those years, USA, Canada, Australia etc. some OECD member Parties and some EU country Parties stated that they appreciated Turkey's request for being removed from the annexes of the Convention. However, these countries, too, wanted Turkey to assume voluntary obligation. Despite all efforts and expectations of Turkey, its request to be removed from the annexes of the Convention was not accepted in UNFCCC's CP-4 meeting held in Buenos Aires in 1998 and CP-5 meeting held in Bonn in 1999 mainly as a result of the objections by USA and EU and was postponed to CP-6 held in November 2000 (The Hague Conference) (Türkeş, 2001b, 2008).

Turkey attended The Hague Conference, held in November 2000, with a new proposal stating that it wanted to be recognized as an Annex I party on condition that it is removed from Annex II and joins UNFCCC with special conditions or it is given the same flexibilities as given to countries whose economies are in transition. Even though Turkey's request was supported by Pakistan and Kazakhstan, it was not accepted once again. Conference Chairman Jan Pronk has announced the results based on their ongoing consultations and invited the parties to consider Turkey's request for change in the 14th meeting of Subsidiary Body for Implementation (SBI) that will be held in mid-2001 to form the basis for the actual decision at CP-7.

In reality, there are many articles and paragraphs in the UNFCCC related with the reasons for Turkey's request for removal from the Annexes and support these reasons. They were in support of Turkey's views on that date. These articles can be summarized by establishing the connection with the 'special conditions' that form the basis for Turkey's request for removal from the annexes:

Turkey's geographical location and the risk of drought and desertification it is facing due to its physical geography, natural disasters, fragile ecosystems, high levels of dependence on fossil fuels in the economy and in energy production and similar special conditions could have been explained by referring to the paragraph 4.8 of the Article of Obligations.

Furthermore, the difficulties of the developing countries, and among them of Turkey, whose economies are dependent on fossil fuels and energy-intensive productions, which will have difficulties in transition to alternative fuels, in meeting the obligations of the Convention, especially reduction of emissions, have been taken into consideration in general in paragraph 4.10 of the Article of Obligations

On the other hand, the special conditions and different responsibilities of the Parties were included in the 'Berlin Mandate' document adopted in CP-2 (FCCC/CP/1995/L.6, 1995) (Türkeş, 1995b, 2001a). As is known, Turkey's problems with the Convention did not only arise from the Convention itself. As a scientist working at MGM and the technical staff managing the process at that time, detailed suggestions prepared by us were presented to the relevant boards and ministries in due time. For example: "Similar problems exist for the 'a voluntary and weak target to limit or control the emissions', which is foreseen for Turkey in Kyoto Protocol (KP). For this reason, it would be beneficial for Turkey to take into consideration the I.1.c and I.1.d articles of the Berlin Mandate. In these articles, it has been emphasized, respectively, that developing countries need to sustain economic growth and eradicate poverty, that they have the right to sustainable development and they have to support it; that the largest share of historical and current global greenhouse gas emissions is in developed countries and the share of developing countries in global emissions, whose per capita emissions are still relatively low, will grow until their social and development needs are met" (Türkeş, 2001a).

4.1. Turkey's Requests for Removal from the Appendices of UNFCCC and their results

Turkey followed the UNFCCC process quite effectively since the beginning, emphasized that it is impossible for it to hold especially energy-related CO_2 and other greenhouse gas emissions at 1990 levels until 2000 in the meetings and reiterated its request that it can be a party to UNFCCC provided that it is removed from both annexes (Türkeş, 1995b, 2001a, 2001b, 2002, 2008, vb.).

Turkey's position on the UNFCCC showed a relative difference for the 1992-1997 (up to Rio to Kyoto) and 1997-2000 periods (Türkeş, 1995b, 2001a, 2001b, 2008, etc.). In a nutshell, Turkey's main position in 1992-1997 period was to be removed from the annexes of the Convention and to become parties to the UNFCCC only under these conditions. Its position in the 1997-2000 that began in Kyoto can be summarized as a softer approach that also included removal from the annexes of the Convention, but at the same time negotiations that explore against Turkey's problem against the Convention and concrete ways to be involved in this process, compared to the previous period. For example, even if it does not involve a very objective and realistic greenhouse gas control or reduction goal, keeping them under an 'everything as it is today' ('business as usual' – BAU) scenario until a specific target year or obligation period, or setting some control / mitigation target on the basis of the OECD average, etc. Furthermore, a National Climate Change Report (ME, 1998) was officially distributed in the CP-4 held in Buenos Aires in this period in November 1998, which can be a substitute for a voluntary National Declaration (Türkeş, 2001a, 2001b).

The common feature of the two periods outlined above was that Turkey was unwilling to become a party to UNFCCC without creating appropriate conditions considering under the 'common but differentiated responsibilities' principle by taking into account its particular circumstances.

With its the initiative at The Hague Conference, Turkey stood before the international community, therefore joined the negotiations process with a relatively different or partly amended approach. This new approach was in the form of "to be removed from Annex II", "to become a party to the Convention in case the same conveniences are granted to it as those granted to former socialist countries in the transition stage to market economy", and "continue with the negotiations on the subject of postponing the obligation of numerically reducing the greenhouse gas emissions to a time when energy will reach a saturation point" (Türkeş, 2001b, 2007, 2008).

In fact, in the negotiations process outlined above, Turkey has clearly stressed many times before the provision of similar convenience or transitional process privileges and in particular, the unique challenges in the energy sector and reduction of the greenhouse gas emissions due to this. This emphasis and negotiations based on it, were met with only 'understanding' most of the time, but were not considered an adequate and substantial grounds for dissolution of Turkey's problems. Moreover, they were not deemed sufficient for a concrete goal or obligation. On the other hand, in terms of the obligations of Annex I Parties of the Convention, it is stated that the convenience and privileges granted for the transition period for the Parties in the transition process to the market economy covers the 1990-2000 period, that this period and therefore its obligations are about to be actually completed, and perhaps more importantly, most of the transition countries are also included in Annex-B of the Kyoto Protocol. For this reason, Turkey's new approach was seen as a target by the parties, especially by the US and the EU (Türkeş, 2001a, 2001b). By contrast, Turkey's intention to continue with the UNFCCC negotiations until most suitable conditions are provided in terms of its own circumstances conditions, has been one of the most accurate approach for the period for monitoring the process and explaining itself.

In a meeting of UNFCCC's subsidiary bodies held in 1997, a proposal has been given by Pakistan and Azerbaijan for the removal of the name of Turkey from Annex I and Annex II lists of UNFCCC. This proposal was accepted to be discussed at the 3rd Conference of the Parties organized in Kyoto in December 1997. During the debate on the proposal in Kyoto, in unofficial talks made with the Party countries, especially the EU and US representatives, it has been proposed that "Turkey can assume the obligation of its per capita CO_2 emissions in 2010 not exceeding half of the average of OECD countries", as it is included in the annexes of the Convention as an OECD country; however, as a result of insisting on setting a quantitative emission reduction target, no consensus was reached and the said proposal was postponed to be discussed in CP-4 (Türkeş, 2001a). Turkey has also distributed from official channels a Climate Change National Report that can be considered a voluntary national statement at CP-4 held in Buenos Aires in November 1998. This proposal by Turkey to become a party to the UNFCCC was not accepted in CP-3 and later in CP-4 and in CP-5 in Bonn in 1999 (Türkeş, 2001a, 2001b). As a result, a just and viable solution has not been achieved for Turkey at that time.

Turkey attended the First Part of CP-6 (The Hague Conference) with a relatively different approach. This new approach was in the form of to be removed from

Annex II and to become a party to the Convention in case the same conveniences are granted to it as those granted to former socialist countries in the transition stage to market economy, and continue with the negotiations on the subject of postponing the obligation of numerically reducing the greenhouse gas emissions to a time when energy will reach a saturation point. In line with this approach, Turkey reminded that it is in the first phase of industrialization and submitted a formal amendment proposal in The Hague Conference for its name to be deleted from Annex to II and remain in Annex I on condition that it is granted favorable conditions such as those provided to the countries in the transition process to the market economy in line with the "common but differentiated responsibility principle" of UNFCCC (Türkeş, 2001a, 2006b, 2008).

In accordance with decisions taken at the Hague Conference, Turkey's request to be deleted from Annex II and to become a party to UNFCCC as an Annex I country was discussed at CP-7 held in Marrakech city of Morocco on 29 October-6 November 2001 by Subsidiary Body for Implementation. Turkey's proposal was first discussed at SBI then at CP General Assembly and accepted unanimously. This long overdue positive development made Turkey a member of the international community's efforts to protect the global climate in the end (TTGV, 2002; Türkeş, 2002). In the decision on Turkey, it was stated in summary that it was agreed to delete the name of Turkey from Annex II and that CP invited parties to accept Turkey's special conditions that differ from the other Parties included in Annex I (FCCC/CP/2001/13/Add.4, Türkeş, 2002).

<u>The full text of the decision is as follows:</u>

"Emphasizing the common but differentiated obligations of the Parties on the basis of equality and their opportunities to meet them to protect the climate system for the benefit of mankind's present and future generations and considering the new proposal submitted by Turkey for the deletion of his name from Annex II especially at CP-6/1 Section (in The Hague), CP decided to delete the name of Turkey from Annex II and invites the Parties to recognize the special circumstances of Turkey, which place Turkey, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention."

Upon this development, "The Draft Law on the Ratification of Participation to the United Nations Framework Convention on Climate Change", presented to Grand National Assembly of Turkey(Parliament) in 1996 was adopted by the related commissions in 2003, then at the General Assembly and was published in the Official Gazette dated October 21, 2003 and numbered 25266. Turkey officially applied to UN on February 24, 2004 to become a party to the UNFCCC legally (Türkeş and Kılıç, 2004). Pursuant to Convention rules, Turkey was admitted to the UNFCCC as the 188th Party country (189th, Considering EU) on 24 May 2004.

4.2. Initial National Preparation Efforts and Activities Regarding the UNFCCC

National preparation efforts regarding the UNFCCC were carried out by MGM in the period 1991-1996, and after 1997 by various national working groups consisting of relevant institutions and organizations under the coordination of the then Ministry of Environment. All national preparedness and climate change in the scope of protection of the atmosphere for the June 1992 Rio Summit are carried out by a National Climate Coordination Group (NCCG) in Turkey, under the presidency and the secretariat of the MGM. As a result of the works of the National Climate Coordination Group, "Protection of the Atmosphere and Climate Change" and "Energy and Technology" reports were prepared (Türkeş, 2001a, 2002). After the Rio Summit, a National Climate Program (NCP) was established in 1993 in order to carry out national and international scientific, technical and political preparation studies for the UNFCCC (TTGV, 2002). MGM also carried out the coordination and secretariat of the NCP, which served between 1993-1996.

When Turkey's status regarding UNFCCC and the related problems gradually began to be a higher priority as an obligation, the national climate change studies and activities were conducted first by the Ministry of Foreign Affairs for a short time after 1996, and then were continued under the coordination of the Ministry of Environment.

In 1999, a Specialization Commission on Climate Change was established within the framework of the national preparations for the Eighth Five-Year Development Plan, which included the 2001-2005 plan period, coordinated by the former State Planning Organization (DPT). The Climate Change Specialization Commission was chaired by an expert from the Ministry of Environment and the reporter from the General Directorate of State Meteorology Affairs. Through this effort, the climate change issue was discussed for the first time within the framework of Turkey's development plans. The Climate Change Special Commission Report prepared as a result of studies carried out with the participation of the related ministries, public institutions and voluntary organizations, contains national policies that can take into account the climate change measures and technologies in sector investments and in all areas of life difficulties in this area and the required sectoral, legal and institutional regulations and a scientific and technical assessment of climate change Turkey's next development period (DPT, 2000). Also addressed were the subjects of Turkey's national priorities and options relating to participation in the UNFCCC and the KP process aimed at greenhouse gas emissions limitation and reduction resulting from various human activities within the framework of global activities to protect the climate system.

In December 1997, position paper titled "Turkey and Greenhouse Gas Emissions" was published as an official document at the 3rd UNFCCC Conference of the Parties held in Kyoto, Japan (FCCC / CP / 1997 / MISC.3) (Türkeş, 2001a, 2002).

Turkey National Climate Change Report (MA, 1998), prepared with the participation of relevant institutions and organizations under the coordination of Ministry of Environment, was recorded in the Conference registration and distributed at the 4th Conference of the Parties held in the city of Buenos Aires, Argentina, in November 1998 (Türkeş, 2001a, 2002).

Initial results from the "Energy and Environment" project (MENR/TEGTC, 2000), implemented by the Ministry of Energy and Natural Resources (MENR) with the support of the World Bank was submitted at Part 1 meeting of the 6th Conference of the Parties held in The Hague, Netherlands (TTGV, 2002; Türkeş, 2001a, 2002).

In addition, with a Prime Ministry Communiqué no 2001/2, it was decided that the Climate Change Coordination Board, which was formed by the high-level representatives of the relevant institutions and organizations, would convene three times a year in order to make the studies on climate change more effective for that period.

5. UNFCCC KYOTO PROTOCOL

KP regulates the legal obligations to reduce greenhouse gas emissions (GHG) after 2000 (Table 1). According to KP, Annex I Parties (OECD, EU and former socialist eastern European countries) are obligated to reduce the greenhouse gases listed in KP Annex A (Table 4) to at least 5% below 1990 levels in the period 2008-2012 (UNEP/CCS, 1998; Türkeş, 2008). While some Parties have the privilege to increase their greenhouse gas emissions during this first obligation period (for example, Australia may increase by 8%), there will be no change in greenhouse gas emissions of New Zealand, Russian Federation and Ukraine compared to 1990 levels. The EU has taken an 8% reduction obligation both as a union and in terms of member countries. USA's emission reduction obligation is 7% (Table 5).

The framework of the legal rules regarding the implementation of KP and Kyoto mechanisms was drawn with the Bonn Agreement adopted in July 2001 (Türkeş, 2001b). The main political consensus issues included in the Bonn Agreement were transformed into legal texts with the Marrakech Agreements adopted at the 7th meeting of the UNFCCC Conference of the Parties (CP-7) held in Marrakech, Morocco in November 2001 (Türkeş, 2006b, 2008).

Table 3: Greenhouse gases, sectors and source classes included in Kyoto Protocol Annex A (UNEP/CCS, 1998).

Greenhouse Gases
Carbon dioxide (CO_2)
Methane (CH_4)
Dinitrogen monoxide (N_2O)
Hydrofluorocarbons (HFC's)
Perfluorocarbons (PFC's)
Sulfur hexafluoride (SF_6)

Sectors/source classes
Energy
Fuel burning
Energy industries
Factory industries and construction
Transportation
Other sectors
Other
Hazardous emissions from fuels
Solid fuels
Petrol and natural gas
Other
Industrial processes
Mineral products
Chemical industry
Metal production
Other production
Production of halocarbons and sulfur hexafluoride
Consumption of halocarbons and sulfur hexafluoride
Other
Solvent and other used products
Agriculture
Stomach fermentation
Animal fertilizer management
Rice agriculture
Agricultural lands
Burning of savannahs
Burning of agricultural wastes on the field
Other
Waste
Solid waste disposal on land
Wastewater management
Waste burning
Other

Table 4: Kyoto Protocol Annex B countries and quantitatively determined emission limitation or reduction obligations (percentage change by base year or period) (UNEP/CCS, 1998)

Party	Obligation (percent change)
Australia	108
Austria	92
Belgium	92
Bulgaria*	92
Canada	94
Croatia*	95
Czech Republic*	92
Denmark	92
Estonia*	92
European Union	92
Finland	92
France	92
Germany	92
Greece	92
Hungary*	94
Iceland	110
Ireland	92
Italy	92
Japan	94
Lithuania*	92
Liechtenstein	92
Latvia*	92
Luxembourg	92
Monaco	92
Holland	92
New Zealand	100
Norway	101
Poland*	94
Portugal	92
Romania*	92
Russian Federation*	100
Slovakia*	92

Party	Obligation (percent change)
Slovenia*	92
Spain	92
Sweden	92
Switzerland	92
Ukraine*	100
England	92
United States of America	93

** Countries in transition to a market economy.*

Kyoto mechanisms (Joint implementation, Clean Development Mechanism and Emission Trading) provide the developed countries with the facility of moving beyond their national borders in order to undertake the greenhouse gas emission reduction and hence climate change mitigation activities at the lowest cost (Türkeş et al., 2000; Türkeş, 2001a, 2001b).

Joint Implementation (JI) will be implemented such that an Annex I country will earn Emission Reduction Units (ERUs) as a result of investing in a project aimed at reducing GHGs in another Annex I country and counting this as its own specified emission obligation and the ERU transferred by the host Annex I country will be deducted from that country's own excess reductions.

Clean Development Mechanism (CDM) is a type of JI that takes place between an obligated investor country (developed country) and a non-liable host developing country. According to KP, projects must establish Approved Emission Reductions (AER) that the investor country can use to fulfill its emission obligation. In other words, AER's, which are units equivalent to a metric ton of CO_2 equivalent that Annex I countries can use to meet part of their binding emission limitation and reduction obligations under the Kyoto Protocol, are a form that can be realized between a developed country party and a developing host country. As a result of the JI project activity, it is a facility that the investor country has earned and can be used to meet part of its emission obligation. A JI and CDM program under the KP is expected to provide capital and loans mainly to finance projects that limit and reduce greenhouse gas emissions in countries with economies in transition and in developing countries, respectively.

An "emission trading regime" has been established through the Emission Trading (ET) system, which will allow the sale and purchase of emission credits, especially between countries with developed industries and countries in the transition to market economy. Although some restrictions and rules have been imposed on emission trading during the regulations on the implementation of Kyoto obligations (for example, in the 2001 Bonn Political Treaty and the Marrakech Accords), emission trade is also a serious 'ethical problem' due to the inequality and negativity ('hot weather') it creates in terms of protecting the global climate system (Türkeş et al., 2000; Türkeş, 2001a) (Türkeş and Bilir, 2013).

5.1. Important Articles Kyoto Protocol

Important articles of the Kyoto Protocol are summarized below (UNEP/CCS, 1998):

Article 2:

Annex I Parties are required to implement and / or further develop policies and measures in line with their national conditions in order to fulfill the emission limitation determined quantitatively for them and the reduction obligations in the 3rd Article, in order to support sustainable development. The national policies and measures of the Parties, in summary, will include the following:

- Increasing energy efficiency in relevant sectors of the national economy;
- Protecting and increasing sinks and reservoirs of greenhouse gases not controlled by the Montreal Protocol, taking into account its obligations arising from relevant international environmental agreements; supporting sustainable

forest management practices, forestation and reforestation;

- Supporting sustainable forms of agriculture in light of climate change concerns;
- Research, development, increasing use and support of environmentally friendly advanced and different technologies, carbon dioxide retaining technologies, new and renewable energies
- Continuous reduction or gradual elimination of market deficiencies, tax and customs privileges incompatible with the objective of the Convention, and incentives in all greenhouse gas emitting sectors, and implementation of market rules;
- Supporting appropriate reforms in the relevant sectors in order to support policies and measures that reduce or limit greenhouse gas emissions not controlled by the Montreal Protocol,
- Measures to reduce and / or limit emissions of greenhouse gases not controlled by the Montreal Protocol in the transport sector;
- Measures to reduce or limit methane through the use of waste management methods and waste treatment, as well as in energy production, transportation and distribution.
- Besides these obligations, in summary:

Bu yükümlülüklerin dışında, yine özetle:

Article 3:

- The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex Band in accordance with the provisions of this Article, with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012.
- Each Party included in Annex I shall, by 2005, have made demonstrable

progress in achieving its commitments under this Protocol.

- The net changes in greenhouse gas emissions from sources and removals by sinks resulting from direct human-induced land use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990, measured as verifiable changes in stocks in each commitment period shall be used to meet the commitments in this Article of each Party included in Annex I. The greenhouse gas emissions from sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 and 8.
- Prior to the first session of the Conference of the Parties serving as the meeting of the Parties to this Protocol, each Party included in Annex I shall provide for consideration by the Subsidiary Body for Scientific and Technological Advice data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session or as soon as practicable thereafter, decide upon modalities, rules and guidelines as to how and which additional human-induced activities related to changes in greenhouse gas emissions and removals in the agricultural soil and land use change and forestry categories, shall be added to, or subtracted from, the assigned amount for Parties included in Annex I, taking into account uncertainties, transparency in reporting, verifiability, the methodological work of the Intergovernmental Panel on Climate Change, the advice provided by the Subsidiary Body for Scientific and Technological Advice in accordance with Article 5 and the decisions of the Conference of the Parties.
- In the first quantified emission limitation and reduction commitment period, from 2008 to 2012, the assigned amount for each Party included in Annex I shall be equal to the percentage inscribed for it in Annex B of its aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A in 1990, or the base year or period determined in accordance with paragraph 5 above, multiplied by five. Those Parties included in Annex I for whom land use change and forestry constituted a net source of greenhouse gas emissions in 1990 shall include in their 1990 emissions base year or period

the aggregate anthropogenic carbon dioxide equivalent emissions minus removals in 1990 from land use change for the purposes of calculating their assigned amount.

- Each Party included in Annex I shall strive to implement the commitments mentioned in paragraph 1 above in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention. In line with relevant decisions of the Conference of the Parties on the implementation of those paragraphs, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session, consider what actions are necessary to minimize the adverse effects of climate change and/ or the impacts of response measures on Parties referred to in those paragraphs. Among the issues to be considered shall be the establishment of funding, insurance and transfer of technology.

Article 4:

- The methods to predict that all human-induced greenhouse gas emissions not controlled by the Montreal Protocol are emitted from sources and retained by sinks will be those adopted by the IPCC and agreed by the Conference of the Third Parties.
- The global warming potentials used to calculate the carbon dioxide equivalents of anthropogenic greenhouse gas emissions not controlled by the Montreal Protocol listed in Annex A, released from sources and retained by sinks, will be those accepted by the IPCC and agreed upon at the third meeting of the Conference of the Parties.

Article 23:

- This Protocol shall be open for signature and subject to ratification, acceptance or approval by States and regional economic integration organizations, which are Parties to the Convention. It shall be open for signature at United Nations

Headquarters in New York from 16 March 1998 to 15 March 1999.

Article 24:

- This Protocol shall enter into force on the ninetieth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accounted in total for at least 55 per cent of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, have deposited their instruments of ratification, acceptance, approval or accession.
- The Kyoto Protocol has allowed Parties to use a variety of mechanisms to help achieve their emission reduction obligations at the lowest cost. Criticized by non-Annex I Parties, particularly those that correspond to developing countries, these new mechanisms allow countries to move beyond their borders to undertake greenhouse gas emissions and therefore climate change mitigation activities at the lowest cost.

The articles related to these facilities called flexibility mechanisms can be summarized as follows according to UNEP/CCS 1998:

- KP/Article 17 (Emission Trading) allows any Annex I Party to trade a portion of its allocated (or designated) emissions. Accordingly, it allows any Party that reduces its emissions more than its target to transfer this additional reduction in emissions to another Party.
- KP/Article 6 (Joint Implementation) allows an authorized legal entity (body, company, etc.) in any Annex I Party that achieves emission reductions through special projects, the opportunity to transfer their excess reductions to another Annex I Party. Accordingly, while the transferring Party reduces the 'emission discount units' based on the project, the Party that earns a certain amount of these units is allowed to increase the amount allocated to it.
- KP/Article 12 (Clean Development Mechanism) constitutes a 'Clean Development Mechanism' that allows developing Parties to transfer 'approved emission reductions' from projects to Annex I Parties. This article allows Annex

I Parties to take into account the project-level emission reductions they have achieved through their activities in the first obligation period (2008-2012), starting from 2000.

5.2. Attitude of the USA and the Russian Federation

In order for the KP to come into force and to be legally binding, it had to be approved by at least 55 countries that are parties to the UNFCCC, and these 55 countries had to include industrialized countries that met at least 55% of the total CO_2 emissions of developed countries in 1990. As it is known, US President G. W. Bush declared in March 2001 that his country would not be a party to the KP, claiming that it would have a negative impact on the economic interests of his country (Türkeş, 2001b, 2006). Indeed, as the USA had a very large share of 36.1% of the total CO_2 emissions of Annex I countries in 1990, this negative attitude of the Bush administration caused a difficulty and delay in the implementation of the KP. Nevertheless, it should not be forgotten that the Russian Federation's not becoming a party to KP for a long time, which had 17.4% of 1990 emissions, had an important effect on this delay. However, the international community has made great effort and cooperation to enable the KP to come into force without the USA (e.g., the Bonn Accord, etc.), despite all US inhibitions and pressure to turn the KP mechanisms in its favor. To summarize, the Russian Federation also played an indirect but important role in KP's failure to come into effect from December 1997 to early 2005, whose idea of obtaining economic benefit by selling unused emission rights to some industrialized countries, especially the USA, especially through emissions trading became impossible, after the withdrawal of USA from KP as well as the USA and Australia, at the same time.

Until February 16, 2005, a total of 140 (38 + 104) countries, including almost all OECD and EU countries that accounted for 44.2% of the total emissions in 1990 - except the USA and Australia - had become a party to KP. The Russian Federation, which owns 17.4% of the 1990 emissions, became a party to KP on February 16, 2005, as the 141st country, as a result of the EU's pressure. In this case, 61.6% of the total emissions of Annex-1 countries in 1990 were achieved without the USA (36.1%). As a result, despite the negative attitude of the USA and Australia to the protection of the global climate system, the KP entered into force on February 16, 2005, after a long period of delay (Türkeş, 2006, 2007, 2008).

5.3. What was expected from the Kyoto Protocol?

The entry into force of the Kyoto Protocol and the implementation of the Marrakech Accords will be able to provide the following in summary, although comprehensive political discussions and scientific/technical studies on many issues are still ongoing (only some of the ones listed here have been realized) (Türkeş, 2006b, 2008):

- A Special Climate Change Fund is established under the UNFCCC to assist developing countries in adapting to the impacts of climate change, obtaining clean technologies and limiting increases in GHG's, and a Least Developed Countries Fund to meet the needs of the least developed countries. Adaptation activities aimed at eliminating the negative effects of climate change will have the first priority in benefiting from the Special Climate Change Fund. Technology transfer and associated capacity building activities are expected to be necessary areas for benefiting from the Fund. In this context, monitoring epidemic diseases and vectors affected by climate change (global warming, increasing heat waves, drought, increase in the severity and frequency of tropical cyclones, floods and overflows, lack of clean drinking water, famine, etc.), the strengthening and, when necessary, establishment of national and regional centers and information networks for rapid response to extreme weather events by using information technology as much as possible will be the main elements of adaptation activities. In addition, a Kyoto Protocol Compliance Fund is established to support concrete compliance projects and programs.
- According to the CDM rules, developed countries will be able to invest in climate-friendly projects in developing countries and in this way receive credits for the GHG's they prevent. The CDM rules clearly state energy efficiency,

renewable energy sources, other projects that directly or indirectly reduce greenhouse gases, and sink (forestation and reforestation) projects. On the other hand, developed countries will refrain from using emission reduction units in CDM arising from 'nuclear activities' to meet their obligations.

- It will be possible to implement the International emissions trading, which enables Annex I countries to purchase and sell emission credits among themselves (mainly between EU / OECD countries and EU countries and non-EU countries in transition) and Joint Implementation mechanisms that enable developed countries to invest in projects in countries with economies in transition.

5.4. Some Selected Important Discussions Regarding Immediately After the Kyoto Protocol Obligation Period

5.4.1. Doha Amendment to the Kyoto Protocol

Negotiations regarding the post-Kyoto period, i.e. the KP second obligation period, which would run from 1 January 2013 to 31 December 2020, were eventually held in Doha, Qatar, on 8 December 2012, at the end of the Kyoto Protocol Doha Amendment or Correction (Doha Amendment to the Kyoto Protocol). However, the Doha Amendment did not come into force, as a total of 144 acceptance documents required for this amendment to come into force have not yet been completed, i.e. the required number of countries for the amendment has not submitted their acceptance documents to the secretariat for the text of the amendment.

The Doha Amendment includes very broadly the following issues (Doha Amendment to the Kyoto Protocol. 2012. Reference: C.N.718.2012.TREATIES-XXVII.7.c (Depositary Notification):

- New obligations for Annex 1 Parties to the Kyoto Protocol agreeing on the obligations (accepting the Doha Amendment) in the second obligation period from 1 January 2013 to 31 December 2020;

- A revised list of greenhouse gases to be submitted by Parties in the second obligation period;
- Corrections for many articles of the Kyoto Protocol, especially for reference issues belonging to the first obligation period - which will need to be updated for the second obligation period.

The Doha Amendment was distributed to all countries that are Parties to the Kyoto Protocol by the UN Secretary General in accordance with Articles 20 and 21 of the Protocol, on December 21, 2012.

During the KP first obligation period, 37 developed countries, countries in the transition to market economy and the European Community agreed to reduce their greenhouse gas emissions by an average of 5% compared to 1990 levels. This obligation could not be fulfilled.

Parties undertook a reduction of at least 18% from 1990 levels in the 7 years in the 2013-2020 period in the second obligation period under the Doha Amendment. However, the composition of the Parties is different in the second obligation period than the first obligation period.

5.4.2. 2007 Bali Road Map

In year 2007, various events at the intergovernmental, global and regional level have been held under the umbrella of the UN and outside of it regarding which legal framework of the post-Kyoto period (e.g. extended Kyoto and/or a similar protocol or a new treaty, etc.) and for which obligation period (second obligation period after 2008-2012) and which numerically determined GHG reduction obligations, mechanisms and rules will be used (Table 1).

Two of the most important of these activities at the beginning are the UNFCCC and KP bodies and CP meetings held in Bali (Indonesia) on December 3-14, 2007 and the Climate Change Talks held in Bangkok (Thailand) on March 31-April 4, 2008. The most important output of the Bali Meetings is the Bali Roadmap for the organization after Kyoto. At the end of the process of similar meetings and preparatory work for the post-Kyoto period, it was foreseen to complete a new international climate change agreement and submit it to the international community for approval, guaranteeing post-2012 obligations aimed at protection of the global climate system and other issues until the UNFCCC (CP-15) and KP meetings held in Copenhagen in December 2009.

The Bali Meetings were perhaps one of the most active conferences of the Turkish delegation since the 7th Conference of the Parties (CP-7) held in Marrakech in November 2001. Although Turkey was not represented at the ministerial level in Bali, the Turkish government's support an EU statement for the first time at Top Level Section and its declaration that it is on the same side with the vast majority of the world including the EU, China, India, Brazil and Pakistan in the historical session on the last day can be considered an important achievement that Turkey achieved (Arıkan, 2008).

6. TURKEY REPUBLIC BEING A PARTY TO THE KYOTO PROTOCOL

After Turkey's participation in the UNFCCC, "The Draft Law on the Ratification of our Accession to the KP for UNFCCC (Law No. 5836)" was accepted with important discussion by Turkey Grand National Assembly on 5 February 2009.

Law No. 5836 was published in the Official Gazette No. 27144 on February 17, 2009. Turkey's accession to the Kyoto Protocol (being a party) entered into force on 26 August 2009, that is, 90 days after formal ratification document is submitted to the UN on May 28, 2009.

As Turkey's name was not among the developed countries listed in Annex B the 1997 Kyoto Protocol, it did not assume any greenhouse gas reduction obligation and its request to be removed from UNFCCC Annex II and become a party as an Annex I country was accepted by UNFCCC 7th Conference of the Parties, Turkey had the opportunity to choose the most appropriate possible greenhouse gas obligations for it under the KP through negotiations (Türkeş, 2017). In other words, in this case to Turkey was granted a significant privilege for being a party to the KP without taking any obligation of reducing or controlling GHG's in 2008-2012 first obligation period and for the negotiations after the first period.

7. DISCUSSION AND CONCLUSIONS

Climate Change is one of the most discussed global change issues, on which many scientific researches and discussions at intergovernmental levels are held today. Human activities such as burning fossil fuels, land use changes, deforestation and industrial processes have caused the accumulation of greenhouse gases such as CO_2, CH_4, N_2O, CFC's, HFC's, PFC's in the atmosphere to increase rapidly since the industrial revolution.

Consecutive hot years that started in the 1980's and record high temperatures in recent years indicate that global warming continues as expected and predicted; it shows that the national, regional and global measures and policies that should be taken to prevent global warming should be implemented without delay (Türkeş, 2000b). Governments and decision-making bodies face the important task of taking urgent and drastic measures for the hazards of human-induced greenhouse gas emissions. The most important of these measures is to control the greenhouse gas emissions released into the atmosphere as a result of various human activities and to keep them below a certain level without wasting too much time. Due to the very long time scales in the climate system, environmental degradation and changes caused by changes in climate cannot be remedied in a short time. Leaving the decisions that need to be taken today to 10-20 years later limits possible future policy options, as it will be necessary to further reduce greenhouse gas emissions to the atmosphere in a short period of time in order to reduce them to a certain level in the future. Delaying the measures to minimize greenhouse gas emissions leaves countries and the world in an unprepared and weak position in combating the negative effects of climate change in the future. Finally, it can be said that, considering the great historical responsibilities and current contributions in the increase of global emissions, what is important in terms of protecting the global climate system and preventing climate change for the developed countries is to make significant changes in the production and consumption (life) styles, and to give the priority to domestic activities and measures in reducing greenhouse gases. The most important factor that could pave the way for this is, in particular, to ensure that especially developed country Parties fulfill their obligations arising from the UNFCCC, UNFCCC KP and the KP Doha Amendments, in case it enters into force, and the nationally determined contributions (national intentions) to the new Paris Treaty of December 2015, which entered into force in November 2016 with strengthened action, financing targets and promises in an effective, realistic, fair and urgent manner.

Continuation of greenhouse gas emissions at or above their present level will cause further warming and possibly many changes in the climate system during the 21st century, which may be greater than those observed in the 20th century. Anthropogenic warming and sea level rise can last for centuries, even if greenhouse gas accumulation is stopped at a certain level, due to the very different and longtime scales associated with climate processes and feedback. This, in turn, will create negative consequences for societies and a major obstacle to development. Therefore, the international community faces an important task to prevent the threat and danger of climate change associated with the increase in human-induced greenhouse gas emissions. The most important way to minimize the predicted climate changes and the possible negative effects of these changes on socioeconomic sectors, natural ecosystems and human health is to reduce human-induced greenhouse gas emissions in all sectors and to protect, develop and increase the sinks. Policies and measures aimed at reducing or controlling greenhouse gases are implemented to reduce greenhouse gas emissions and / or include scientific and technical / technological approaches and measures that may be implemented in the near future and comprehensive policy instruments at the national level.

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PARIS AGREEMENT

Prof. Dr. Murat Türkeş

1. TWO IMPORTANT CLIMATE CHANGE STOPS AFTER COPENHAGEN BEFORE PARIS: 2011 DURBAN AND 2013 WARSAW CONFERENCES

After the United Nations (UN) Framework Convention on Climate Change (UNFCCC) Kyoto Protocol, numerous UNFCCC meetings of the Parties for the preparation of the UNFCCC Paris Agreement were held, which was adopted in December 2015 and entered into force rapidly in November 2016 (Table 1 and Figure 1). Among these, the December 2011 Durban and November 2013 Warsaw conferences and the legal reconciliation texts adopted at these conferences stand out in enabling us to better understand how the Paris Agreement was prepared and how it was created.

For this reason, before moving on to the general features and key outputs of the Paris Agreement in this study, the circumstances were evaluated on the basis of the conditions at the time of the meetings based on the official meeting documents of these two CP meetings (UNFCCC 17 and 19th Conferences of the Parties), our published and unpublished CP meeting reports that we attended and our articles on this subject (e.g. Türkeş, [1], [2], [3], [4], [5], [6]; Türkeş, 2012a).

1.1. Main Consequences of the November-December 2011 Durban Climate Change Conference

The 17th Meeting of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties and the 7th Meeting of the Kyoto Protocol Conference of the Parties (UNFCCC COP17 / CMP7) were held between 28 November - 9 December 2011 in Durban, South Africa. The primary objective of the Durban Conference can be summarized as to determine, inter alia, the numerical greenhouse gas emission reduction and financial-technological obligations of developed countries after the 2008-2012 first obligation period of the Kyoto Protocol, for example until 2020 and beyond and to ensure the implementation of Green Climate Fund.

By the time the Durban Climate Change Conference reached its official closing day, December 9, 2011, midnight, the nations and societies of the world had not yet reached a consensus to continue a joint and global fight against climate change and to make it more or less effective. However, at around 06:30 am on December 11, 2011, it was announced that UNFCCC officials agreed on certain issues and made decisions.

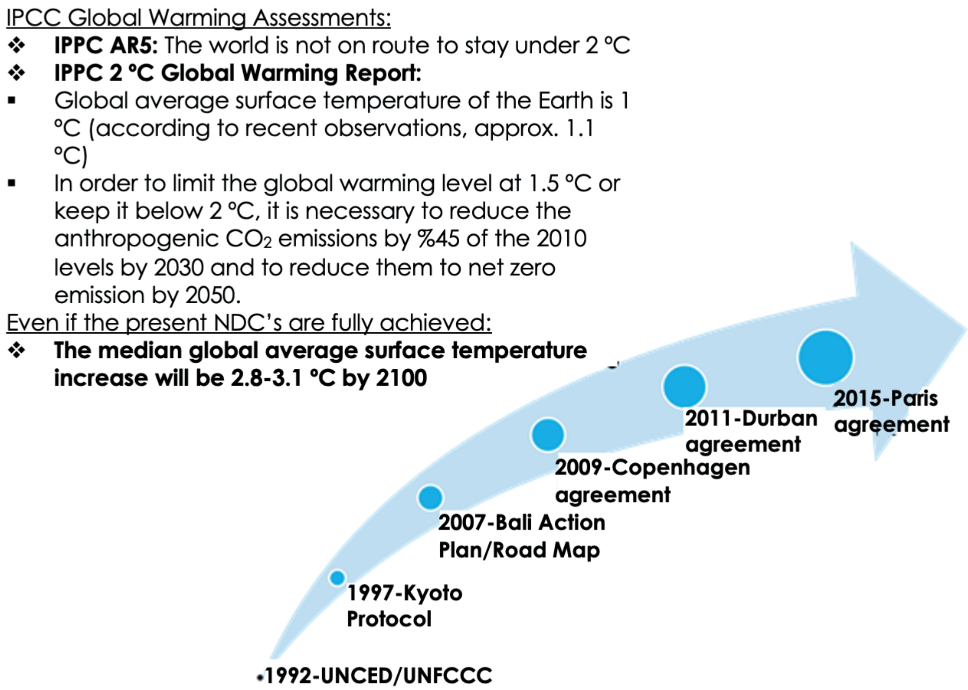
Table 1: Important milestones and developments in the process of international and intergovernmental negotiations on climate change in the period 1979-2020 (Updated and rearranged according to Türkeş 1995a, 1995b, 2001a, 2001b, 2006a, 2006b, 2008, 2009, 2010, 2012a, 2012b, 2017, 2021 and, Türkeş and Bilir 2013)

Work / Action / Activity / Process	Major Conferences, Arrangements, Agreements and Developments
Scientific and technical evaluation and information studies	• WMO World First Climate Conference (1979) • Villach Climate Change Conferences (1985 and 1987, Villach) • Toronto Changing Atmosphere Conference (1988, Toronto) • Establishment of WMO / UNEP IPCC (1988) • IPCC 1st Assessment Report (December 1990, Geneva)
Preparation for a legal intergovernmental framework climate regime	• UN Global Climate Protection Resolution (December 1988, New York) • Noordwijk Ministerial Conference (November 1989, Noordwijk) • WMO World Second Climate Conference (October-November 1990, Geneva) • UN Intergovernmental Talks on Climate Change (1991-1992, in various cities around the world, mostly in Geneva)
Action strategies aimed at a framework climate agreement that will form the basis for the legal climate regime	• UN Conference on Environment and Development (June 1992, Rio de Janeiro) • Adoption of the UN Framework Convention on Climate Change (UNFCCC, June 1992, Rio de Janeiro) • UNFCCC enters into force (March 1994, New York) • UNFCCC Berlin Directive (April 1995, Berlin)

Work / Action / Activity / Process	Major Conferences, Arrangements, Agreements and Developments
Legal liability objectives	• Adoption of UNFCCC Kyoto Protocol (December 1997, Kyoto) • FCCC Buenos Aires Action Plan (November 1998, Buenos Aires)
Legal obligations enforcement activities (Kyoto rules)	• UNFCCC Bonn Political Agreement (July 2001, Bonn) • FCCC Marrakech Accords (November 2001, Marrakech) • UNFCCC Montreal Conference Resolutions (November-December 2005, Montreal)
Enforcement of legal greenhouse gas obligations	• UNFCCC Kyoto Protocol enters into force (February 2005, New York)
Establishing a post-Kyoto legal climate regime, Determination of greenhouse gas obligations and Stopping the global warming at 1,5 °C	• UNFCCC Bali Action Plan / Roadmap (December 2007, Bali) • FCCC Bangkok Climate Change Talks (March-April 2008, Bangkok) • UNFCCC Copenhagen Accord (December 2009, Copenhagen) • FCCC Cancun Agreements (December 2010, Cancun) • UNFCCC Durban Agreements (December 2011, Durban) • FNCC CP Doha Corrections (December 2012, Doha) • UNFCCC Warsaw Mechanisms (November 2013, Warsaw) • Adoption of UNFCCC Paris Agreement (December 2015, Paris) • UNFCCC Paris Agreement enters into force (November 4, 2016)

As we have always emphasized in our work on UNFCCC conferences held in the previous years, regardless of whatever the outcome may be, that about 190 countries and many governments with different world views, national and regional interests, religions, cultures and histories, and most importantly, very different education levels, living standards and development levels, external organizations, institutions and individuals came together for a common purpose to work and fight jointly, and to discuss how they can combat climate change and how they can act together in a democratic way was the most important output of this meeting; not its success.

Figure 1: Illustration of the process of multilateral intergovernmental climate change negotiations, selected key milestones, and the levels of struggle to prevent global warming, which are considered to be linked to human-induced global climate change in this period, and scientific evaluations on global warming predictions (Table 1, IPCC 2018; Edited according to Türkeş 2020a and 2020b)



The main consequences of a package of resolutions, which is the main output of the Durban Conference (Durban Platform), have been briefly discussed below, without getting involved in the different approaches, initiatives and special circumstances of the countries (e.g. United States of America (USA), Canada, People's Republic of China, India), by underlining that it is not sufficient and significant in terms of protecting the climate system, reducing and / or stopping the negative effects of human on the climate system and preventing human-induced climate change, based on the predictions and demands of science (Türkeş, 2012a):

- In Durban, 194 countries that are Parties to the UNFCCC agreed on a package of Conference of Parties resolutions called the "Working Group on Durban Platform for Enhanced Action (ADP)". The Durban Platform basically included the launching of a new climate change protocol or a legal setup that could be applied to all Parties, a second obligation period for the Kyoto Protocol (the first obligation period was completed at the end of 2012) and the launching of the Green Climate Fund.

- According to this, governments have decided in Durban to adopt a universal legal agreement to combat climate change no later than 2015. The work required for this will start immediately under the Durban Platform Working Group (ADP).
- Governments of 35 developed countries agreed on the second obligation period of the Kyoto Protocol, which will begin on January 1st, 2013. In order for the issue to be clarified quickly, the Parties of this second obligation period will turn their economy-based targets into qualitative emission limitation or reduction obligations or objectives and submit them by May 1st, 2012 in order to ensure the review of these objectives. This is a particularly important agreement point or decision, as the Kyoto Protocol calculation rules, mechanisms, and carbon markets will all continue to operate to sustain global climate action and set an example for future agreements.
- At the Durban Conference, it was agreed on an improved framework for notifying emission reductions for both developed and developing countries, by taking into account the common but differentiated responsibilities of different countries.
- Active operation of the Green Climate Fund (GCF), which was established in Cancun in 2010, will help developing countries to protect themselves from the effects of climate change, access a development path that includes low-carbon and renewable energies, and adapt to existing climate change. However, the Fund does not yet have a ready-made budget to act for this purpose. The capital required for this budget will be expected to be created by developed countries as soon as possible (later developments did not allow this to happen).
- For this, the Parties must complete their financial obligations for 2012 as soon as possible in order to meet the costs of the Green Climate Fund. The established Green Climate Fund Committee was tasked with reviewing and supervising climate finance under the UNFCCC and assisting the Conference

of the Parties. This committee will be represented by 20 members, creating a balanced structure between developed and developing countries.

► Also, an agreement was also reached on a special work program to ensure the Fund's long-term financing in this context. This program will be expected to make contribution to the determination of future climate change financing and to analyze the options for the movement of financial resources from various sources.

► The parties will be able to maintain Cancun Agreements in one way or another. The new measures include the establishment of a Technology Mechanism that will support the transition of developing countries to clean and low carbon technologies, and the establishment of an Adaptation Committee that will coordinate the actions and studies for adaptation on a global scale.

► The established Technology Mechanism will be fully implemented in 2012. In this context, an applied branch of this Mechanism, the full name of which is decided as the Climate Technology Center and Network, will also come into force.

► The Adaptation Committee, which consists of 16 members, will inform the Conference of the Parties of its efforts to improve the coordination of global adaptation actions and studies. Adaptation capacities of all poor and vulnerable countries (most sensitive, most vulnerable to climate change) will be strengthened.

► National Adaptation Plans will enable developing countries to assess and reduce their vulnerability statuses to climate change. Parties with the highest vulnerability will receive the best protection against damage and loss caused by extreme weather and climate events and disasters associated with climate change.

► In addition to the above, governments also adopted procedures or guidelines for carbon capture/retain and accumulation projects under the Kyoto Protocol Clean Development Scheme. These guidelines will be reviewed every five years to ensure environmental integration and protection.

► Finally, among others, governments also agreed in Durban to develop a market-based mechanism to help developed countries meet some of their objectives and obligations under the UNFCCC. The details of this new Market Setup will be determined during the negotiations by the end of 2012.

According to the agreement reached in Durban and all these decisions, it can be said that the possibility of creating new investments, collaborations and carbon markets (emission trade or exchanges) for new technologies and infrastructure needed for the combat against climate change and keeping the global average surface temperature below 2 ºC can be continued, whether weak or strong, using the second obligation period of the Kyoto Protocol, in other words, the Kyoto Protocol will continue on its way and fulfill its function for a while, even though it is seriously damaged (further developments did not allow this to happen).

However, in terms of numerical emission control or reduction obligations and targets on a global scale, except for the European Union and some OECD countries, the attitude of developed countries such as the USA, Canada, Australia and Japan and "advanced" developing countries such as China, India, South Korea, South Africa, Saudi Arabia, Argentina, Russian Federation, Mexico and Turkey, whose economies and emissions are growing very rapidly, is also noteworthy. It is impossible for these countries to achieve the global greenhouse gas reduction goals required by the Kyoto Protocol for which they did not take any qualitative emission control or reduction obligation before or after 2020 or by a new legal climate order/regime, or for protecting the global climate system and preventing the climate change.

According to the United Nations Environment Program's (UNEP) study titled "Emission Deficits Report, Are the Copenhagen Agreement Promises Sufficient to Limit the Global Warming to 2 °C or 1,5 °C?", in order to keep global warming below 2 °C, global greenhouse gas emissions in 2020 should not exceed 44 billion tons (Mt) of carbon dioxide (CO_2) equivalent ($MtCO_2e$) (subsequent developments did not allow this to happen and this level was exceeded). For this, developed countries will have to reduce their CO_2e emissions by approximately 40% by 2020 and 80% by 2050 (UNEP, 2010).

In conclusion, the Durban Conference "managed" to keep the doors "ajar" (not much or fully open) to the world to combat the climate change in the near and medium future, partly based on scientific foundations, and mainly on the common sentiments and future interests of countries or groups of countries, albeit with great difficulty. However, it has generally failed to protect and develop the global targets and achievements envisaged in the Cancun Accords last year and prior to that, in terms of legally quantitatively determined greenhouse gas emission reduction obligations for developed countries.

1.2. Main Consequences of the November 2013 Warsaw Climate Change Conference

The 19th United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (CP) Conference of the Parties (COP19/CMP19) meetings held in Warsaw between 11-22 November 2013 were once again strained due to long and delayed negotiations and discussions; they were completed on the night of November 23rd, 2013 and closing took place (Türkeş, 2013).

1.2.1. International Warsaw Mechanism for Loss and Damage Caused by Climate Change

The main reason for this delay, among others (e.g. Durban Platform Working Group - ADP, etc.), is that "a new and additional legal mechanism to compensate for climate change damages and losses", demanded by the People's Republic of China and other developing countries persistently and strongly, which foresees technical assistance and financial support to developing and particularly least developing countries in combating the negative effects of climate change and adaptation, was delayed to the last minute because of obstructions made by developed countries, especially USA.

In this new 'climate crisis', the draft UNFCCC CA resolution entitled "International Warsaw Mechanism for Loss and Damages Associated with Impacts of Climate

Change" (FCCC/CP/2013/L.15), which contains the proposals of the President, was overcome “for the time being” and “special to the summit”, as a result of tense and unofficial individual and group negotiations mainly between USA, Canada, Australia and Japan that lasted approximately 48 hours [7].

Friends of the Earth and Climate, who are concerned for the future of the earth's climate and all living beings on it including human beings and who want universal climate treaty to be accepted and implemented as soon as possible that foresees a new "fair, balanced, robust, numerically determined legal greenhouse gas emission reduction or control obligations" that will minimize the negative human impact on the global climate system and ensure the protection of the global climate system became very 'happy' by finding these 'developments' acceptable! This document, like the other decisions, will be discussed in detail until the 2015 Paris Summit and will be tried to be put into a form to be included in the new climate agreement.

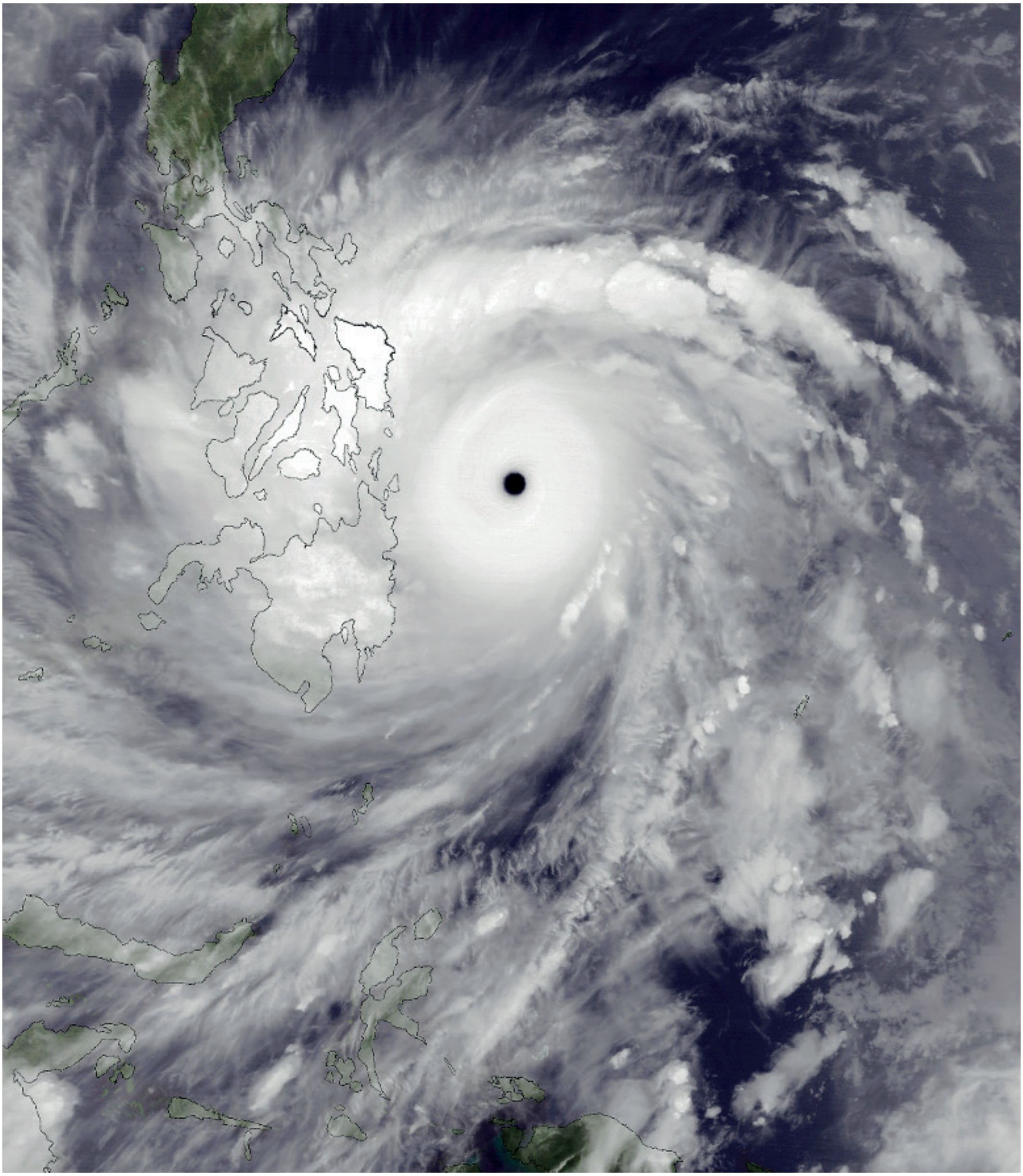
With the acceptance of the International Warsaw Mechanism for Loss and Damages Associated with Impacts of Climate Change, the developed countries have assumed obligation on the subjects of technical expertise and potential financial assistance against fast onset disasters such as tropical storms and slow onset climate-related disasters such as drought and desertification of developing countries, starting from the next year.

Considering that obligations such as providing regular and adequate financing and financial assistance, transferring technology, scientific and technical knowledge and expertise, etc. for combating climate change (reducing, limiting and/or controlling greenhouse gas emissions, etc.) and adaptation are not actually implemented, it can be expected with a very high probability that such a 'timid' or 'barren' document that refuses to take clear, effective and sufficient obligations to cover the 'damage and loss' of developing countries with high vulnerability levels that are particularly affected by climate change, will only create a new 'negotiation agenda' that will be discussed perhaps for years.

1.2.2. Financing of Climate Change

The resentment and anger that arose at the Warsaw Conference of the Parties was not limited to the resistance of the United States and some developed countries to establish a new mechanism for loss and damage . This also occurred for the case of determining and accepting new stipulations for the new greenhouse gas reduction and climate change financing for a new universal climate change agreement (now known as the Paris Agreement), which is adopted at the end of 2015 and is expected to enter into force starting from 2020 and will encompass all countries (which will allow them to take obligations to reduce or limit their greenhouse gas emissions). For example, despite the decisions taken at the 2010 Cancun and 2011 Durban summits, developed countries were invited once again and with a very clear compulsion to announce every two years how they are planning a 100 billion USD annual climate financing by 2020 (subsequent developments did not allow this to happen and this level has never been reached until today).

Figure 2: Visible satellite image of the super typhoon Haiyan approaching the Philippines in its most severe phase on November 7th, 2013. According to NASA from [8].



Another bitter aspect of the matter was that even though the super typhoon Haiyan (Figure 2), one of the most devastating tropical cyclones in the history of natural disasters, hit the Philippines just before the Warsaw Conference in early November

2013, causing more than 5,000 deaths and millions of dollars of damage in the Philippines alone, developed countries such as the United States, Canada, Australia and Japan refused to take digital greenhouse gas reduction and other (e.g. financial and technological) obligations in the second obligation period of the Kyoto Protocol (December 2012 Kyoto Protocol Doha Amendment or Amendment) and a new universal climate change treaty, which will most likely be adopted in 2015 and come into force after 2020.

Among the outputs of the Warsaw climate change meetings, introduction of some new rules for the management of the new financial mechanisms for the protection of forests, which are the Earth's important carbon sinks and reservoirs, and the management of their sink capacities, in connection with the very rich biodiversity and ecosystem opportunities they possess and establishing of standards for measuring, reporting and verification activities also take an important place.

1.2.3. Work Schedule for Preparing a Universal Climate Change Agreement and Climate Change Combat Obligations

At the Warsaw CP meetings, the Parties agreed on new a work schedule and calendar, albeit with great difficulty, which will be executed at the end of 2015 until the UNFCCC Paris Summit, where a new universal climate change agreement (shaped as the Paris Agreement) is expected to be adopted by all developed and developing countries to reduce and limit or control their greenhouse gas emissions.

As briefly explained in the discussion on the Durban Platform Ad- Hoc Working Group (ADP), one of the key outputs of the Durban Conference, in the discussions on the subject, both developed and developing Parties and the People's Republic of China (PRC) requested that countries' climate change obligations until 2015 be defined clearly within the framework of a clear schedule. In this context, both the developed Parties, especially the USA and the EU, and the developing Parties, especially the PRC and India, were not satisfied with the work schedule covering the period until the Paris Summit at the end of 2015. In the talks on the subject, there were also discussions (in the form of counter-opinion and criticism) accusing them of not keeping their promises and blocking the talks from time to time, for example between the PRC-USA and some developed countries, the USA and some developed countries-PRC, India and some developing countries, or between the PRC-Russian Federation (RF) and the RF-PRC.

According to the adopted Draft Work Schedule, it is foreseen that the Parties, instead of taking legally determined obligations until 2015, will make contribution to the global climate change struggle on a 'voluntary' basis, which can be expressed, in summary, as "whoever is ready and how much they want to do".

As can be seen, although consisting of quite weak and mostly unclear voluntary contributions (not obligations), it can be said that a consensus has emerged in the Warsaw Climate Change Summit in terms of doing their homework for the preparation of a new universal climate change agreement that will be adopted by 2015 and will come into force after 2020 and will bind all countries. A new work schedule and calendar, which will be taken as the basis for the implementation of this agreement until 2015, has also been prepared.

1.2.4. Synthesis of the Warsaw Conference Results

- Considering all the negative effects of climate change (severe weather and climate events and disasters), the magnitude and urgency of the risks, the results of the Warsaw climate change talks and the decisions adopted, albeit with difficulty, are very inadequate in terms of action and effectiveness for combating the climate change, taking countermeasures for effects, reducing and compensating the damage and losses and climate change adaptation obligations, actions and activities.
- The Warsaw conclusions and decisions are not at a level that could provide a fair, sound, scientifically sufficient and viable basis for the 2015 new universal

climate change agreement (recall the scientifically necessary emission reduction and resultant atmospheric carbon dioxide accumulation reduction levels required to stay below the 2 °C temperature rise limit on a global scale) (Figure 1).

- The participating countries have once again returned to their homes where they are "expected to do their homework" with the unbearable lightness and happiness of doing nothing but clearly repeating "their own positions, special conditions, demands, excuses and reasons or unwillingness". Meanwhile, the numerically determined legal greenhouse gas reduction and limitation obligations of developed countries and advanced developing Parties have been postponed until 2020, and very high probability, to another agreement after 2020 and to an unknown period(s) of obligations, which are already difficult to know.
- When we consider the Warsaw climate change talks as a whole, we can foresee that the tension and conflict between developed countries and developing countries, especially developing countries and Japan, Australia and Canada in addition to USA will continue to exacerbate from time to time, which have decided to remain ineffective, withdraw and/or not to take new obligations in the new climate change process (CP Doha Correction and most likely the 2015 agreement).

2. PARIS AGREEMENT

2.1. Adoption and Coming into Force of the Paris Agreement

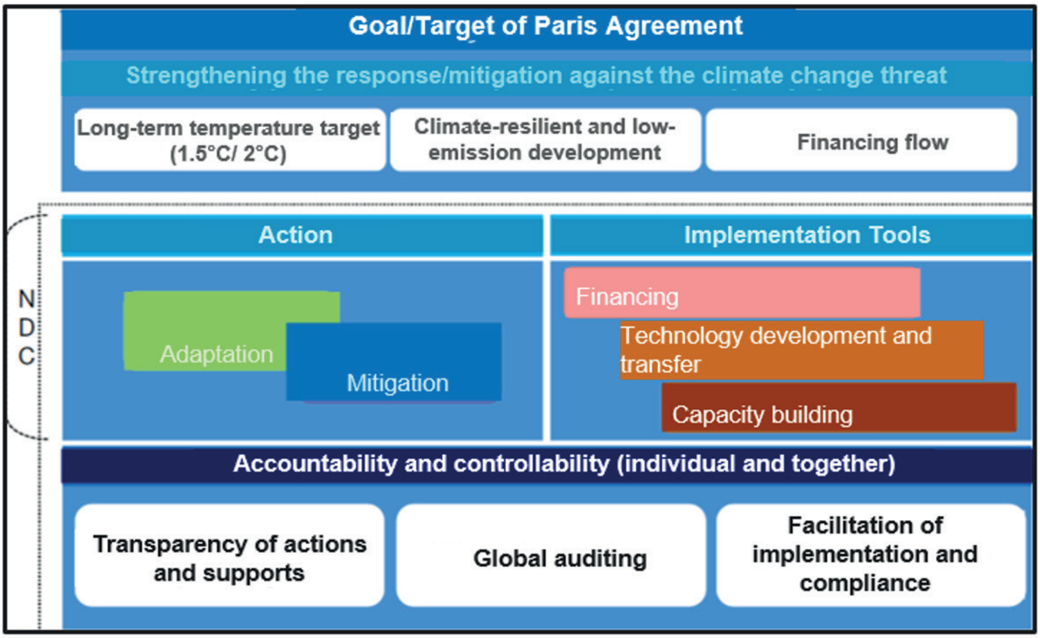
The United Nations Framework Convention on Climate Change Paris Agreement was signed and accepted at the UNFCCC 21st Conference of the Parties held in Paris on 30 November-13 December by most of the countries participating in this meeting, in preparation for a global agreement that could secure the obligations for the period after 2020 after the signing of the Kyoto Protocol in December 1997 after dozens of challenging meetings held over a period of nearly 20 years.

The original full official document on the acceptance of the Paris Agreement and other details adopted on 12 December 2015 by 196 Parties is available in the UNFCCC 21st Conference of the Parties Report (FCCC/CP/2015/10/Add.1) CP Decision Number under the heading Adoption of the Paris Treaty (Decision 1/CP.21-Adoption of the Paris Agreement) [9].

Under the heading of the Adoption of the Paris Treaty, reference was made to the Conference of the Parties, primarily the decision number 1/CP.17 for the establishment of the Ad-Hoc Working Group on Durban Platform for Enhanced Action and Articles 2, 3 and 4 of the UNFCCC and relevant decisions including the resolutions 1/CP.16, 2/CP.18, 1/CP.19 and 1/CP.20 were reminded, and reference was made to the United Nations General Assembly, "Our Transforming World: 2030 Agenda for Sustainable Development", in particular, to its resolution A/RES/70/1 on the adoption of the Addis Ababa Action Agenda of the 3rd International Conference on Financing Development and the Sendai Framework for Disaster Risk Reduction. Afterwards, recognizing the urgent and potentially irreversible threat of climate change on human societies and on our planet, it has been considered that this threat requires widest possible cooperation of all countries and acceleration of greenhouse gas emissions by all countries, it has been agreed that participation is necessary in an effective and appropriate international response or mechanism (Figure 3). In this context, it has been acknowledged that significant reductions in global emissions are urgently necessary to achieve the final goal of the UNFCCC, emphasizing that it is necessary for the fight against climate change.

Under the title of Adoption of the Paris Agreement, reference was made to the fact that the climate change is the common concern of humanity, and when the Parties take action against climate change, they should be respectful and encouraging, they are asked to take into account their relative obligations on human rights, the right to health, the rights of indigenous peoples, indigenous communities, children, persons with disabilities and vulnerable (sensitive) people, gender equality, women's rights and intergenerational equality as well as the right to development

Figure 3: Simplified graphical representation of the main goal/target, function and general operating mechanisms of the Paris Agreement (Revised and re-drawn according to Tubua 2020).



At the end of these introductory paragraphs, it has been declared the adoption of the Paris Agreement was decided under the UNFCCC and the UN Secretary-

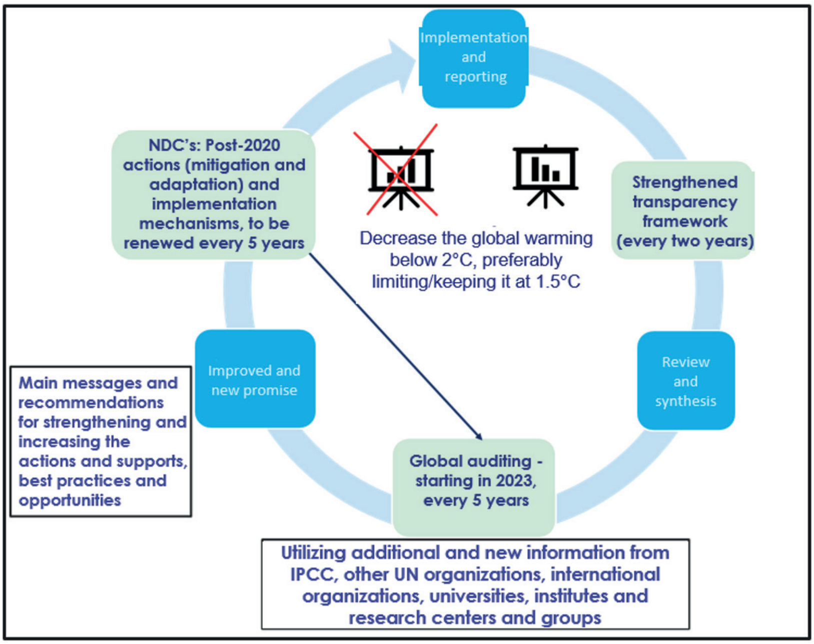
General was requested to be the Depositary of the Paris Agreement and to ensure that the Agreement is kept open for signature in New York City of the United States of America (USA) from 22 April 2016 to 21 April 2017.

Although it was foreseen to be open for signature at the UN for 1 year, the UNFCCC Paris Agreement entered into force on November 4, 2016, as a result of the submission of the necessary approval documents to the UN in a very short time.

2.2. The Objective, General Scope and Main Outputs of the Paris Agreement

The Paris Agreement (New Paris Climate Regime) is regarded a legally binding 'continuous' (self-renewing and/or self-repeating) global agreement, covering the emission reduction obligations, more precisely 'intentions' of 187 countries starting in 2020, aimed at the protection of the global climate system, combat in and/or limiting the climate change.

Figure 4: Simplified graphic representation of the internal relations of the Paris Agreement



The Paris Agreement has two main outputs, whose various features, principles, provisions, mechanisms and work plans are summarized in the following paragraphs. These are:

- Decisions of the Conference of the Parties (CP) (FCCC/CP/2015/10/Add.1; Decision 1/CP.21 - Adoption of the Paris Agreement): The CP has mainly reached a consensus on a series of decisions that could be urgently effective to accelerate actions under the new climate regime for the post-2020 period.
- Paris Action / Work Agenda: In addition to the legally binding agreement adopted in CP 21, a large number of 'obligations' or 'statements of intent' have been announced by countries, regions, cities and businesses (investors, companies, etc.) as additional actions to reduce greenhouse gas emissions and increase resilience or flexibility. The Paris Agreement Work Schedule includes provisions governing these (FCCC/CP/2015/10/Add.1; Decision 1/CP.23, paragraph 3) [10].

2.2.1. Objective of the Paris Agreement

The main objective of the Paris Agreement has been identified as to reduce the global temperature rise below 2 °C below pre-industrial levels as much as possible, or to limit or stop the global temperature rise at 1,5 °C, if possible, and to ensure flow of financing harmonized with a climate resilient society having low greenhouse gas emission and development path (Figures 3 and 4)

In order to achieve the long-term goal of limiting the increase in global temperatures foreseen by the Paris Agreement, the main objective of the Parties can be summarized as the rapid reduction of greenhouse gas emissions as soon as possible from the global peak towards the middle of the century, in line with the aim of a world in which the climate is balanced.

As it is the first legal agreement that brings together all countries for one common reason to undertake strong or determined efforts to combat climate change and adapt to its effects, there are also circles that see the Paris Agreement as a turning point in the multilateral climate change process. The basis of this optimistic thought is that and its Parties, countries that are parties to the agreement have not been separated by taking different responsibilities through annexes in the Paris Agreement, as in the UNFCCC itself and in the Kyoto Protocol.

2.2.2. What Are Nationally Determined Contributions?

The implementation of the Paris Agreement requires the implementation of important social and economic transformations, based on the best available scientific knowledge. How will this transformation occur? It is foreseen that the Paris Agreement will operate based on the 5-year cycles of increasingly determined or strengthened climate actions to be carried out by the Parties (Figures 3 and 4). In this context, the Parties will be obliged to submit their own plans for climate actions known as 'nationally determined contributions' (NDCs) by year 2020 (Figure 3).

Countries will guarantee the actions to reduce their greenhouse gas emissions in order to achieve the Paris Agreement goals in their NDC's. They will also notify the Parties of the actions in their NDC actions that will create resilience to adapt to the effects of rising temperatures or global warming (Figure 3).

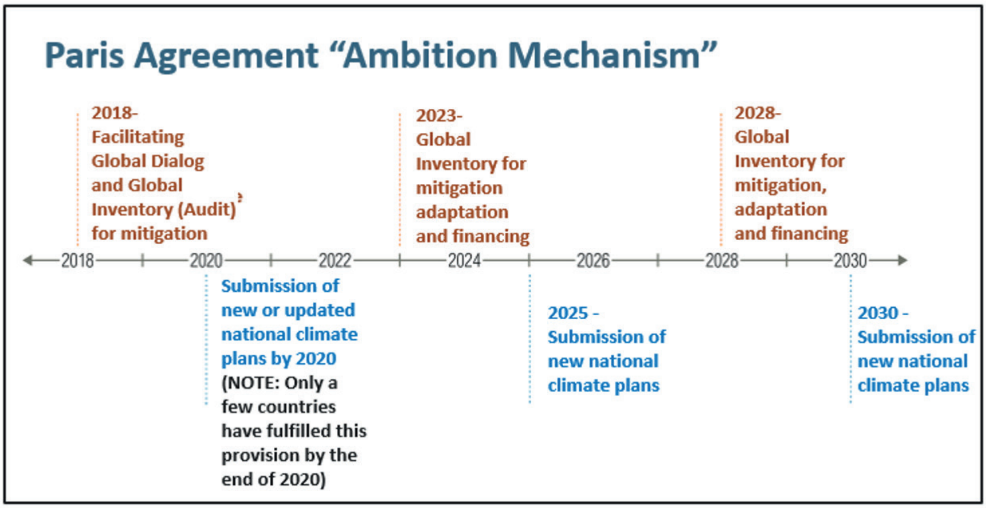
2.2.3. What Is Technology Mechanism?

It can be said that the main vision (farsightedness) of the Paris Agreement aimed at increasing and / or improving the resilience of society and countries to the climate change (climate change resilience) is to strengthen the climate change resilience and reduce greenhouse gas emissions through technology development and technology transfer (Figure 3). The Paris Agreement has created a Technology Framework in line with this vision. The Technology Framework provides a long-term guide for the full functionality of the Technology Mechanism. This mechanism established by the Paris Agreement aims to accelerate the transfer of technology development with the policy and executive instruments or organs of the Paris Agreement.

2.2.4. Capacity Building

Not all developing country Parties have the capacity to cope with many issues and problems related to climate change. Therefore, the Paris Agreement places great emphasis on climate-related capacity building for developing countries. In this context, the Paris Agreement asks all developed countries (DC's) to increase their efforts to support capacity building studies and actions in developing countries.

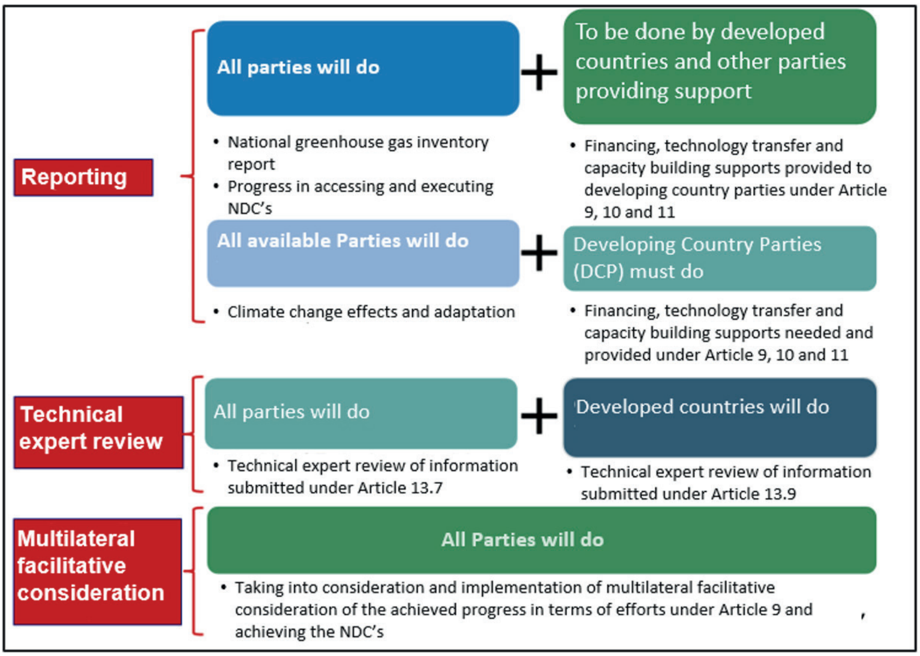
Figure 5: Time steps of Ambition Mechanism as foreseen by Paris Agreement (Revised per Paris Agreement decisions and Hansen et al., 2017).



2.2.5. Monitoring the Process and Ambition Mechanism

Within the scope of the Paris Agreement, an Enhanced Transparency Framework (ETF) has been created on actions and supports (Figure 6). In the ETF process, which is expected to start in 2024, the Parties will have to transparently report the prevention and actions they have taken and the climate change mitigation and adaptation measures and the supports they provide and / or receive. Also, it is considered that the information gathered during the ETF process will support the Global Inventory and the Global Inventory will have the opportunity to achieve common progress towards long-term climate goals (Figures 4 and 5). At the end of this process, it will be made possible to provide recommendations to the signatory countries to make more effective and ambitious plans within the scope of an Ambition Mechanism in the next obligation period (Figures 4 and 5).

Figure 6: Generalized graphical representation of an Enhanced Transparency Framework setup on actions and supports under the Paris Agreement (revised and re-drawn according to Paris Agreement decisions and Tubua 2020).



Perhaps for the first time in the history of global climate policy, the Paris Agreement constitutes a continuous and regular legal process that is 'anticipated' or 'considered' to increase the actions foreseen to be carried out by all countries, even though it does not give "numerically determined obligations to the parties to limit or reduce emissions". This process, which will be reviewed and revised every 5 years, provides ways in which the Paris Agreement's objective of "making persistent efforts to keep the global temperature increase well below 2 °C or to limit the global temperature increase to 1,5 °C" (Figure 3 and 4).

In order to understand "this climate mechanism or regime, or the mechanism of action cycles based on 'option' or 'goodwill'", we find it useful to examine this concept by dividing it into its main components. Accordingly, the following points stand out (Figures 3, 4 and 5):

- A 'Global Current Situation Determination' or 'Global Audit', which is expected to show the 5-year implementation and joint progress;
- Each Party country submitting updated 'Nationally Determined Contributions (NDCs)' and informing them in accordance with the 'Global Inventory' mechanism;
- Existence of progress and highest possible expectations and/or intentions for each 5-year consecutive contribution.

As we explained at the beginning, the Paris Agreement does not impose a numerically defined obligation on Parties to reduce and/or monitor their 'mandatory' greenhouse gas emissions, instead, it expects countries to make the mitigation for climate change through 'loose' and/or 'voluntary' NDC's ('loosely controlled statements of intent').

3. TECHNICAL EVALUATION OF THE KEY OUTPUTS OF THE PARIS AGREEMENT

In addition to the 1,5 °C and 2 °C global warming targets described above, where strengthening the global response to the threat of climate change is one of the main objectives, Paris Agreement aims at increasing the ability of countries to cope with the effects of climate change and to ensure a harmonious flow of financing through low greenhouse gas emission levels and climate resilient development (Figure 3).

The Paris Agreement should support appropriate provision and mobility of financial resources, a new technology framework and strengthened capacity building actions in order to achieve more effective and stronger goals, and within this scope, it is to support the actions of developing countries and the most vulnerable countries, provided that they are in line with their national objectives.

The Paris Agreement is an agreement that in principle requires all Parties to make their best efforts through their NDCs and to strengthen these efforts in the coming years. This requires all Parties to regularly report their actions and activities regarding their emissions and their own enforcement efforts. In addition, a global stocktake will be held every 5 years where the Parties will evaluate the joint efforts and progress towards achieving the goal of the Paris Agreement and provide information on additional individual actions taken by the Parties.

The Paris Agreement was opened for signature on an Earth Day on April 22nd, 2016 at the UN headquarters in New York. The Paris Agreement came into effect on November 4th, 2016, when the so-called "double-threshold" conditions (requiring ratification by 55 countries, corresponding to at least 55% of global emissions) were quickly met. Since then, 191 of the 197 countries that are parties to the UNFCCC have become parties to the Paris Agreement [11].

A Work Schedule was put in place in Paris to make the Paris Agreement fully implemented. The purpose of the Work Schedule is determined as developing applications, operations and guidelines on many subjects that can be identified in a very broad level. The Parties have been working together in the subsidiary executive bodies (e.g. APA, SBSTA and SBI) since 2016.

The Conference of the Parties (CP), which served or convened as the meeting of the Parties to the Paris Agreement, convened for the first time in November 2016 in the city of Marrakech, Morocco, and adopted its first two decisions here. At that time, the Work Schedule was also foreseen to be completed in 2018. The Paris Agreement, adopted by the CP decision No. 1/CP.21, refers to the vital issues and/or areas necessary to combat climate change.

Some key features of the Paris Agreement are summarized in the following paragraphs by directly referring to the relevant article [12] [13] [14].

3.1. Long Term Global Temperature Goal

Article 2 - The Paris Agreement aims to limit the global temperature increase well below 2 °C in search of the possibility to strengthen global responses to climate change, and if possible, it aims to continue the efforts to stop or limit the temperature increase at 1,5 °C by further strengthening the efforts.

3.2. Global peaking of greenhouse gases and climate neutrality balance

Article 4 - Global peaking of greenhouse gases and 'climate neutrality' balance: In order to achieve the projected temperature goal, Parties aim for greenhouse gas emissions (GHG's) to reach their global peak as soon as possible, and it is expected that it will take a longer time for developing country Parties to accept achievement of the peak. This way, it will be possible to establish and maintain the balance between anthropogenic emissions from sources and those removed from sinks of greenhouse gas emissions.

The Paris Agreement also establishes the rules for Parties to notify their NDC's every 5 years and to submit the information required for openness and transparency. According to these established rules, each consecutive NDC notification is to present a more positive improvement or progress than the previous NDC in order to create a solid basis for higher efforts. While developed country Parties must maintain their leadership in securing economic-scale absolute reduction targets, developing countries will continue to strengthen their combat efforts and will be supported over time to move towards economy-scale targets, taking into account the existence of different national conditions.

3.3. Sinks and Reservoirs

Article 5 - Sinks and reservoirs: The Paris Agreement encourages Parties to protect and develop sinks and reservoirs of greenhouse gases under appropriate conditions, as referred to Article 4 paragraph 1 (d) of the UNFCCC and to include forests.

3.4. Voluntary cooperation/market- and non-market-based approaches

Article 6 - Voluntary cooperation/market- and non-market-based approaches: The Paris Agreement recognizes the potential voluntary cooperation between Parties that allow stronger or strengthened efforts and the rigid calculation mechanisms necessary for any cooperation involving the establishment of principles that include environmental integrity and transparency and the transfer of international combat outputs.

The Paris Agreement defines an appropriate framework and platform for non-market approaches for sustainable development by organizing a mechanism to contribute to the reduction of GHG's and the promotion of sustainable development, and lays down the rules on how to implement or operate them.

3.5. Adaptation

Article 7 – Adaptation: The Paris Agreement establishes the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the Agreement's temperature goal (Figures 3 and 4). This adaptation goal, organized by the Paris Agreement, aims to significantly strengthen national adaptation efforts, including those through support and international cooperation. The adaptation goal also recognizes adaptation as a global problematic challenge facing all Parties. In this context, all Parties should be closely linked to the issue of adaptation, which includes the preparation and implementation of National Adaptation Plans. In this context, the parties will have to submit adaptation communications that define their priorities, needs, plans and actions and update them periodically. In addition, adaptation efforts of developing countries must also be taken into account.

3.6. Loss and Damage

Article 8 – Loss and damage: The Paris Agreement recognizes the importance of paying attention to, mitigating the effects of and alerting about the damage and loss associated with the adverse effects of climate change, including extreme weather and climatic events and disasters, and slow-onset climate and/or climate-related events (e.g. drought and desertification). The Paris Agreement also emphasizes the role of sustainable development in reducing the risk of damage and loss. Parties to the Paris Agreement have to strengthen their capacity to understand and support the issue of damage and loss through the "Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts". The said Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (FCCC/

CP/2013/L.15) is one of the main outputs of the 19th Conference of the Parties meeting in Warsaw in November 2013 [7]. Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts, regulates various topics and actions, such as cooperation and facilitation in terms of damages and losses associated with the negative effects of climate change, such as extreme events and slow-onset events, especially in developing countries that are sensitive (highly vulnerable) to the negative effects of climate change.

3.7. Finance, technology and capacity-building support

Article 9, 10 and 11 – Finance, technology and capacity-building support: While the Paris Agreement clearly emphasizes the obligation of developed countries to support the efforts of developing countries to build a clean and climate-resilient future, it encourages the voluntary contributions of other Parties in these matters for the first time. According to the Paris Agreement, funding or deciding on the resource to be offered should also aim at reaching a balance between adaptation and mitigation. In other words, importance was attached to the correct channeling of the source. In addition to the reporting on the provided financial support, developed country Parties should provide clear information on future support every two years, including estimated levels of public funding. The Paris Agreement regulates that the UNFCCC's financing mechanism, which mainly includes the Green Climate Fund (GCF), will serve the Paris Agreement. Within this framework, international efforts and cooperation on capacity building in developing countries with the development and transfer of climate-safe technology (which does not harm the climate system, does not have any adverse effect, etc.) should also be strengthened. In this context, a technology framework is established under the Paris Agreement and capacity building activities and efforts will be strengthened through action and mechanisms, in addition to others, through support in terms of capacity building actions in developing country Parties and appropriate institutional agreements and cooperation, etc.

3.8. Information to Public

The Paris Agreement regulates under Article 12 the issues of climate change education, training, public awareness, public participation and public access to information.

3.9. Transparency, implementation and compliance

Article 13 'transparency' and Article 15 'implementation and compliance' regulate activities, actions and cooperations. The Paris Agreement foresees a strong transparency and accounting system that provides clarity on the actions and support of the Parties, taking into account the flexibility of the differing capabilities of the Parties, and determines the rules for its implementation (Figure 6). In addition to reporting and reporting on mitigation, adaptation and support issues, the Paris Agreement regulates the inclusion of the information submitted by each Party to the international technical expert review process. The Paris Agreement also includes a mechanism that is expected to facilitate implementation and promote compliance.

3.10. Global Stocktake

Article 14 – Global stocktake or inventory: A 'Global Stocktake system, which will come into force in 2023, will evaluate collective progress towards achieving the objective of the Paris Agreement in a comprehensive and facilitating context every 5 years after that date (Figures 3 and 4). This evaluation will be based on the best available scientific knowledge and progress and a long-term global goal. The outputs of this will be presented to the Parties as information and show them the right way, both in updating and strengthening their actions and declarations and strengthening an international cooperation focused on climate action (mitigation, adaptation, etc.).

Decision 1/CP.21 regulated various measures aimed at strengthening pre-2020 climate action. These actions include strengthening the technical review of the process, promoting urgent financing, technology and support issues, and increasing their high level of association and similar precautions.

This decision of the Paris Agreement (1/CP.21) also opens the door to the efforts of all actors besides the Parties, such as civil society, private sector, financial institutions, local governments in cities and other authorities at various levels to respond to climate change. These actors besides the Parties have been invited to communicate or report their efforts through the Non-State Actor Zone for Climate Action Platform [15].

Also, the Parties acknowledges within the scope of the Paris Agreement, the important role in securing investments through various means such as domestic policies and carbon pricing, etc., as well as what is needed to strengthen the knowledge, technology, practice and efforts of local communities and indigenous communities.

4. LONG-TERM STRATEGIES AND COLLABORATIONS UNDER THE PARIS AGREEMENT

To provide a better framework for efforts directed at the long-term objective, the Paris Agreement invites countries to formulate and present the Long-Term Low Emission Development Strategies (LT-LEDS) by 2020. LT-LEDS offers a long range plane for NDC's. Unlike NDC's, LT-LEDS are not a mandatory application action. However, they provide a vision and direction for future developments by placing NDC's within the long-term planning and development priorities of countries.

The Paris Agreement provides financial, technical and capacity-building support to countries in need of support in terms of countries' actions to support another country.

The Paris Agreement reiterates that developed countries should take the lead in providing financial assistance to less resilient and more vulnerable countries, and also supports the voluntary contributions of other Parties for the first time.

Climate finance is essential for the combat against climate change, because large-scale investments are required to significantly reduce greenhouse gas emissions. Climate finance is equally important for adaptation, because, important financing resources are required to adapt to the negative effects of the changing climate and to reduce the effects of the changing climate.

5. WHAT HAS THE PARIS AGREEMENT ACHIEVED IN THE PAST 5 YEARS?

Even insufficient NDC's of the Parties to the Paris Agreement did not materialize; the new and/or additional 'combats' or 'combat intentions' of the Parties, that must be presented by the end of 2020, have been postponed to the end of 2021 together with the UNFCCC 26th Conference of the Parties (CP-26) due to the global pandemic (COVID-19 pandemic). In this context, it may not really be very meaningful to say clearly what the Paris Agreement has achieved in the 5-year period in the context of "minimizing or stopping the negative and irreversible effects of humans on the climate system". At best, this can be seen as a very well intentioned or optimistic approach.

Nevertheless, with an optimistic approach mentioned above, it can be said that some progress has been made within the scope of the Paris Agreement. For example, since the Paris Agreement came into force, it has been observed that it has focused on low carbon solutions and new carbon markets. In addition, zero-carbon solutions seem to become competitive among socioeconomic sectors responsible for approximately 25% of emissions. This trend, in other words, the observed progress is considered to be remarkable in the energy and transportation sectors and has created many new job opportunities for those who act early. It is also foreseen that the zero-carbon solutions envisaged by 2030 under the Paris Agreement will be at a competitive level in sectors representing more than 70% of global greenhouse gas emissions [12].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6. EVALUATION OF THE IPCC 1,5 °C GLOBAL WARMING SPECIAL REPORT UNDER THE GLOBAL WARMING TARGET OF THE PARIS AGREEMENT

The 1,5 °C Global Warming Special Report (IPCC SR1,5 °C), published in 2018 by the Intergovernmental Panel on Climate Change (IPCC), to put it briefly, addresses the effects of 1,5 °C global warming compared to pre-industrial levels on global greenhouse gas emission pathways associated with natural and human systems in the context of global greenhouse gas emission reduction (response), sustainable development and poverty eradication efforts required to address the threat of climate change (Figures 1 and 4) (IPCC, 2018). In other words, the emphasis of "climate change, sustainable development, inequality and poverty reduction" made in the IPCC III Working Group Evaluation Reports (since the IPCC 3rd Assessment Report published in 2001), is made in IPCC SR 1,5 °C this time, in the context of limiting the increase in surface average air temperatures of the Earth to 1,5 °C in the coming years, moreover, the effects associated with a possible 2 °C warming today and in the future and combatting them. IPCC SR1,5 °C ensures that the human-induced greenhouse gas emissions, which form the basis of the combat against climate change, can be reduced at certain costs, without wasting any time and significantly, with various measures and policies, especially in the related sectors such as energy, industry, transportation and housing, etc. by reducing the use of fossil fuels in these sectors. The ways in which this will be achieved, at what level of greenhouse gas emission reduction will be made and at what costs are discussed in the relevant sections (IPCC, 2018).

The main findings and messages can be grouped under 2 headings:

Projected Climate Changes, Potential Impacts and Related Risks

Projected risks will vary according to the magnitude and rate of warming, geographical region, development and vulnerability level, as well as the application and degree of success of adaptation and mitigation methods.

Perhaps the strongest message of the 1,5 °C Global Warming Report - which we can say as a surprise in terms of climate policy - is that it also discusses two alternatives that are not really far from each other: 1,5 °C and 2 °C global warming targets. In fact, when Governments accepted the 1,5 °C target, which they so enthusiastically imposed under the Paris Agreement five years ago in December 2015, they knew little about what risks they avoided compared to 2 °C warming, or did not know exactly what the routes to the target looked like.

One of the questions clarified by SR1,5 °C is that global warming of 1,5 °C will have major impacts, such as that ocean ecosystems will reach critical levels and tropical coral reefs will disappear at the level of 70-90%. If the current greenhouse gas emission rates continue, it is predicted that these significant risks will occur in 20-30 years.

Another of the most important messages of the report is to emphasize that the impacts will be significantly higher than the 2 °C warming scenarios. The report showed that global warming of 2 °C, compared to 1,5 °C, probably means the following:

- The difference in global mean sea level rise is 10 cm (0,1 m) less in at 1,5 °C limitation compared to 2,0 °C in 2100. Sea level rise will continue at different rates depending on the emission pathways to be followed in the future.
- Lower sea level rise increases the chances of people and ecological systems

on small islands for adaptation.

- Species losses due to impacts on terrestrial, aquatic and coastal ecosystems and biodiversity are significantly less at 1,5 °C than at 2,0 °C.
- Limiting the increase to 1,5 °C decreases the increase in ocean temperatures compared to 2,0 °C and provides a corresponding decrease in ocean acidity increase and in ocean oxygen level decrease.
- Twice as many of the terrestrial species will lose their climatically determined (biome, biotope) geographic spread.
- Over a period of more than a century, there will be more than 2 million km^2 permafrost land loss.
- On average, twice as many people as today (in some regions this rate will be higher) will experience climate-related water stress.
- A few hundred million more people will be exposed to climate-related risks and will be more vulnerable to poverty.

IPCC SR1,5 °C also gives a glimmer of hope news! For example, it is still possible to limit the global warming level to 1,5 °C, but it will not be easy. Accordingly, human-induced carbon dioxide (CO_2) emissions must be reduced by 45% by 2030 compared to 2010, and net zero emission must be achieved by 2050. This means that CO_2 emissions from energy, industry, agriculture, housing and transportation will be reduced by 75-90% by 2050 compared to 2010.

Most of the 1,5 °C routes that do not push the target forward include carbon dioxide removal (CRD) technologies, which can cause additional problems and which are not easily accessible. These technologies include uncertain and immature technologies such as direct capture and storage of carbon in the air, increased weathering and ocean alkalization.

In addition, afforestation and biotechnology applications must include irreversible land use changes. This can have significant impacts on agriculture and food systems, biodiversity and other ecosystem services.

Routes without CDR are based on scenarios involving significant emission reductions through common behavioral changes in areas such as transportation and energy use.

Despite all these clear scientific evaluations and warnings, it is necessary to point out that the efforts and policies of developed countries and advanced developing countries to combat climate change and to minimize the negative impact of humans on the climate system, which has now become almost impossible, in other words, which is rapidly moving towards an irreversible point, are very inadequate.

In a very similar manner to the failure occurred in the Kyoto Protocol, in my opinion, it is completely impossible for especially the developed (most EU and OECD members) and advanced developing countries (PRC, South Korea, Mexico, Argentina, Turkey, etc.) to decrease their greenhouse gas emissions and to mitigate and prevent climate change through NDC's adopted under the Paris Agreement. Obviously, when we take into account the failure of the Kyoto Protocol, it does not seem possible to directly prevent all these severe weather and climatic events in the short, medium and possibly long term without the preventing dangerous and potentially disastrous human impacts on the global climate system, which could be impossible for hundreds of years to reverse, such as land use changes and deforestation, reducing such adversities as fossil fuel consumption and greenhouse gas emissions.

Indeed, it is seen that the willingness and ability of developed countries and countries of the world as a whole to reduce their greenhouse gas emissions are still very insufficient. It is impossible to talk about any "achievement" and "success" on this subject. For this reason, considering the changes and trends in the current observed climatic and greenhouse gas accumulations, threshold values for global average surface temperature of the Earth such as not exceeding 1,5 °C or keeping below 2 °C, which are considered threshold values that will prevent the adverse effects of climate change in the future, or more precisely, the existence of all living things in the biosphere, genetic diversity and ecological systems and for their adaptation to changing climatic conditions, are not realistic. It is too late to meet these threshold values.

If the governments decide to stop the accumulation of carbon dioxide in the atmosphere at 550 ppmv (about twice the pre-industrial level), it is estimated that global emissions will peak by about 2025 and fall below their current levels in the 2040-2070 period. Low emission levels will include the presence of different patterns in the development and operation of energy resources (e.g. reducing fossil fuel use, increasing renewable energies, etc.) and increases in end-use efficiency. For this, it is necessary to spend great effort, change priorities for fossil fuel use, urgently implement legal policies and measures that will reduce greenhouse gas emissions in all areas of life and all socioeconomic sectors and ensure the adequate, effective and efficient use of all energy resources.

In the report, there is no special information or assessment about Turkey. However, it is very clearly understood in all evaluations and recommendations in the report that countries whose conditions are similar to Turkey's need to make every effort to reduce greenhouse gas emissions in a given year or keep them at a certain level. In other words, as Turkey is located in the Mediterranean climate region, where the future climate change will create more problems in the future (in addition to the present ones), decision-makers, the government and politicians should evaluate the findings of the report from Turkey's point of view. Turkey must do these for the present and future welfare of its citizens, their health and quality of life, if not for the Paris Agreement. Turkey, for example, must make legal regulations in this regard, especially for fossil fuel-based industries and consuming less fossil fuel and renewable energy sources in the energy system. Development plans and strategies should also be prepared and put into practice by taking into account the issues such as combat against climate change, the effects of climate change and adaptation, etc.

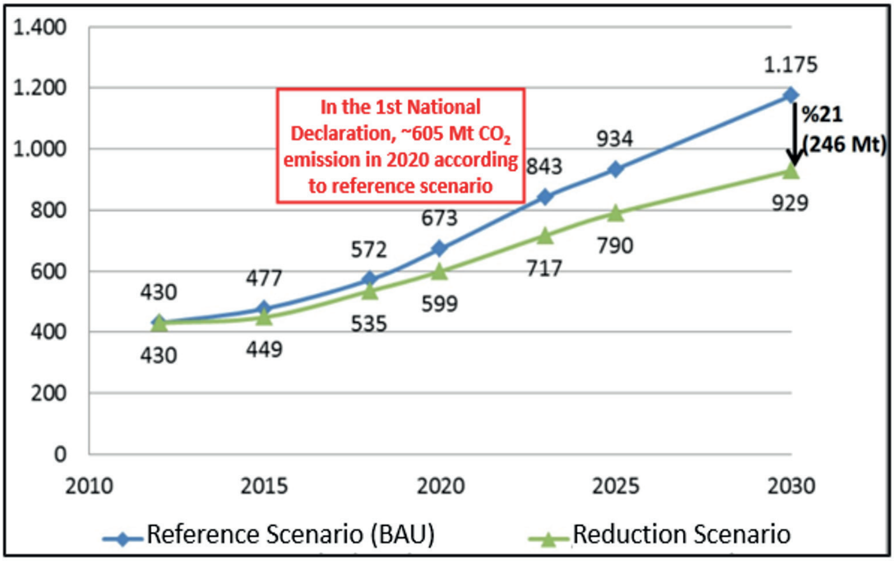
7. STATUS OF THE TURKISH REPUBLIC IN PARIS AGREEMENT

The status of the Republic of Turkey of being a party to the Paris Agreement (being a legal party / approval / acceptance) can be summarized as follows:

Although the Republic of Turkey signed the Paris Agreement in Paris in December 2015, it has not yet passed a confirmation from Parliament an Approval/Ratification/ Acceptance certificate to date and has not become a party legally to the UNFCCC Paris Agreement.

In accordance with UNFCCC 1/CP.19 and 1/CP.20 decisions in September 2015, the Republic of Turkey has submitted to the UN Secretariat the Intended Nationally Defined Contribution (INDC) document aimed at achieving the final goals as defined in Article 2 of UNFCCC and in the descriptive information. However, because it is not a country party to the Paris Agreement, the Republic of Turkey has not submitted an NDC, in other words a technical document containing the "Intended Greenhouse Gas Emission Control Measures" aimed at a new climate regime mainly be implemented after 2020, in other words, the targets of combat against climate change and reinforced efforts and so on adopted at the Paris Conference in December 2015 under UNFCCC.

Figure 7: According to INDC for the 2021-2030 period submitted to the Secretariat by the Republic of Turkey under UNFCCC, it is foreseen that a reduction of 21% will be made from the increase in CO_2e (million ton) greenhouse gas emissions in 2030.



It has been emphasized in the INDC of Turkey dated 2015, that the protection of natural assets, adoption of individual measures such as public transport and sustainable consumption/behavior styles are important. However, in the solution of such an important and multidimensional global problem, the existence of regional and global economic and environmental/climate agreements, ensuring their applicability together with clear, calculable, auditable, accountable/questionable, fair, equal and differentiated obligations is much more important and vital.

The national conditions are briefly explained in the document as follows: "… In the 2012 National Greenhouse Gas Emission Inventory Report, the total greenhouse gas emissions for 2012 were determined as approximately 440 million tons of carbon dioxide equivalent. Energy-related emissions had the largest share with 70.2% in carbon dioxide equivalent emissions in 2012, followed by industrial process emissions with 14.3%, waste with 8.2% and agricultural activities with 7.3%. In addition, the per capita emission amount in 2012 was calculated as 5.9 tons/person, which is much lower than OECD and EU averages."

Supporting Information on Intended National Contribution

In the INDC, which is expected to be implemented in the 2021-2030 period, it is stated that a reduction of greenhouse gas emissions will be made up to 21% until 2030 according to a Reference Scenario (BAU). Within the scope of this reduction, emphasis is mainly placed on economic transformations in energy, industrial processes, agriculture, land use, land use change, and forestry and waste.

8. DISCUSSION AND CONCLUSIONS

The Paris Agreement, which was adopted on 12 December 2015 by 196 Party countries at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) on 30 November-13 December held in Paris and came into force in a very short time, on 4 November 2016, is a legally binding international agreement that stipulates combating climate change, limiting global warming and all developed and developing countries making contribution to this combat under the UNFCCC.

The Paris Agreement does not impose numerically binding obligations on the subjects of "reducing or stopping the dangerous human-induced impact on the global climate system" and "reducing or limiting the emissions of greenhouse gases that cause climate change" on the Parties to limit, stop or reduce the emissions of greenhouse gases in a certain period according to a specific reference year.

On the other hand, the most important output of the Paris Agreement in this context is the regulation of "voluntary, optional or intended" actions and obligations to limit climate change below dangerous levels (below 2 °C or 1,5 °C). For example, it is seen as a turning point in terms of ending the "everything is as it is today" approach in the energy sector and industries. In this context, their future investments must be competitive in terms of “zero or very low carbon world”.

The Paris Agreement constitutes a sustainable legal and open regime in which all Parties can have 'voluntary, optional or intended' obligations aimed at reducing greenhouse gas emissions and managing the effects of climate change. In this context, there are circles who believe with an optimistic point of view that they can shape their climate actions and obligations that may last for decades in the future. It is considered that it brings together these long-term climate actions and obligations on a legal intergovernmental (the previous ones were predominantly so and more ‘formal’) and international (the recent ones are like this and less ‘formal’) platform.

However, despite all these positive and even more bona fide writing style and expectations regarding the United Nations Framework Convention on Climate Change Paris Agreement, the 25th Conference of the Parties (CP-25) held in Madrid, the capital of Spain, on 2-13 December 2019, which is the last CP meeting as CP-26 was postponed to the end of 2021 due to the COVID-19 pandemic, ended in complete failure and disappointment.

The global climate is changing rapidly due to various human activities such as the human-induced increase in the accumulation of greenhouse gases in the atmosphere from the combustion of fossil fuels, deforestation, energy, transportation, housing and industrial processes. The global average surface temperatures of the Earth are increasing rapidly compared to the previous centuries. The last 10 years have been the hottest years on record globally.

According to the last three special reports released by the Intergovernmental Panel on Climate Change (special reports on 1,5 °C Global Warming, Climate Change and Land, Oceans in a Changing Climate and Ice Globe), the effect of the observed warming will be much more severe than we previously knew. For example, accelerated sea level rise, warming of oceans, more vulnerability of major ecosystems and biomes, increased risk of limiting adaptation, etc. The effects of climate change are an increasing challenge to the adaptation capacities of society and ecosystems now and in the future.

Furthermore, the Emission Deficit Report published by the United Nations Environment Program (UNEP, 2019) also emphasizes that every year (despite the scientific warnings and political obligations) the countries of the world do not do what is necessary and greenhouse gas emissions continue to increase.

The resulting bad or negative situation can be summarized as follows:

- Greenhouse gas emissions have increased by 1,5% per year in the last decade. Total greenhouse gas emissions (including land use changes) reached a record high of 55.3 billion tons of CO_2 equivalent (Gt CO_2e) in 2018

- Fossil-based CO_2 emissions from energy use and industry, corresponding to most of the total greenhouse gas emissions, increased by 2% in 2018 and reached 37,5 Gt CO_2/year.
- Although the number of countries that announced their net zero greenhouse gas emission targets for 2050 is increasing, only a few countries have submitted their long-term legal strategies to the UNFCCC so far.
- Even if all countries fulfill their Nationally Determined Contributions under the Paris Agreement, the Earth will face a high temperature increase of 3,2 °C.
- In this sensitive period, the Earth must take more robust and gradual actions that need to be strengthened increasingly. In order to implement the required reductions, the countries of the world should review their NDCs, which they have submitted for the 1,5 °C targets, and increase them by 5 times in 2020. For a global warming target of 2 °C, they need to triple their national contribution.

The 25th Conference of the Parties of the UNFCCC, which was held in Madrid, the capital of Spain, which is a treaty with structural weaknesses such as not placing on the agenda the main outputs of the IPCC 1,5 ºC Global Warming Special Report (IPCC, 2018) and the United Nations Environment Program (UNEP) Emission Deficit Report (2019), not including the emission reduction obligations, receiving the support of significant support of only the supporters of globalization and market economy, multinational energy etc. companies and the business world, ended on December 15, 2019 with a 2-day delay due to the prolongation of the discussions on many important Articles.

In our opinion, as a not very surprising or "disappointing" result, no progress was made in the summit in terms of climate change combat, adaptation and creation of international carbon markets, providing support and increasing the new financial support and especially the financing promised to developing and least developed countries, which will face the devastating effects of climate change in the fastest and most severe way. António Guterres, the United Nations Secretary-General, shared his message on his Twitter account, saying, "While expressing his disappointment with the outcome of CP25, the international community has missed an important opportunity to show an increasing or strengthening interest in combating climate change, adaptation and finance."

Although the Republic of Turkey signed the Paris Agreement in Paris in December 2015, it has not yet passed a confirmation from Parliament an Approval/Ratification/ Acceptance certificate to date and has not become a party legally to the UNFCCC Paris Agreement. On the other hand, as it has not yet ratified the Paris Agreement even though it may exhibit such a view of not giving enough support to the global transformation that has achieved acceleration with the Paris Agreement, Turkey is reviewing its policies in almost every area of combating climate change by adhering to sustainable development principles and is progressing on the way to improve its legal, institutional and economic system the context of new climate economy in recent years (Talu and Kocaman, 2019). Within the scope of combating climate change, implementation is being made with public and private sector resources in many sectors such as promoting the widespread use of renewable energy, implementation of all kinds of resource efficiency policies particularly with regard to energy efficiency, reduction of greenhouse gas emissions, capacity building for carbon trading (Turkey is included in the voluntary carbon trading market since 2005), improvement of ecosystem services, developing sustainability standards in the industry. In addition to these, legal and institutional infrastructure is being strengthened in order to realize the investments needed in transition to a low carbon economy, especially in cities, such as smart cities, smart transportation systems, smart grids, green buildings and green infrastructures (Talu and Kocaman, 2019).

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UNITED NATIONS 2030 AGENDA AND SUSTAINABLE DEVELOPMENT TOOLS

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1. UNITED NATIONS 2030 AGENDA

At the General Assembly of the United Nations (UN) convened in September 2000, recognizing that the strengthening of the principles of human dignity, equality and well-being at the global level is the common responsibility of the world societies, the Millennium Declaration has been announced in consensus on the development of economic, environmental and social conditions in the world by 2015. Eight Millennium Development Goals (MDGs) have been determined for the implementation of these principles. These goals are as follows:

- Eradicating extreme poverty and hunger
- Realization of universal primary education
- Ensuring gender equality
- Reducing child mortality
- Improving maternal health
- Struggle against HIV / AIDS, malaria and other diseases
- Ensuring environmental sustainability
- Developing a global partnership for development (UN, 2021).

The Millennium Development Goals have been developed for each country in a measurable and traceable way to show the progress achieved in the field of sustainable development and poverty eradication until 2015 (Peşkircioğlu, 2016).

At the United Nations Sustainable Development Summit held in September 2015, MDGs' 15 years of performance was evaluated on a global scale, which were accepted in 2000, and it was declared that the performance put forward in terms of achieving these goals was far from bringing the expected solutions to the economic, social and environmental problems faced by our world. At the summit, in the light of the experiences gained from the sustainable development process initiated with the MDGs, it was pointed out that it was necessary to determine inclusive and sustainable development goals that will provide solutions to the current problems of our world

(UN, 2015). In this context, the "2030 Agenda for Sustainable Development" has been accepted with the signature of 193 member countries, including Turkey. The Sustainable Development Goals (SDG 2030), consisting of 17 goals and 169 targets, have been defined in the 2030 Agenda document (Figure 1). This new global agenda requires the shaping of the development plans and policies of countries with an understanding that emphasizes the principle of human rights for all by 2030 (UN, 2015).

Figure 1: Global Goals

Source: UNDP, 2021

The implementation process of the SDG, which is considered as the continuation of the MDGs and includes the targets that will be universally accessible for everyone with the slogan "no one left behind", started on January 1, 2016. SDGs, which are broader than the MDGs, go beyond the MDGs by addressing the universal need for development under equal conditions for all people. Based on the progress momentum for the MDGs, the SDGs additionally include goals aimed at strengthening the economic growth and employment, improving cities and settlements, improving industrialization and infrastructure, protecting the oceans, providing sustainable energy, preventing climate change, promoting sustainable production and consumption, ensuring peace and justice and the protecting the human rights. While the MDGs are intended to act only in developing countries, SDGs have been universally adopted by all countries. Furthermore, another basic feature of SDGs is that they focus on implementation tools (financing, capacity building, trade, technology, etc.). Although SDGs are not legally binding, governments are expected to show ownership and start their implementation on a national scale to achieve SDGs (Presidency of the Republic of Turkey Strategy and Budget, 2020; UN, 2021). Sustainable Development Goals are aimed to promote combating poverty in the world in general, ensuring food and water security, meeting many social needs such as education, health, social protection and unemployment, using reliable and sustainable energy resources, making cities and human settlements safe and durable, creating durable infrastructures, protecting natural resources and ecosystems, reducing the loss of biological diversity, providing economic growth, reducing inequality, preventing income inequality, ensuring social peace and ensuring global partnership.

The Scientific Approaches and Solutions Network for Sustainable Development established by the United Nations in 2012 to bring together academia, business and civil society to work and produce solutions in line with concrete goals that will ensure the sustainability of societies, economies and nature is also supported by United Nations Sustainable Development Solutions Network (SDSN) (SDSN Turkey, 2021). In the UN 2030 agenda, development is reconsidered not only on the issue of economic growth, but also to include environmental and social concerns (UN, 2021). Emphasis is placed on the necessity of keeping the temperature increase below 1,5-2 °C and on green growth strategy by eliminating climate change from being an environmental issue. The importance of transformation has been highlighted in all sectors, and this has been reflected in environmental, economic and social goals. Combating climate change has been seen as a precondition for sustainability in order to achieve many goals (Peşkircioğlu, 2016; UN, 2021).

There is a multifaceted relationship between climate change and SDGs. The effects of climate change that threaten the future of the world and people are observed in many parts of the world. It has become a necessity to take urgent action to combat climate change and its effects, and to search for ways to become stronger and resilient against climate effects. SDG 13 focuses on urgent action to combat climate change and its effects. Unless action is taken, climate change may cause the loss of many gains achieved in recent years. Today's food and water shortages can lead to an increase in health problems and this situation may bring social conflicts with it. It is not possible to achieve global goals unless the focus is on climate change mitigation and adaptation in countries that are affected by consecutive natural disasters that cause great economic losses.

2. SUSTAINABLE DEVELOPMENT GOALS AND TARGETS

The sustainable development goals and targets and the indicators defining the evaluation criteria for these goals are given below (UNDP, 2021):

	SDG 1: End poverty in all its forms everywhere
Target 1.1:	By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day
	1.1.1 Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)
Target 1.2:	By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
	1.2.1. Proportion of population living below the national poverty line, by sex and age 1.2.2. Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
Target 1.3:	Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable
	1.3.1. Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable
Target 1.4:	By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance
	1.4.1 Proportion of population living in households with access to basic services 1.4.2. Proportion of total adult population with secure tenure rights to land, with legally recognized documentation, and who perceive their rights to land as secure, by sex and type of tenure

 Target 1.5:	By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters
	1.5.1. Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population 1.5.2. Direct economic loss attributed to disasters in relation to global gross domestic product (GDP) 1.5.3. Proportion of countries that adopt and implement national disaster risk reduction strategies
 Target 1.a:	Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programs and policies to end poverty in all its dimensions
	1.a.1. The proportion of resources allocated directly to poverty reduction programs by the government 1.a.2. Proportion of total government spending on essential services (education, health and social protection)
 Target 1.b:	Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions
	1.b.1. The proportion of government recurrent and capital spending to sectors that disproportionately benefit women, the poor and vulnerable groups

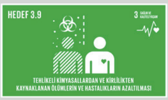
	SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
 Target 2.1:	By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round
	2.1.1. Prevalence of undernourishment 2.1.2. Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)

Target 2.2:	By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons
	2.2.1. Prevalence of stunting (height for age <-2 standard deviation from the median of the World Health Organization (WHO) Child Growth Standards) among children under 5 years of age 2.2.2. Prevalence of malnutrition (weight for height >+2 or <-2 standard deviation from the median of the World Health Organization (WHO) Child Growth Standards) among children under 5 years of age, by type (wasting and overweight)
Target 2.3:	By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
	2.3.1. Volume of production per labor unit by classes of farming/pastoral/forestry enterprise size 2.3.2. Average income of small-scale food producers, by sex and indigenous status
Target 2.4:	By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
	2.4.1. Proportion of agricultural area under productive and sustainable agriculture
Target 2.5:	By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed
	2.5.1. Number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities 2.5.2. Proportion of local breeds classified as being at risk, not-at-risk or at unknown level of risk of extinction

Target 2.a:	Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries.
	2.a.1. The agriculture orientation index for government expenditures 2.a.2. Total official flows (official development assistance plus other official flows) to the agriculture sector
Target 2.b:	Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round
	2.b.1. Producer support prediction 2.b.2. Agricultural export subsidies
Target 2.c:	Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility
	2.c.1. Indicator of food price anomalies

	SDG 3: Ensure healthy lives and promote well-being for all of all ages
Target 3.1:	By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births
	3.1.1. Maternal mortality ratio 3.1.2. Proportion of births attended by skilled health personnel
Target 3.2:	By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under 5 mortality to at least as low as 25 per 1,000 live births
	3.2.1 Under-5 mortality rate 3.2.2. Neonatal mortality rate

Target 3.3:	By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases
	3.3.1. Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations 3.3.2. Tuberculosis incidence per 100,000 population 3.3.3. Malaria incidence per 100,000 population 3.3.4. Hepatitis B Malaria incidence per 100,000 population 3.3.5. Number of people requiring interventions against neglected tropical diseases
Target 3.4:	By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being
	3.4.1. Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease 3.4.2. Suicide mortality rate
Target 3.5:	Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol
	3.5.1 Coverage of treatment interventions (pharmacological, psychosocial and rehabilitation and aftercare services) for substance use disorders 3.5.2. Alcohol per capita consumption (aged 15 years and older) within a calendar year in liters of pure alcohol
Target 3.6:	By 2020, halve the number of global deaths and injuries from road traffic accidents
	3.6.1 Death rate due to road traffic injuries
Target 3.7:	By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programs
	3.7.1 Proportion of women of reproductive age (aged 15–49 years) who have their need for family planning satisfied with modern methods 3.7.2. Adolescent birth rate (aged 10–14 years; aged 15–19 years) per 1,000 women in that age group

 Target 3.8:	Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all
	3.8.1. Coverage of essential health services (defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged population) 3.8.2. Proportion of population with large household expenditures on health as a share of total household expenditure or income
 Target 3.9:	By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
	3.9.1. Mortality rate attributed to household and ambient air pollution 3.9.2. Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services) 3.9.3. Mortality rate attributed to unintentional poisoning
 Target 3.a:	Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate
	3.a.1 Age-standardized prevalence of current tobacco use among persons aged 15 years and older

Target 3.b:	Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all
	3.b.1. Proportion of the target population covered by all vaccines included in their national program 3.b.2. Total net official development assistance to medical research and basic health sectors
Target 3.c:	Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States
	3.c.1. Health worker density and distribution
Target 3.d:	Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks
	3.d.1. International Health Regulations (IHR) capacity and health emergency preparedness

4 NİTELİKLİ EĞİTİM	SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Target 4.1.:	By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and Goal-4 effective learning outcomes
	4.1.1. Proportion of children and young people (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex

Target 4.2.:	By 2030, ensure that all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education
	4.2.1. Proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial well-being, by sex 4.2.2. Participation rate in organized learning (one year before the official primary entry age), by sex
Target 4.3.:	By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university
	4.3.1. Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex
Target 4.4.:	By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship
	4.4.1. Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill
Target 4.5.:	By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations
	4.5.1. Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated
Target 4.6.:	By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy
	4.6.1. Proportion of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex

 Target 4.7.:	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development
	4.7.1. Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment
 Target 4.a:	Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all
	4.a.1. Proportion of schools with access to (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; (e) basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic hand washing facilities (as per the WASH indicator definitions)
 Target 4.b:	By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programs, in developed countries and other developing countries
	4.b.1. Volume of official development assistance flows for scholarships by sector and type of study

Target 4.c:	By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states
	4.c.1. Proportion of teachers in (a) pre-primary; (b) primary; (c) lower secondary; and (d) upper secondary education who have received at least the minimum organized teacher training (e.g. pedagogical training) pre-service or in-service required for teaching at the relevant level in a given country

5 TOPLUMSAL CİNSİYET EŞİTLİĞİ	SDG 5: Achieve gender equality and empower all women and girls
Target 5.1:	End all forms of discrimination against all women and girls everywhere
	5.1.1. Whether or not legal frameworks are in place to promote, enforce and monitor equality and non discrimination on the basis of sex
Target 5.2:	Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation
	5.2.1. Proportion of ever-partnered women and girls aged 15 years and older subjected to physical, sexual or psychological violence by a current or former intimate partner in the previous 12 months, by form of violence and by age 5.2.2. Proportion of women and girls aged 15 years and older subjected to sexual violence by persons other than an intimate partner in the previous 12 months, by age and place of occurrence
Target 5.3:	Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation
	5.3.1 Proportion of women aged 20-24 years who were married or in a union before age 15 and before age 18 5.3.2. Proportion of girls and women aged 15-49 years who have undergone female genital mutilation/cutting, by age

 Target 5.4:	Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate
	5.4.1. Proportion of time spent on unpaid domestic and care work, by sex, age and location
 Target 5.5:	Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life
	5.5.1. Proportion of seats held by women in local administrations and national parliaments 5.5.2. Proportion of women in managerial positions
 Target 5.6:	Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Program of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences
	5.6.1. Proportion of women aged 15–49 years who make their own informed decisions regarding sexual relations, contraceptive use and reproductive health care 5.6.2. Number of countries with laws and regulations that guarantee full and equal access to women and men aged 15 years and older to sexual and reproductive health care, information and education
 Target 5.a:	Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws
	5.a.1. (a) Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; and (b) share of women among owners or rights-bearers of agricultural land, by type of tenure 5.a.2. Proportion of countries where the legal framework (including customary law) guarantees women's equal rights to land ownership and/or control

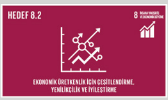
Target 5.b:	Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women
	5.b.1. Proportion of individuals who own a mobile telephone, by sex
Target 5.c:	Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels
	5.c.1. Proportion of countries with systems to track and make public allocations for gender equality and women's empowerment

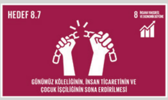
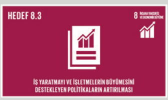
6 TEMİZ SU VE SANİTASYON	SDG 6: Ensure access to water and wastewater services and sustainable water management for all
Target 6.1:	By 2030, achieve universal and equitable access to safe and affordable drinking water for all
	6.1.1. Proportion of population using safely managed drinking water services
Target 6.2:	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
	6.2.1. Proportion of population using safely managed wastewater and sewerage services including a hand-washing facility with soap and water
Target 6.3:	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
	6.3.1. Proportion of wastewater safely treated 6.3.2. Proportion of bodies of water with good ambient water quality
Target 6.4:	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
	6.4.1. Change in water-use efficiency over time 6.4.2. Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

Target 6.5:	By 2030, implement integrated water resources management at all levels, including through trans boundary cooperation as appropriate
	6.5.1. Degree of integrated water resources management implementation (0-100) 6.5.2. Proportion of trans boundary basin area with an operational arrangement for water cooperation
Target 6.6:	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
	6.6.1. Change in the extent of water-related ecosystems over time
Target 6.a:	By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
	6.a.1. Amount of water- and wastewater-related official development assistance that is part of a government-coordinated spending plan
Target 6.b:	Support and strengthen the participation of local communities in improving water and sanitation management
	6.b.1. Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

7 ERİŞİLEBİLİR VE TEMİZ ENERJİ	SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all
Target 7.1:	By 2030, ensure universal access to affordable, reliable and modern energy services
	7.1.1. Proportion of population with access to electricity 7.1.2. Proportion of population with primary reliance on clean fuels and technology for heating, lighting and cooking
Target 7.2:	By 2030, increase substantially the share of renewable energy in the global energy mix
	7.2.1. Renewable energy share in the total final energy consumption
Target 7.3:	By 2030, double the global rate of improvement in energy efficiency
	7.3.1. Energy intensity of the economy

 Target 7.a:	By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
	7.a.1. USD mobilized per year in line with the $ 100 billion payable commitment (undertaken by countries parties to the UN Framework Convention on Climate Change to address the needs of developing countries) by 2020
 Target 7.b:	By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programs of support
	7.b.1. Investments in energy efficiency as a proportion of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services

	SDG 8: Promote stable, inclusive and sustainable economic growth, full and productive employment and decent work for all
 Target 8.1:	Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries
	8.1.1. Annual growth rate of real GDP per capita
 Target 8.2:	Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors
	8.2.1. Annual growth rate of real GDP per employed person
 Target 8.3:	Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services
	8.3.1. Proportion of informal employment in non-agriculture employment, by sex

 Target 8.4:	Improve progressively, through 2030, global resource efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programs on sustainable consumption and production, with developed countries taking the lead
	8.4.1. Material footprint, material footprint per capita, and material footprint per GDP 8.4.2. Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP
 Target 8.5:	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value
	8.5.1. Average hourly earnings of female and male employees, by occupation, age and persons with disabilities 8.5.2. Unemployment rate, by sex, age and persons with disabilities
 Target 8.6:	By 2020, substantially reduce the proportion of youth not in employment, education or training
	8.6.1. Proportion of youth (aged 15-24 years) not in education, employment or training
 Target 8.7:	Take immediate and effective measures to eradicate forced labor, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labor, including recruitment and use of child soldiers, and by 2025 end child labor in all its forms
	8.7.1. Proportion and number of children aged 5-17 years engaged in child labor, by sex and age
 Target 8.8:	Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment
	8.8.1. Fatal and non-fatal occupational injuries per 100,000 workers, by sex and migrant status 8.8.2. Level of national compliance with labor rights (freedom of association and collective bargaining) based on International Labor Organization (ILO) textual sources and national legislation, by sex and migrant status
 Target 8.9:	By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products
	8.9.1. Tourism's impact on GDP as a proportion of total GDP and growth rate 8.9.2. Number of jobs in tourism sectors as a proportion of total employment and employment growth rate, by gender

	Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all
Target 8.10:	8.10.1. Number of commercial bank branches and number of automated teller machines (ATMs) per 100,000 adults 8.10.2. Proportion of adults (15 years and older) with an account at a bank or other financial institution or with a mobile-money-service provider
	Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries
Target 8.a:	8.a.1. Aid for Trade commitments and disbursements
	By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labor Organization
Target 8.b:	8.b.1. Total government expenditure on social protection and employment programs as a proportion of national budgets and GDP

9 SANAYİ, YENİLİKÇİLİK VE ALTYAPI	SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation
	Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all
Target 9.1:	9.1.1. Proportion of the rural population who live within 2 km of an allseason roads 9.1.2. Passenger and freight volumes, by mode of transport
	Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries
Target 9.2:	9.2.1. Manufacturing value added as a proportion of GDP and per capita 9.2.2. Manufacturing employment as a proportion of total employment
	Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets
Target 9.3:	9.3.1. Proportion of small-scale industries in total industry value added 9.3.2. Proportion of small-scale industries with a loan or line of credit
	By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
Target 9.4:	9.4.1. CO_2 emission per unit of value added

Target 9.5:	Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending
	9.5.1. Research and development expenditure as a proportion of GDP 9.5.2. Researchers (in full-time equivalent) per million inhabitants
Target 9.a:	Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States
	9.a.1. Total official international support (official development assistance plus other official flows) to infrastructure
Target 9.b:	Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities
	9.b.1. Proportion of medium and high-tech industry value added in total value added
Target 9.c:	Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020
	9.c.1. Proportion of population covered by a mobile network, by technology type

10 EŞİTSİZLİKLERİN AZALTILMASI	SDG 10: Reduce inequality within and among countries
Target 10.1:	By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average
	10.1.1. Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population
Target 10.2:	By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status
	10.2.1. Proportion of people living below 50 per cent of median income, by sex, age and persons with disabilities

Target 10.3:	Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard
	10.3.1. Proportion of population reporting having personally felt discriminated against or harassed in the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law
Target 10.4:	Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality
	10.4.1. Labor share of GDP, comprising wages and social protection transfers
Target 10.5:	Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations
	10.5.1. Financial Soundness Indicators
Target 10.6:	Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions
	10.6.1. Proportion of members and voting rights of developing countries in international organizations
Target 10.7:	Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies
	10.7.1. Recruitment cost borne by employee as a proportion of yearly income earned in country of destination 10.7.2. Number of countries that have implemented well-managed migration policies
Target 10.a:	Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements
	10.a.1. Proportion of tariff lines applied to imports from least developed countries and developing countries with zero-tariff
Target 10.b:	Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programs
	10.b.1. Total resource flows for development, by recipient and donor countries and type of flow (e.g. official development assistance, foreign direct investment and other flows)
Target 10.c:	By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent
	10.c.1. Remittance costs as a proportion of the amount remitted

	SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable
Target 11.1:	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
	11.1.1. Proportion of urban population living in slums, informal settlements or inadequate housing
Target 11.2:	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons
	11.2.1. Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities
Target 11.3:	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
	11.3.1. Ratio of land consumption rate to population growth rate (for settlement) 11.3.2. Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically
Target 11.4:	Strengthen efforts to protect and safeguard the world's cultural and natural heritage
	11.4.1. Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship)
Target 11.5:	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations
	11.5.1. Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population 11.5.2. Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters

Target 11.6:	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management
	11.6.1. Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities 11.6.2. Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)
Target 11.7:	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities
	11.7.1. Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities 11.7.2. Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months
Target 11.a:	Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning
	11.a.1. Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city
Target 11.b:	By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels
	11.b.1. Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030 11.b.2. Proportion of local governments that adopt and implement local disaster risk reduction strategies
Target 11.c:	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials
	11.c.1. Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resourceefficient buildings utilizing local material

12 SORUMLU ÜRETİM VE TÜKETİM	SDG 12: Ensure sustainable consumption and production patterns
Target 12.1:	Implement the 10-year framework of programs on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
	12.1.1. Number of countries with sustainable consumption and production (SCP) national action plans or SCP mainstreamed as a priority or a target into national policies
Target 12.2:	By 2030, achieve the sustainable management and efficient use of natural resources
	12.2.1. Material footprint, material footprint per capita, and material footprint per GDP 12.2.2. Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP
Target 12.3:	By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
	12.3.1. Global food loss index
Target 12.4:	By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
	12.4.1. Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement 12.4.2. Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment
Target 12.5:	By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse
	12.5.1. National recycling rate, tons of material recycled
Target 12.6:	Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
	12.6.1. Number of companies publishing sustainability reports

Target 12.7:	Promote public procurement practices that are sustainable, in accordance with national policies and priorities
	12.7.1. Number of countries implementing sustainable public procurement policies and action plans
Target 12.8:	By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
	12.8.1. Extent to which (i) global citizenship education and (ii) education for sustainable development (including climate change education) are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment
Target 12.a:	Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
	12.a.1. Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies
Target 12.b:	Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products
	12.b.1. Number of sustainable tourism strategies or policies and implemented action plans with agreed monitoring and evaluation tools
Target 12.c:	Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities
	12.c.1 Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels

13 İKLİM EYLEMİ	SDG 13: Take urgent action to combat climate change and its impacts
Target 13.1:	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
	13.1.1. Number of deaths, missing persons and directly affected persons attributed to disasters 13.1.2. Number of people affected, missing and killed by disasters per 100 000 people

Target 13.2:	Integrate climate change measures into national policies, strategies and planning
	13.2.1. Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other)
Target 13.3:	Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
	13.3.1. Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula 13.3.2. Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions
Target 13.a:	Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
	13.a.1. Amounts mobilized in United States dollars per year in line with the $ 100 billion payable commitments (undertaken by countries parties to the UN Framework Convention on Climate Change to address the needs of developing countries) by 2020
Target 13.b:	Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities
	13.b.1. Number of least developed countries and small island developing States that are receiving specialized support, and amount of support, including finance, technology and capacity-building, for mechanisms for raising capacities for effective climate change-related planning and management, including focusing on women, youth and local and marginalized communities

14 SUDAKİ YAŞAM	SDG 14: Conserve and sustainably use the oceans, seas and marine resources

	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
Target 14.1:	14.1.1. Index of coastal eutrophication and floating plastic debris density
	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
Target 14.2:	14.2.1. Proportion of national exclusive economic zones managed using ecosystem-based approaches
	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels
Target 14.3:	14.3.1. Average marine acidity (pH) measured at agreed suite of representative sampling stations
	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics
Target 14.4:	14.4.1. Proportion of fish stocks within biologically sustainable levels
	By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information
Target 14.5:	14.5.1. Coverage of protected areas in relation to marine areas
	By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation
Target 14.6:	14.6.1. Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing
	By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism
Target 14.7:	14.7.1. Sustainable fisheries as a proportion of GDP in small island developing States, least developed countries and all countries

Target 14.a:	Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
	14.a.1. Proportion of total research budget al.,located to research in the field of marine technology
Target 14.b:	Provide access for small-scale artisanal fishers to marine resources and markets
	14.b.1. Progress by countries in the degree of application of a legal/regulatory/ policy/institutional framework which recognizes and protects access rights for small-scale fisheries
Target 14.c:	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want
	14.c.1. Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nations Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources

15 KARASAL YAŞAM	SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Target 15.1:	By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and dry lands, in line with obligations under international agreements
	15.1.1. Forest area as a proportion of total land area 15.1.2. Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type
Target 15.2:	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally
	15.2.1. Progress towards sustainable forest management

Target 15.3:	By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
	15.3.1. Proportion of land that is degraded over total land area
Target 15.4:	By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development
	15.4.1. Coverage by protected areas of important sites for mountain biodiversity 15.4.2. Mountain Green Cover Index
Target 15.5:	Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species
	15.5.1. Red List Index
Target 15.6:	Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed
	15.6.1. Number of countries that have adopted legislative, administrative and policy frameworks to ensure fair and equitable sharing of benefits
Target 15.7:	Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products
	15.7.1. Proportion of traded wildlife that was poached or illicitly trafficked
Target 15.8:	By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species
	15.8.1. Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species
Target 15.9:	By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts
	15.9.1. Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011–2020
Target 15.a:	Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems
	15.a.1. Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems
Target 15.b:	Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation
	15.b.1. Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems

	Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities
Target 15.c:	15.c.1. Proportion of traded wildlife that was poached or illicitly trafficked

	SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Target 16.1:	Significantly reduce all forms of violence and related death rates everywhere
	16.1.1. Number of victims of intentional homicide per 100,000 population, by sex and age 16.1.2. Conflict-related deaths per 100,000 population, by sex, age and cause 16.1.3. Proportion of population subjected to physical violence, psychological violence and sexual violence in the previous 12 months 16.1.4. Proportion of population that feel safe walking alone around the area they live
Target 16.2:	End abuse, exploitation, trafficking and all forms of violence against and torture of children
	16.2.1. Proportion of children aged 1-17 years who experienced any physical punishment and/or psychological aggression by caregivers in the past month 16.2.2. Number of victims of human trafficking per 100,000 population, by sex, age and form of exploitation 16.2.3. Proportion of young women and men aged 18–29 years who experienced sexual violence by age 18
Target 16.3:	Promote the rule of law at the national and international levels and ensure equal access to justice for all
	16.3.1. Proportion of victims of violence in the previous 12 months who reported their victimization to competent authorities or other officially recognized conflict resolution mechanisms 16.3.2. Unsentenced detainees as a proportion of overall prison population
Target 16.4:	By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime
	16.4.1. Total value of inward and outward illicit financial flows (in current United States dollars) 16.4.2. Proportion of seized, found or surrendered arms international standards and legal instruments

Target 16.5:	Substantially reduce corruption and bribery in all their forms
	16.5.1. Proportion of persons who had at least one contact with a public official and who paid a bribe to a public official, or were asked for a bribe by those public officials, during the previous 12 months 16.5.2. Proportion of businesses that had at least one contact with a public official and that paid a bribe to a public official, or were asked for a bribe by those public officials during the previous 12 months
Target 16.6:	Develop effective, accountable and transparent institutions at all levels
	16.6.1. Primary government expenditures as a proportion of original approved budget, by sector 16.6.2. Proportion of population satisfied with their last experience of public services
Target 16.7:	Ensure responsive, inclusive, participatory and representative decision-making at all levels
	16.7.1. Proportions of positions (by sex, age, persons with disabilities and population groups) in public institutions (national and local legislatures, public service, and judiciary) compared to national distributions 16.7.2. Proportion of population who believe decision making is inclusive and responsive, by sex, age, disability and population group
Target 16.8:	Broaden and strengthen the participation of developing countries in the institutions of global governance
	16.8.1. Proportion of members and voting rights of developing countries in international organizations
Target 16.9:	By 2030, provide legal identity for all, including birth registration
	16.9.1. Proportion of children under 5 years of age whose births have been registered with a civil authority, by age
Target 16.10:	Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements
	16.10.1. Number of verified cases of killing, kidnapping, enforced disappearance, arbitrary detention and torture of journalists, associated media personnel, trade unionists and human rights advocates in the previous 12 months 16.10.2. Number of countries that adopt and implement constitutional, statutory and/or policy guarantees for public access to information
Target 16.a:	Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime
	16.a.1. Existence of independent national human rights institutions in compliance with the Paris Principles

Target 16.b:	Promote and enforce non-discriminatory laws and policies for sustainable development
	16.b.1. Proportion of population reporting having personally felt discriminated against or harassed in the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law

	SDG 17: Strengthen implementation tools and stimulate global partnership for sustainable development
Finance Target 17.1:	Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection
	17.1.1. Total government revenue as a proportion of GDP, by source 17.1.2. Proportion of domestic budget funded by domestic taxes
Finance Target 17.2:	Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent ODA/GNI to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries
	17.2.1. Net official development assistance, total and to least developed countries, as a proportion of the Organization for Economic Cooperation and Development (OECD) Development Assistance Committee donors' gross national income (GNI)
Finance Target 17.3:	Mobilize additional financial resources for developing countries from multiple sources
	17.3.1. Foreign direct investment (FDI), official development assistance and South-South cooperation as a proportion of total domestic budget 17.3.2. Volume of remittances (in United States dollars) as a proportion of total GDP
Finance Target 17.4:	Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress
	17.4.1. Debt service as a proportion of exports of goods and services
Finance Target 17.5:	Adopt and implement investment promotion regimes for least developed countries
	17.5.1. Number of countries that adopt and implement investment promotion regimes for least developed countries

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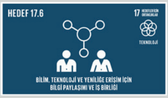
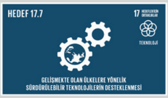
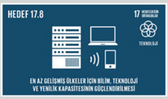
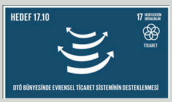
<tr><td rowspan="2">
Technology Target 17.6:</td><td>Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism</td></tr>
<tr><td>17.6.1. Number of science and/or technology cooperation agreements and programs between countries, by type of cooperation
17.6.2. Fixed Internet broadband subscriptions per 100 inhabitants, by speed</td></tr>
<tr><td rowspan="2">
Technology Target 17.7:</td><td>Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed</td></tr>
<tr><td>17.7.1. Total amount of approved funding for developing countries to promote the development, transfer, dissemination and diffusion of environmentally sound technologies</td></tr>
<tr><td rowspan="2">
Technology Target 17.8:</td><td>Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology</td></tr>
<tr><td>17.8.1. Proportion of individuals using the Internet</td></tr>
<tr><td rowspan="2">
Capacity Development Target 17.9:</td><td>Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation</td></tr>
<tr><td>17.9.1. Dollar value of financial and technical assistance (including through North-South, South-South and triangular cooperation) committed to developing countries</td></tr>
<tr><td rowspan="2">
Trade Target 17.10:</td><td>Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda</td></tr>
<tr><td>17.10.1. Worldwide weighted tariff-average</td></tr>
<tr><td rowspan="2">
Trade Target 17.11:</td><td>Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020</td></tr>
<tr><td>17.11.1. Developing countries' and least developed countries' share of global exports</td></tr>
</table>

Trade Target 17.12:	Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access
	17.12.1. Average tariffs faced by developing countries, least developed countries and small island developing states
Policy and institutional coherence Target 17.13:	Enhance global macroeconomic stability, including through policy coordination and policy coherence
	17.13.1. Macroeconomic Dashboard
Policy and institutional coherence Target 17.14:	Enhance policy coherence for sustainable development
	17.14.1. Number of countries with mechanisms in place to enhance policy coherence of sustainable development
Policy and institutional coherence Target 17.15:	Respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development
	17.15.1. Extent of use of country-owned results frameworks and planning tools by providers of development cooperation
Multi-stakeholder Partnerships Target 17.16:	Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries
	17.16.1. Number of countries reporting progress in multistakeholder development effectiveness monitoring frameworks that support the achievement of the Sustainable Development Goals
Multi-stakeholder Partnerships 17.17:	Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships
	17.17.1. Amount of United States dollars committed to (a) public-private partnerships and (b) civil society partnerships

 Data, monitoring and accountability Target 17.18:	By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts
	17.18.1. Proportion of sustainable development indicators produced at the national level with full disaggregation when relevant to the target, in accordance with the Fundamental Principles of Official Statistics 17.18.2. Number of countries that have national statistical legislation that complies with the Fundamental Principles of Official Statistics 17.18.3. Number of countries with a national statistical plan that is fully funded and under implementation, by source of funding
 Data, monitoring and accountability Target 17.19:	By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries
	17.19.1. Dollar value of all resources made available to strengthen statistical capacity in developing countries 17.19.2. Proportion of countries that (a) have conducted at least one population and housing census in the last 10 years; and (b) have achieved 100 per cent birth registration and 80 per cent death registration

CONCLUSION

In conclusion, the Sustainable Development Goals, which adopt a universal development approach by adopting holistic approaches to economic, social and environmental problems and ending the discrimination between rich, poor and middle-income countries, aims at achieving sustainable development and welfare level by monitoring progress on the global scale through basic indicators. (Republic of Turkey Presidency Strategy and Budget Office (2020)).

The UN 2030 agenda foresees the shaping of countries' development plans and policies with an understanding that emphasizes the principle of human rights for everyone, and provides guidance for the measures to be taken at national and local scale.

SDGs, which offer possibilities and opportunities in every field, are considered as guidance tools for the development plans of the countries. For example, the New Urban Agenda (Habitat III - Kito Declaration on Sustainable Cities and Settlements for All) adopted in 2016, one year after the announcement of the SDG, was developed on the basis of the SDG (New Urban Agenda, 2017). While the Agenda is based on the 11th SDG Sustainable cities and communities, it also makes reference directly or indirectly to other SDGs.

SDGs have been incorporated in the action plans of many developing countries. Global Goals have also been taken into account in the preparation of the Eleventh Development Plan in our country. Plan addressed the SDGs in a comprehensive manner and goals that can be adapted for Turkey were identified (Çelikyay, 2020).


SECRETARY-GENERAL

In addition, the European Green Deal published on 11 December 2019 and the New EU Strategy on Adaptation to Climate Change announced on 24 February 2021 directly, which clearly demonstrates the political consistency of the European Union in adaptation to climate, directly emphasize global goals. Building on the 2013 Climate Change Adaptation Strategy, the New Adaptation Strategy aims to achieve the 2050 climate-resilient EU vision by making climate adaptation smarter, more systematic, and faster and by accelerating international action. The Strategy integrates the Global Harmonization Target in Article 7 of the Paris Agreement and the 13th Sustainable Development Goal into EU law. In addition, the strategy also makes reference to SDG 14 (Life on water) and SDG 15 (Life on land), emphasizing the need to invest more in nature-based solutions to understand the relationship between climate change, ecosystems and ecosystem services, to adapt and mitigate climate change, reduce disaster risk, produce benefits in terms of biodiversity and health. With the strategy, the EU and its member states are committed to making continuous progress to increase adaptation capacity, strengthen resilience and reduce vulnerability to climate change. The new adaptation strategy includes important steps towards making this progress a reality.

In order to achieve sustainable development goals, all segments of society have duties and responsibilities. It is important for the realization of global goals that all segments of sustainable development, including states, private sector, civil society, science, business and technology, act in cooperation and collaboration in line with common goals and targets.

SDG offers a variety of opportunities by providing guidance for funding on a global scale. Goals, targets and indicators have been defined to guide the world to a sustainable route, and the right steps are required to be taken.

ACKNOWLEDGEMENT

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EU ADAPTATION STRATEGY AND INFORMATION SOURCES FOR ADAPTATION TO CLIMATE CHANGE

Prof. Dr. Ayşe Gül Tanık

1. EU ADAPTATION STRATEGY

In this section, first of all, the explanation of the basic concepts in the context of the EU adaptation strategy is given and then the studies of the EU's adaptation activities are summarized.

1.1. Basic Concepts

Climate Change:

"In addition to natural climate change observed in a comparable period, a change in climate as a result of human activities that directly or indirectly disrupts the composition of the global atmosphere"

Adaptation:

"Minor adjustments were seen in natural and human systems to combat the actual or anticipated climate alert or its effects that reduce harm or increase beneficial opportunities"

Adaptation: Adapting to the effects of climate change
Narrow Meaning: Adaptation according to the new or changing environment
Broad Meaning: Adjustments that aim at reducing the level of vulnerability to actual or predicted climate change or variability in natural systems or human systems (vulnerability) or benefiting from the opportunities.

Vulnerability states to what extent a system is affected by the adverse effects of climate change, including climate vulnerability and extreme climatic conditions, and to what extent it is unable to cope with it.

First the vulnerability should be determined in the issue of adaptation to climate change.

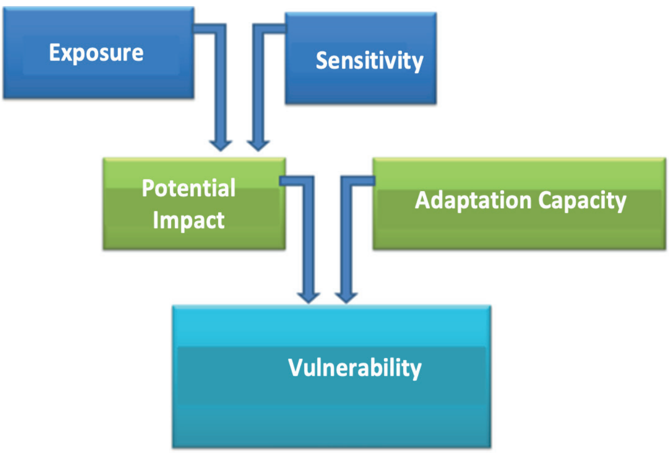
Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as "a function of characteristics, size and speed of, and sensitivity and adaptation capacity to Climate Change and variability to which a system is exposed to".

IPCC defines vulnerability from climate change as a function of three elements.

These are:

- Types and dimensions of exposure to the effects of climate change,
- Sensitivity of target systems to be exposed at a certain level,
- Capacity of the target system to cope or to adapt (UÇES, 2006; Tekten, 2016; Çörtoğlu, 2019). In Figure 1, the vulnerability functions and the relationship between functions are given schematically.

Figure 1: Vulnerability (Fragility) functions (Tekten, 2016)



Exposure: It refers to elements outside the system under study, such as changes in climate variability, including extreme weather events, or rates of change in average climatic conditions.

Sensitivity: The degree to which a system is negatively or positively affected by climate variability or change. This effect can be direct or indirect.

Adaptation Capacity: It means the ability of a system to adapt to climate change, variability and possible extreme and moderate harms, to take advantage of opportunities and cope with its consequences.

1.2. What is Climate Change Adaptation Activity?

Essentially, adapting to the effects of climate change is explained as making people's livelihoods, economies and natural systems less affected by changes due to climate, and in some cases benefitting from adaptation.

Mitigating negative consequences = reducing the likelihood of adverse events occurring
Adapting = reducing the severity of many impacts if adverse conditions persist

1.3. Why are Adaptation Activities Needed?

Climate change adaptation activities have become an increasingly important issue, especially in the last 20 years. Climate change adaptation is the actions and measures taken to help societies and ecosystems cope with changing climatic conditions. In other words, adaptation to climate change is the process of strengthening, developing and implementing strategies to combat the effects of climate events (risks), gain benefits and manage their effects (IPCC, 2007).

Even if the factors that cause climate change (greenhouse gas emissions, deforestation, etc.) are now eliminated, it is a known fact that their effects will continue for the next 50 years. For this reason, the importance of adaptation to climate change is increasing day by day. On the other hand, the economic cost to be met in order to adapt to the impacts of climate change will be much lower than the cost of the damage caused by climate change if sufficient and necessary measures are not taken, which is highlighted in the IPCC 5th Evaluation Report. For this reason, adaptation to climate change is not a necessity, it has become an obligation (IPCC, 2013).

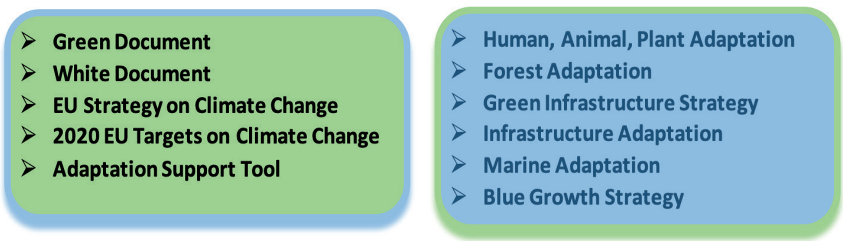
Climate change adaptation should be implemented for the following reasons:

- To understand the effects of climate change well,
- To minimize its negative effects,
- To turn some of its effects into opportunities,
- To be prepared for the effects,
- To reduce the risk and damage with the least cost,
- To solve current problems.

2. THE STUDIES-STRATEGY OF THE EU IN THE PROCESS OF ADAPTATION ACTIVITIES

The main purpose of all the documents prepared by the European Commission (EU Commission) is to ensure the preparedness of the regions that will be affected by climate change in Europe and to determine the priorities for the first and basic actions at the community level. In this context, various documents have been published and adaptation has been planned. In this section, documents and adaptations will be briefly mentioned (EU Commission, 2009; EU Commission, 2012; EU Commission, 2013a; EU Commission, 2013b; EU Commission, 2013c; EU Commission, 2015). Figure 2 schematically shows the EU harmonization documents and the sectors subject to adaptation, respectively.

Figure 2: EU adaptation documents and adaptation sectors (Tekten, 2016)



2.1. Green Paper (Document)

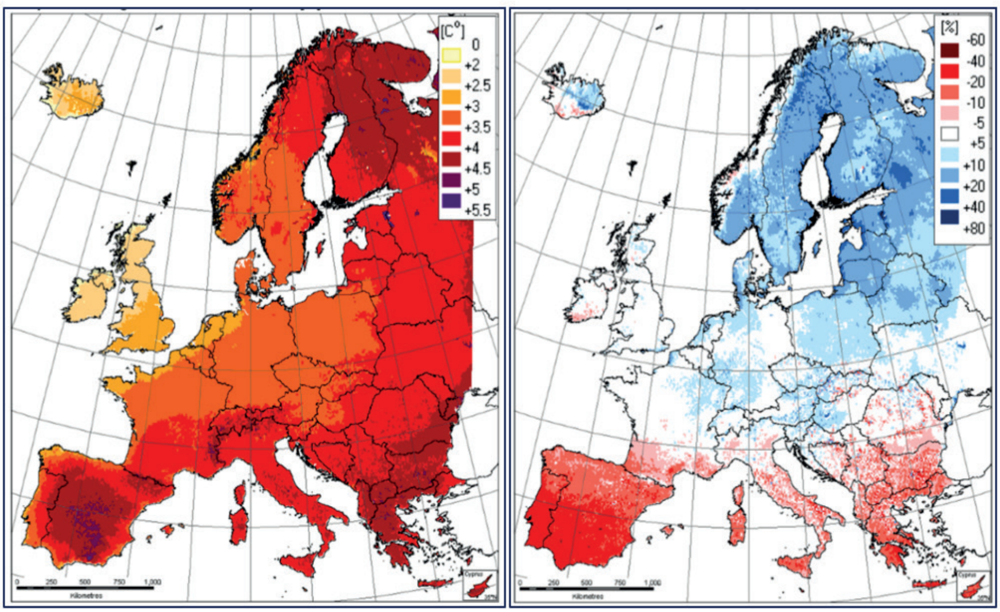
It is the first document prepared by the European Commission. The purpose of the Green Paper is the setting of priorities for the first and main actions at the community level. For this reason, the commission has focused on 4 main lines.

- Developing adaptation strategies at European level.
- Coordinating adaptation measures with neighbors and strengthening them with international organizations.

- Reducing uncertainties and expanding the knowledge base. Also integrating research results into policy and practice.
- Discussion of coordinated strategies and actions in the European Advisory Group on Adaptation to Climate Change under the European Climate Change Program.

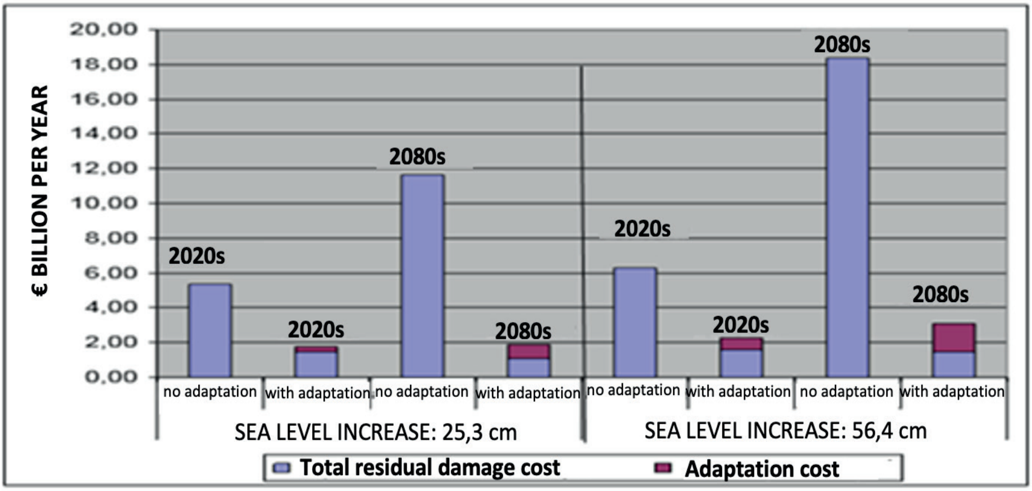
Figure 3 shows the annual (a) temperature change forecast between the years 2071-2100, (b) the precipitation rate variation forecast, made with reference to the changes in the years 1961-1990. In Figure 4, the impact of the adaptation measures to the damage caused by low and high sea level rise and the costs that will occur if adaptation measures are taken and not taken, are given as an example study.

Figure 3: Annual (a) temperature change estimation, (b) precipitation rate variation estimation between 2071-2100 made with reference to the changes in the years 1961-1990 (Arıkan & Özsoy, 2008)



(a) (b)

Figure 4: The impact of the adaptation measures to the damage caused by low and high sea level rise and the costs that will occur if adaptation measures are taken and not taken



2.2. The EU's Studies-Strategy in the Process of Adaptation Activities

The aim of the strategy it to create a basic framework to minimize the effects of climate change and to ensure that the EU countries act together within this framework. Ongoing/proposed / planned studies within this framework are summarized below.

- Reviewing the economic situation for strategic approaches,
- Expanding the knowledge base,
- Increasing the resilience of coastal and marine areas, agriculture and animal husbandry, ecosystems, production systems and physical infrastructure,
- Providing the necessary financing to carry out the studies,
- Carrying out joint works with The United Nations Framework Convention on Climate Change (UNFCCC),
- Supporting all member states to create comprehensive adaptation strategies.
- Supporting LIFE (HAYAT) funds in order to support capacity building and

accelerate adaptation actions in Europe between 2014 - 2020.

- Promoting adaptation to mayors under the Convention.
- Filling the information gaps.
- Also developing 'Climate-ADAPT' understanding in Europe.
- Facilitating the Common Agricultural Policy (CAP), the Adaptation Policy (AP) and the Common Fisheries Policy (CFP) in the context of climate proofing.
- Building more resilient infrastructure systems.
- Introducing insurance and other financial products for flexible investment and business decisions (Climate-ADAPT, 2020).

2.3. 2020 EU Joint Environmental Action Program

The European Parliament and the European Council set the targets to be achieved by 2020 in November 2013. The action program consists of the following nine priority targets that the EU needs and are desired to be achieved by 2020. All the information given below is compiled from the report '2020 EU Objectives' published by the European Commission (EU Commission, 2015). These goals are outlined below.

- Preserving, saving and increasing the Union's 'Natural Capital'.
- Transforming the Union into a resource-efficient, green and competitive low-carbon economy.
- Protecting EU citizens from environmental pressures and risks for health and well-being.
- Maximizing the benefits of European Union environmental legislation by developing practices.
- Increasing environmental information and expanding the database for policies.
- Preserving, saving and increasing the Union's 'Natural Capital'.
- Transforming the Union into a resource-efficient, green and competitive low-carbon economy.
- Protecting EU citizens from environmental pressures and risks for health

and well-being.

- Maximizing the benefits of European Union environmental legislation by developing practices.
- Increasing environmental information and expanding the database for policies.

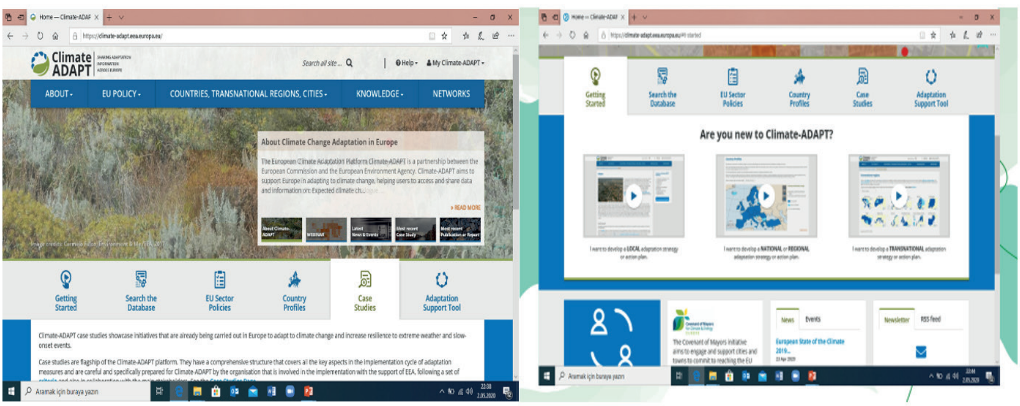
2.4. Adaptation Support Tool

6 steps of the adaptation support tool are given on the Climate-ADAPT web page (Climate-ADAPT, 2020). These are:

- Preparing the region for adaptation,
- Making risk and sensitivity assessment to climate change,
- Determining adaptation options,
- Evaluating adaptation options,
- Implementation,
- Monitoring and development.

Figure 5 presents images of the explanatory guide page for those who first enter the EU Climate Adaptation website.

Figure 5: Climate-ADAPT web page images (Climate-ADAPT, 2020).



2.4.1. Human, Animal and Plant Adaptation

The focus is on how the EU can take action against all diseases seen or likely to be seen in Europe. In addition, the human, animal and plant health monitoring follow-up programs used by the EU are also included in the document. All the information given below is compiled from the report "Human, Animal, Plant Adaptation" published by the European Commission (EU Commission, 2013d).

I.Direct and indirect effects of climate change on human health

- Increase of extreme weather events and their impact on human health
- Food and foodborne diseases
- Food and food safety issues
- Water-related problems
- Air quality
- Allergies
- Ultraviolet radiation
- Increasing health inequalities
- Vulnerable groups
- Environmental migrations

II. EU capacity in responding to the effects of climate change on human health

- Legal rule
- International Health Regulations
- Political context
- European Environment and Health Action Plan
- EU health strategy
- EU health program
- EU statistics program
- Networking for infectious diseases control

- Health Safety Committee
- European Center for Disease Prevention Control (ECDC)
- Food safe response mechanisms
- European food safety authority - foodborne risks
- EU Framework Programs for research on human health

2.4.2. Forest Adaptation

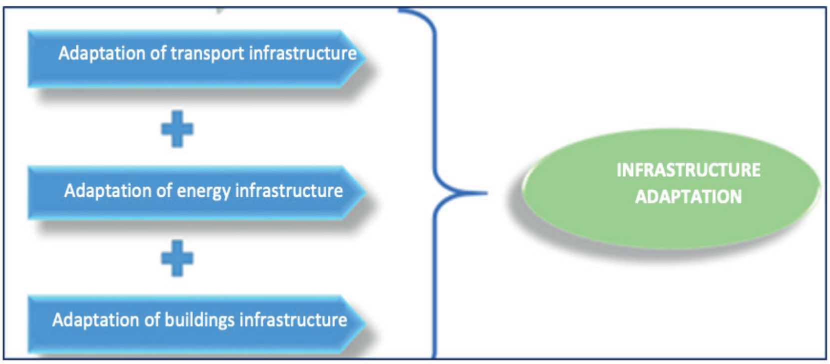
It is aimed with this adaptation step to ensure that all forests in the EU are managed according to forest management principles. So this attitude of the EU will increase the promotion of sustainable forest management and reduce deforestation on a global scale (EU Commission, 2013a).

- It meets the demands of balancing various forest functions and contributes to the development of vital ecosystem services.
- It provides a competitive and sustainable environment for forestry and all forest-based value chains to contribute to the bio-economy.

2.4.3. Infrastructure Adaptation

Infrastructure adaptation is generally divided into 3 as transportation, energy and building infrastructure adaptation (EU Commission, 2013b). Figure 6 shows the components of infrastructure adaptation.

Figure 6: Components of infrastructure adaptation



Case Studies:

- Responding to climate effects: Railways between Copenhagen and Ringsted in Denmark,
- Greening roofs and facades in Austrian cities,
- In Sweden and Norway adaptation of electricity networks to climate change.

2.4.3.1. Benefits of Green Infrastructure

Green infrastructure is an extremely important issue in the EU. The benefits of green infrastructure are explained at every opportunity (EU Commission, 2013c). Figure 7 shows the EU's report and book frontend on green infrastructure for information.

Environmental benefits

- Providing clean water,
- Separation of pollutants from air and water,
- Increased pollination,
- Protection against soil erosion,
- Rainwater accumulation,
- Increased pesticide control,
- Improving the land quality.

Social benefits

- Health and human well-being,
- Formation of new professions,
- Diversification of the local economy,
- Creation of more impressive and greener cities,
- High property values and region-specific properties,
- More integrated transportation and energy solutions,

- Increasing tourism and recreation opportunities.

Climate change adaptation and mitigation benefits

- Flood reduction,
- Increasing ecosystem resilience,
- Carbon storage,
- Reducing the heat island effect in cities,
- Protection from natural disasters such as forest fires and landslides.

Benefits to biological diversity

- Developing habitats for wildlife,
- Creating ecological corridors,
- Increasing the permeability of the land.

Figure 7: The EU's report and book frontend on green infrastructure (EU Commission, 2013c)

2.4.4. Marine Adaptation

Effects of climate change on coastal areas and the sea were determined by the EU Commission in 2012 (EU Commission, 2012). The main effects are briefly listed below. Also in Figure 8, the annual average sea surface temperature time series created by taking the average temperatures of the European seas between 1986 and 2010 as a reference is shown. Figure 9 shows the sea level rise in Europe between 1970 - 2010.

Environmental Impact:

- Increase in seawater temperature,
- Change in the ice layer,
- Sea level rise,
- Acidification of the oceans,
- Coastal erosion,
- Coastal wetlands,
- Thermohaline cycle,
- Marine fish population,
- Biodiversity,
- Eutrophication.

Current policy framework and related adaptation activities at EU level:

- Marine Framework and Flood Directives.
- Maritime Strategy Framework Directive.
- Integrated Coastal Management.
- Natura 2000, Habitats and Bird Directives.
- EU Fund.

Figure 8: Time series of average annual sea surface temperatures based on the average temperatures of European seas between 1986 and 2010.

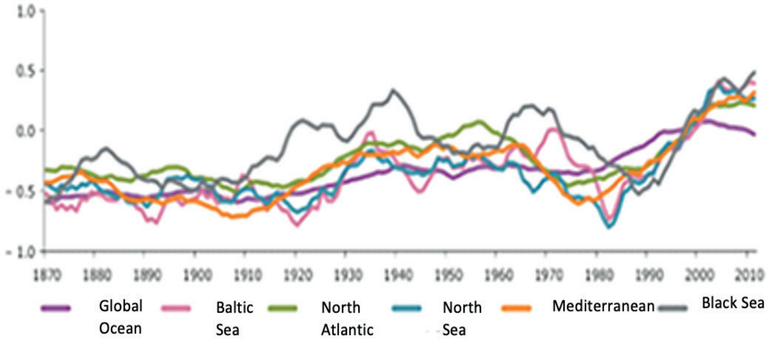
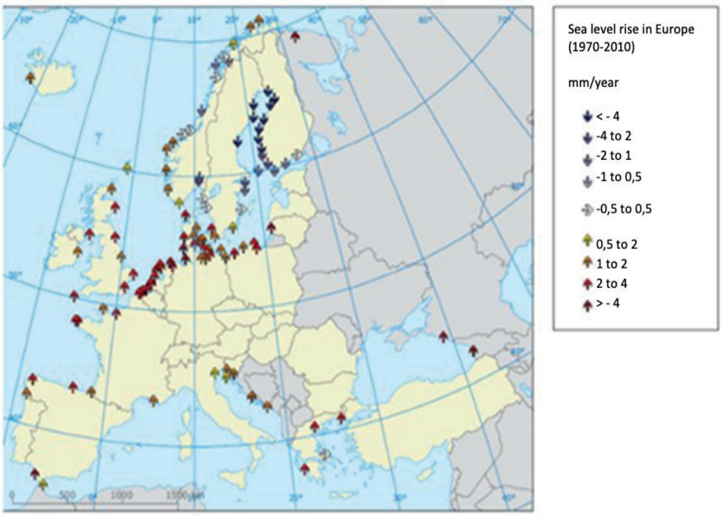


Figure 9: Sea level rise in Europe between 1970 and 2010.



Activities of the Member States:

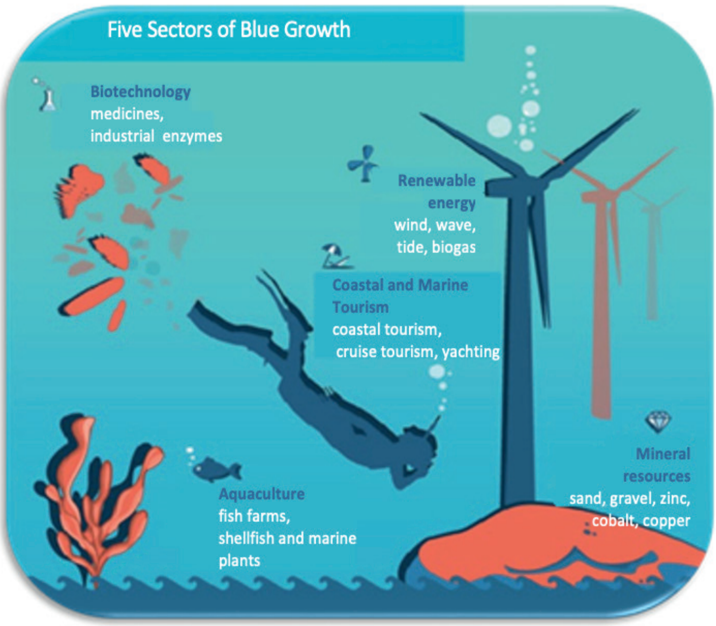
- Protection: Sea walls or rigid structures.
- Withdrawal Management.
- Accommodation: Reinforcing hills or allowing periodic flooding through wetlands.

2.4.4.1. Blue Growth Strategy:

The 5 sectors of blue growth are visually shown in Figure 10. These are:

- Blue energy
- Aquatic culture
- Maritime, coastal and cruise tourism
- Marine mineral resources
- Blue biotechnology.

Figure 10: 5 sectors of blue growth (EU Commission, 2015)



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CLIMATE CHANGE ADAPTATION

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

1. CLIMATE CHANGE ADAPTATION

Climate of the earth has been changing rapidly and these effects have been experienced prominently. Scientific findings show that the atmosphere temperature has increased one degree compared to the pre-industrial era and that this increase will continue. Even if the greenhouse gas emissions are reduced significantly, earth will continue to warm for decades and the effects of the emissions which accumulate in the atmosphere throughout years will be felt for centuries (ABTRD, 2016).

The increase of pressure on the natural resources results in the pollution of soil, water and air. These also increase the climate risks. Evidence show that climate change enhances the severity and the frequency of the extreme weather events such as droughts, floods, fires, storms and agricultural product loss. It is expected that the climate change will cause large scale ecological, social and economic outcomes until the end of this century and even after that.

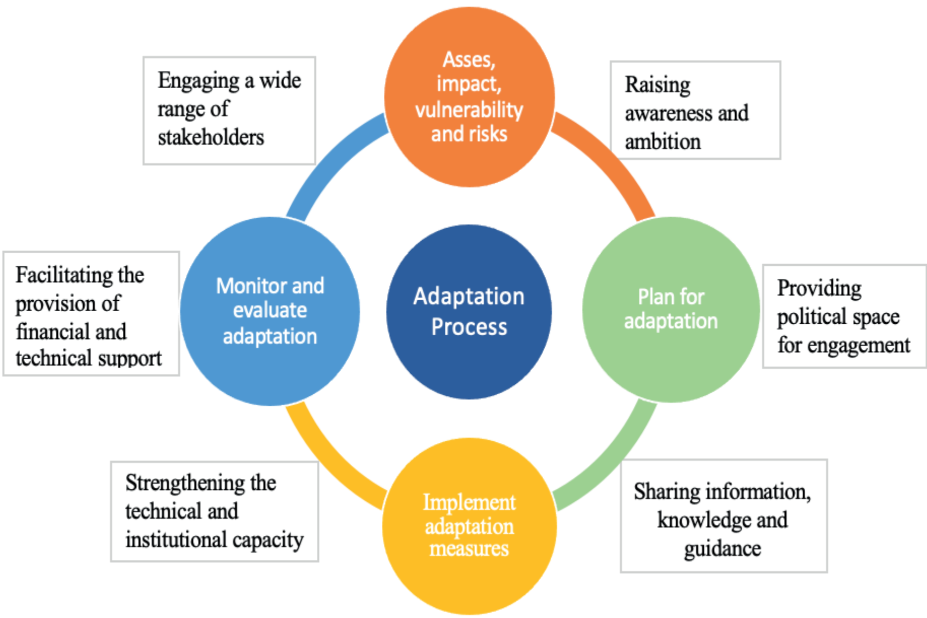
Climate change is a global problem and its effects are experienced in local scale. Therefore; all countries must be prepared for the climate effects; take measures in order to protect ecosystems, human populations and their economies against the climate effects and learn how to live with the changing climate; in order words, they must adapt to the climate change.

Climate change adaptation is defined as to anticipate the negative effects of the climate change, to prevent or minimize the damage which can be caused by these effects and to take the necessary measures regarding the ecological, social and economic aspects with the aim of strengthening of the climate resilience (ABTRD, 2016).

In this context, adaptation involves comprehending how and in what way the climate changes by utilizing the existing scientific data, mitigating the risk and vulnerability against the possible effects by developing predictions and estimates with regards to how the climate may change in the future and what effects this might have, investigating the possibilities of capacity building in order to cope with the climate change effects and the transferring this capacity into decisions and actions (Tompkins et al., 2010) (Figure 1).

The actions of adaptation and mitigation are not their alternatives; instead they complement each other. Mitigation refers to reducing or limiting the greenhouse gas emissions; whereas adaptation refers to strengthening the resilience to the climate change by decreasing the vulnerability and minimizing the negative effects of the climate change while simultaneously providing benefit.

Figure 1: Adaptation process



Source: United Nations Climate Change, 2020

Questions regarding the climate change adaptation process:

What are the possible effects that can result from the climate change?
What are the vulnerabilities in the face of these effects?
What are the risks that can be encountered with?
How can we adapt to these difficulties and changes?
How can we decrease the severity of the changes which may occur in the future?
How can the climate resilience be built?
Is there a legislation supporting the adaptation process?

Under the leadership of United Nations and European Union, many countries take a series of measures in order to decrease greenhouse gas emissions. Adaptation policies support these endeavors. When the adaptation and mitigation endeavors are combined by a "mitigate and adapt" perspective, the scope of risk becomes narrower; nonetheless, not all the risks are eliminated. The adaptation measures determine the level of climate risks in the future and facilitate to cope with the inevitable results of the climate change. By managing the risks caused by the climate effects; the adaptation changes ensure to protect the ecosystems as well as the societies and individuals, to make the economy resilient and to benefit from the potential opportunities.

Climate Change Adaptation;

involves solutions decreasing the vulnerability.
provides risk management with regards to the climate change.
involves local solutions with effects expanding to larger scales.
ensures high success when integrated to the existing spatial plans.
The adaptation measures can be reactive or proactive.

There is no 'one-size-fits-all-solution' for climate change adaptation. Adaptation types and methods are determined uniquely based on the ecological, socio-cultural and economic circumstances of the field for which a solution is desired to be created; by taking the necessities resulting from the climate risks and vulnerabilities into the account (Noble et al., 2015; United Nation Climate Change, 2020) and they can be in various scales and forms. Many nations and communities are already taking steps to build resilient societies and economies, but considerably greater action and ambition will be needed to cost-effectively manage the risks, both now and in the future (United Nation Climate Change, 2020).

Climate change adaptation is defined as a social learning process where many sectors and stakeholders focusing on the same goal work in cooperation and take responsibility (Smit and Wandel, 2006). In this process; all central and local administration units, public institutions, private businesses, national and international non-governmental organizations and respective stakeholders as well as the individuals have a complementary role. Individuals and businesses often provide support to the climate adaptation decisions in order to protect their incomes and livelihoods against the climate risk. Efficient administration of the scientific knowledge strengthens the adaptation process by the active and continuous participation of the stakeholders into the process.

In order to be successful in the climate adaptation process; countries must take measures in various fields (Leary et al., 2008; Climate Change National Action Plan, 2012; ABTRD, 2017; Talu, 2019; Talu and Kocaman, 2019; United Nation Climate Change, 2020). These measures can be defined as;

- identification of the climate risks,
- Taking the adaptation actions as soon as possible,
- Preparing climate change adaptation strategies / improving the strategies according to new approaches,
- Preparing / improving the climate change action plans,
- Fulfilling the required legal and administrative conditions which are needed in order to realize the adaptation actions (Integrating the climate adaptation measures into the sectoral, local, national and international climate change policies by making the required arrangements in the legislation),
- Integrating the adaptation measures into local administration policies, preparing local climate adaptation action plans,

- Allocating financial resources for the climate adaptation actions,
- Strengthening the institutional capacities for adaptation actions,
- Developing a climate communication strategy,
- Establishing a national climate platform,
- Developing a combined, integrated approach between the sectors,
- Increasing the awareness and knowledge in the society with regards to the climate change,
- Ensuring the scientific data collection and data management for climate change adaptation,
- Ensuring data and information flow between the relevant institutions,
- Identifying the adaptation as research priority, providing research and development support,
- Assigning duties and responsibilities to related stakeholders in the climate adaptation process,
- Ensuring the active participation of the risk groups (sensitive groups) into the adaptation process,
- Ensuring that the adaptation actions are embraced,
- Monitoring and evaluating the activity of the adaptation actions regularly.

As the climate change affects all countries, a coordinated and efficient action in an international level must be taken. The climate change adaptation began to be a subject of arguments in the international platform since the beginning of the 2000's; even so, its importance in the fight against the climate change has been clearly emphasized in the Paris Agreement (November 2016). For this reason, the Paris Agreement is considered to be a milestone in the international arena in terms of coping with the effects caused by the climate change. Turkey has signed the Paris Agreement in 2016, but did not ratify it.

In article 7 of the Agreement, "a global adaptation goal" is defined which must contribute to a sustainable development in the context of long term temperature goal; strengthen the adaptation capacity against the climate change in a manner to ensure that the adequate adaptation measures are taken; increase the resilience and decrease the vulnerability (Craft and Fisher, 2018; Cerit Mazlum, 2019).

European Union have been taken the most significant steps in the world for the climate change adaptation. European Commission has developed an EU adaptation strategy devoted to making Europe in 2013 more resilient to the climate change. This strategy provides a framework with regards to coping with the existing and future effects of the changing climate. The strategy has three main priorities as: encouraging the actions performed by the EU countries; incorporating the issues regarding the climate change adaptation into the EU policies and programs and managing the decision-making processes in a more informed manner by eliminating the lack of information by the adaptation endeavors (ABTRD, 2017).

The countries need to provide financial support for adaptation actions. It is a subject of controversy how and under which circumstances this support will be accessed by the developing countries during the climate adaptation process. There are several funds supports which can be used within this scope.

EU member nations are supported by the European Structural and Investment Funds (ESI Funds) for the adaptation to climate change actions, which are integrated to all sectoral policies. These are: European Regional Development Fund (ERDF), European Social Fund (ESF), Cohesion Fund (CF), European Agricultural Fund for Rural Development (EAFRD), and European Maritime and Fisheries Fund (EMFF). In addition that other types of funds are available such as Horizon 2020, which supports the research and development regarding the climate change adaptation which is funded by the EU for non-EU countries; LIFE, which finances various projects relating to the environment, emission mitigation and adaptation to the climate and EU Solidarity Fund, which is created for natural disasters (Talu, 2019). In addition; the investments for the adaptation to the effects of the climate change are financed and integrated to the credits by European Investment Bank and European Bank for Reconstruction and Development (Talu, 2019).

Climate-ADAPT (European Climate Adaptation Platform) finances the adaptation endeavors in Europe. Mayors Adapt initiative has been started in 2014 under the Covenant of Mayors by the European Commission with the aim of encouraging the climate change adaptation actions for the cities. The initiative ensures the establishment of communication and cooperation networks to support the climate change adaptation process and to increase public awareness at the local level where the effects of climate change will be felt the most. (ABTRD, 2016). This initiative has been included into the Covenant of Mayors on Climate and Energy Contract, which is currently re-structured.

One of the most significant steps taken by EU relating to the adaptation to the climate change after the EU Adaptation Strategy is the new growth strategy titled European Green Deal, which is declared on 11 December 2019. This strategy, which simultaneously includes the mitigation and adaptation measures, aims to become a carbon-neutral continent by reducing the emissions by year of 2050, to create new business opportunities and to improve the quality of life. Moreover, the strategy is considered as a route map directed to the use of the resources in an efficient and sustainable manner by a clean economy, decreasing of pollution, the promotion and enhancement of the biological diversity.

Another important step by the EU is the proposal of the European Climate Law, which is approved by the EU commission on 4 March 2020. The Climate Law is significant due to the fact that not only it is going to legally bind the zero-emission goal of the EU for the year 2050 but also it is going to form basis for the mitigation and adaptation measures.

In addition to these; European Industrial Strategy which is declared on 10 March 2020, Circular Economy Action Plan proposal which is declared on 11 March 2020, Farm to Fork Strategy which is expected to be declared in year 2020 and 2020 EU Biological Diversity Strategy are going to strengthen the legal legislation of the EU regarding the climate adaptation.

Lack of financial resources to be used for the adaptation actions, inadequacy of the human capacity and lack of data, complication of authority between the institutions, lack of experienced personnel and administrators, ambiguities related to the effects of the climate change, insufficiency of the legislations, inadequacy of the political and individual embracing and the lack of technological equipment can be listed among the factors which are encountered as hindrances in the process of adaptation to the climate change (Augiar et al., 2018; Smit and Wandel, 2006).

Climate change adaptation is a learning by doing process. In order to achieve the goals from the combined efforts with regards to the climate adaptation; the adaptation strategies must be considered as prioritized goals and must be continuously improved considering the current circumstances and support of the society must be obtained. Regular monitoring and evaluation of the activity of the adaptation actions as well as making necessary changes when needed are very important for the success of the adaptation process. The experiences and results will constitute benefits for the further investigations.

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CLIMATE CHANGE ADAPTATION PLANNING
MATRIX FOR ADAPTATION PLANNING

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

CLIMATE CHANGE ADAPTATION PLANNING

Solutions specific to local conditions are developed in climate adaptation planning. The first stage in adaptation planning is identifying the vulnerabilities. A reliable up-to-date national (central) database, evaluation tools and expert personnel who have the knowledge and skill to use data processing and evaluation tools are needed to identify the vulnerabilities. Experience obtained from example works make quite valuable contributions to the process.

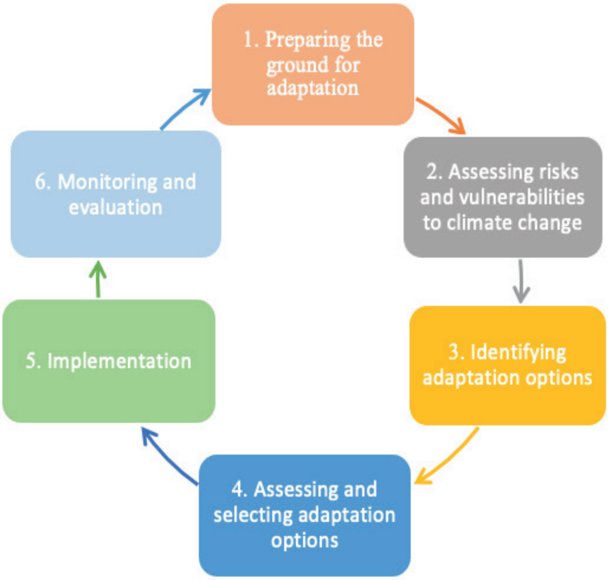
First of all, the climate resilience of the area/region must be determined, for which climate adaptation planning will be made. Resilience is the capacity of the system to have the functions before the risk, under the risk and after the risk in order for the system to function healthily. The wisest solution here is to increase the resilience, that is, resistance, of the system's capacity. By this means, occurrence of non-compensable problems in the system will be prevented when the next risk happens. A climate resilient system may completely reverse an occurred risk.

In some countries, software packages were developed, called climate resilience tool, that can be used for this purpose (Urban Adaptation Support Tool, 2020; Climate Risk Screening and Management Tool, 2017; Urban Adaptation e-Guide, 2020; Let`s respond toolkit 2012; US Climate Resilience Toolkit, 2019). There are also tools that allows access the details of adaptation plans of the countries and the mx and adaptation actions they have taken at global scale such as `NDC Explorer, The Economics of Climate Adaptation (ECA) and Tool and Urban Adaptation Map Viewer` (NDC Explorer, 2020; Munich Climate Insurance Initiative (MCII), 2020; ClimateADAPT, 2020).

The method used for developing solutions to mitigate climate-induced risks by identifying the damages caused by climate change generally consists of 6 stages (US Climate Resilience Toolkit 2019; ClimateADAPT, 2020) (Figure 1). These are as follows:

1.Preparing the ground for adaptation (Identifying effects and damages),
2. Assessing risks and vulnerabilities to climate change
3. Identifying adaptation options (investigating the options),
4. Assessing and selecting adaptation options (identifying the priorities) and planning,
5. Implementation (taking action),
6. Monitoring and evaluation

Figure 1: Adaptation planning process



Source: ClimateADAPT, 2020

1. PREPARING THE GROUND FOR ADAPTATION (IDENTIFYING EFFECTS AND DAMAGES / SENSITIVITY ANALYSES)

At this stage, proper conditions for implementing the climate adaptation actions are identified. The method to be used for this may be described as follows:

1.1. Obtaining political support for adaptation

Climate change is not often considered a political goal because of lack of information on climate change, uncertainties in long term climate risks and economic priorities. However, strong political support and reinforcing legal legislation are needed for the adaptation actions to be successful. To ensure long term commitment for adaptation from political decision-makers or senior public management (which goes beyond the legislative period), raising awareness might be necessary at first.

1.2. Collecting initial information

Development of adaptation policy must be based on evidence and reliable information. It will be identified whether the climate constitutes a risk for natural and cultural assets. Before adaptation planning climate stressors and non-climate stressors are identified. Conditions that exacerbate hazards and promote damage are called stressors, and they come from both climate and non-climate realms. Climate stressors are weather events; non-climate stressors are changing of drainage pattern due to long land use decisions, increasing of impermeable surfaces, deterioration of natural ecosystems, etc. (US Climate Resilience Toolkit, 2019).

For example, heavy rain may occur in the place where adaptation planning will be made. In a case where rainwater drainage system collects the entire water and removes it there will not be any problem. However, if the heavy rain falls on a day when the soil is saturated with water, then the soil holds less water, the rainfall runoff may exceed the capacity of the rainwater drainage system and a flood may occur.

The best way to identify the potential climate risks is to evaluate the past events (Table 1). After identifying climate and non-climate stressors, it will be investigated whether these stressors increase, remain constant or decrease.

Table 1: Climate/non-climate stressors

Data type	Data source
Weather forecasts Observed trends Climate projections	Seasonal and daily weather forecasts Extreme events monitoring (heat waves, cyclones, storms, floods) Modelling results of global circulation models Modelling results of regional climate and impact models Local knowledge
Environmental assessments and natural hazards	Environment agencies Resource management authorities
Current vulnerability and adaptive capacity assessments	Population, demographic and socio-economic data Health records Maps of infrastructure, green/blue and grey infrastructure maps, green space, public health facilities
Socio-economic future projections	Population projections Spatial development plans Scenarios of political developments, consumption patterns, infrastructure development, market transformation, etc.
Other relevant strategies, policies and plans	Existing flood, storm, heat wave, drought, or other hazard plans. Strategies for: Sustainable/economic development Spatial planning Water and resources management Environmental protection

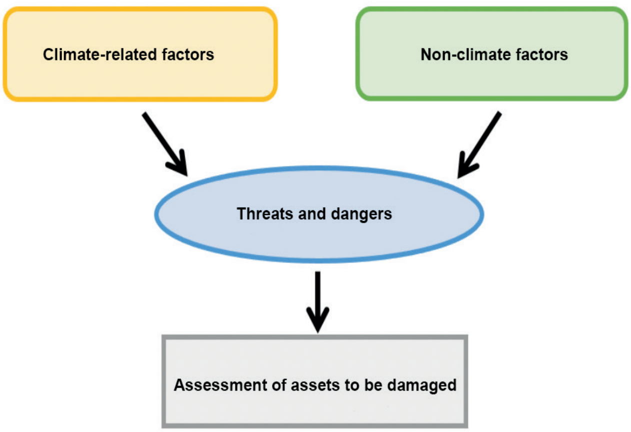
Kaynak: ClimateADAPT (2020)

In order to develop solutions for climate hazards it is necessary to understand the climate data in the past periods. It will be determined how the climate changed in the past using various models and tools for this purpose and predictions will be developed for how it will change in the future. It will be determined whether there is any change in climate effects such as heavy rain, drought, hot air wave that intensify the damage and their frequencies of occurrence. Non-climate stressors (changing of natural drainage patters, increasing of impermeable surfaces, etc.) which were caused by wrong land use decisions that would turn into hazards at the time of the risk will be identified.

Natural and cultural assets to be protected will be identified with a common understanding taking into consideration the present climate data and the potential conditions in the future and it will be evaluated how these will be affected from climate change (Figure 2).

Natural and cultural assets to be protected and climate hazards that would affect them will be compiled in a list. Giving all stakeholders the opportunity to express what they value and the reason for it would be very beneficial.

Figure 2: Identifying climate and non-climate stressors and damages



Source: US Climate Resilience Toolkit (2019)

It needs to be determined to which assets will be affected by the climate risks and to what extent. Potential or previously occurred hazards will be identified. All this data will be marked on a matrix (Table 2).

Table 2: Example of matrix for identifying assets and related hazards

Stakeholder	Natural and cultural as-sets	Climate hazard	Potential or Historical Consequences	Climate stressors	Non-climate stressors
City	Metro sta-tion	Flood	Flooded Sta-tion, interrup-tion of trans-portation ser-vices	Uzun süreli şiddetli yağış	Kent içindeki akarsu yataklarının daraltılması, beton kanallara alınması ve kentte geçirimsiz yüzeylerin artması nedeniyle yeşil/mavi ve gri altyapıya taşıyamayacağı kadar yük binmesi
City	Forest ecosystem in the vicinity of the city	Prolonged high temperature	Forest fires	Extreme tem-peratures and drought peri-od	Forest ecosystems being damaged due to human im-pacts such as building roads and high-tension lines and houses into the forest

Source: US Climate Resilience Toolkit (2019)

After the matrix is completed, it will be determined whether climate hazards will cause damage to natural and cultural assets and decision will be made in line with the common opinions of the stakeholders which problem will be dealt with.

At this stage, answer will be sought for the question;

`Do the climate risks harm the people or valuable assets?' (Yes / No). If the answer is YES, then there is a climate resilience problem to be solved. Vulnerability and risk analyses must be made.

1.3. Setting up adaptation processes within and beyond the municipality

Adaptation requires making numerous decisions among sectors at different levels. A certain institutional structure needs to be established for a successful, consistent adaptation that ensures continuity. An organization, department or a smaller employee group should be given clear assignment for the management of the adaptation process. In order for the process to continue without interruption, tasks must be distributed in the group, representatives must be appointed, and communication program and communication strategies must be defined.

1.4. Identifying and obtaining human and technical resources

Different requirements and different resources need to be accessed in adaptation processes. For this reason, every adaptation process has a structure peculiar to itself regarding institutional structure and management characteristics. There are many different options for the human resources and technical infrastructure to be used in adaptation actions. The most appropriate options must be determined by taking into consideration the level of exposure of the area for which adaptation planning will be made to climate change risks and its vulnerability, the size of the population and the assets under risk, diversity of the sensitive sectors and existing institutional structure.

1.5. Identifying and obtaining financing and funding

Financial limitations are often shown as an obstacle for initiating and implementing adaptation actions at all scales. There are various funds at global level that provide financial support for adaptation actions. These funds, which are provided by public and private sector, may also be used together. Besides the funds, financial resources can also be provided for adaptation actions through taxes and various incentive loans.

Being well informed about fund and finance opportunities will facilitate integration of adaptation to existing planning processes and existing budgets.

1.6. Identifying and engaging stakeholders

Adaptation is a process which runs at horizontal and vertical planes and brings together various sectors. For this reason, in order to develop a suitable stakeholder strategy and to benefit from the stakeholders representing the sectors in the best way based on this strategy, it is important to define the key stakeholders at the beginning of adaptation planning process.

In identifying the sectors to be included in the process, classifying them and making the job descriptions it is possible to utilize RESIN method, which has been developed for this purpose (RESIN, 2020).

1.7. Communicating adaptation to different target audiences

A successful communication network is needed for obtaining the political and public support for adaptation actions, strengthening public participation and encouraging private sector activities. It is a prerequisite for communication to be in suitable formats to allow access to different target groups and designed to include proper messages for common adaptation efforts between responsible authorities and affected stakeholders.

Adaptation to climate change may be a new subject for the stakeholders or it may be familiar to them or there may be previous negative connotations related with terms such as 'risks' or 'security flaw'. A communication strategy can be developed to convey the adaptation with easily understandable messages that are associated with familiar expressions and that will create positive attitudes.

1.8. Finding additional support

Additional support can be provided for adaptation process by organizing activities such as meetings, workshops and seminars for adaptation actions at different scales.

1.9. Preparing the ground for adaptation: Self check

It will be evaluated by using checklists whether the conditions targeted at the preparation stage are achieved or not. The stages where expected progress was not made will be reviewed and new solutions will be developed. Afterwards vulnerability and risk analysis stage will be started.

2. ASSESSING CLIMATE CHANGE RISKS AND VULNERABILITIES

This is the most complicated stage of the climate adaptation planning and climate resilience building process. The risks that emerge due to present and predicted climate hazards will be identified together with the vulnerabilities against these risks. It will be decided whether the climate risk affecting natural and cultural assets is acceptable or not.

For example, if the people and the natural and cultural assets to be protected in the area of adaptation planning are in flood zones, fire risk areas or in regions where there is the risk of occurrence of a climate hazard, then they are under risk and they will be affected by these risks. Determining the extent these risks will take effect in case they occur will provide guidance data for adaptation planning.

The steps to follow in this process can be defined as follows:

2.1. Recognizing past and present climate impacts

Analyzing the climate in the past periods and the change the climate has shown in time, obtaining detailed information about extreme weather events experienced in the past will help to better understand how the present risks will be affected by the climate change effects in the long term.

2.2. Understanding climate projections and future impacts

Climate change adaptation must be based on the assessment of the future effects of changing climate conditions. It is predicted that many climate effects will cause much more frequent and more severe versions of the present extreme weather events.

Different projections must be developed involving optimistic and pessimistic scenarios by utilizing climate data of the past periods. Climate change is affected by many factors directly or indirectly and does not have a linear characteristic. Projections based on this prediction, which defines possible climate effects, will be utilized in developing the adaptation actions.

2.3. Identifying vulnerable urban sectors

Climate change is a global problem and affects all geographical regions. However, some regions, areas and sectors are affected more by the present and predicted climate effects because of their high vulnerabilities or low adaptation capacities.

Identifying sensitive and vulnerable sectors is important for prioritizing and focusing on the adaptation efforts. Especially, the vulnerabilities of urban sectors may be high.

For example, floods may affect human health, transportation and infrastructure sectors. Hot and cold air waves are among biggest climate threats for human health. They also have significant effects on functioning of ecosystems.

2.4. Conducting risk and vulnerability assessments

Risk analyses focus on predicted changes in climate conditions, inventory of potentially affected assets, probability of occurrence of the effect and its consequences. Vulnerability analysis defines how systems, natural and cultural assets and human communities are exposed to this effect, their sensitivities and their adaptive capacity against the effect. Risk and vulnerability analyses address both the defenselessness and effects of the climate hazards.

Various methods have been developed for risk and vulnerability analyses. In top-down planning approach, quantitative data (population data, climate models, etc.)

and maps are used for defining the risks. In bottom-up planning approach, on the other hand, risks are identified using local information. In vulnerability analyses based on indicators, predetermined indicators are used that may be qualitative or quantitative and that can be evaluated by consultation with stakeholders. Besides these, a rapid risk scanning method based on existing information can also be utilized.

The stages of a vulnerability analysis based on indicators developed for the purpose of identifying the probability of climate change causing irreversible changes on natural and cultural assets are given below.

In this example, it is intended to determine how close the natural and cultural assets in the city and in its immediate vicinity are to the potential tipping point.

First of all, the situations that define the tipping points of the natural and cultural assets will be identified. If possible, some indicators of the probability of reaching the tipping point will be defined (for example (1) high probability, (2) probable, (3) low probability and (4) very low probability, etc.) and this data will be marked in the relevant sections of the matrix (Table 3).

Table 3: Example of matrix for identifying assets and related hazards

Assets	Climate hazard	Potential or Historical Consequences	Climate stressors	Non-climate stressors	Tipping point and reaching the tipping point (1-2-3-4)
Metro station	Flood	Flooded Sta-tion, interruption of transportation ser-vices	Prolonged heavy rain	Due to the nar-rowing of the river beds, tak-ing them them into concrete canals and the increase of impermeable surfaces in the city, the load on green /blue and gray infra-structure can not be carried	Frequency of heavy rainfall sincreases, the region where the metro station is located is below the road elevation, the metro station was built on the wetland High probability - 1

Assets	Climate hazard	Potential or Historical Consequences	Climate stressors	Non-climate stressors	Tipping point and reaching the tipping point (1-2-3-4)
Forest ecosystem in the vicinity of the city	Prolonged high temperature	Forest fires	Extreme temperatures and drought period	Forest ecosystems being damaged due to human impacts such as building roads and high-tension lines and houses into the forest	Frequency of high temperature increases the drought and fire hazard, it increases pressure and climate risk factors on the forest ecosystem High probability -1

Source: US Climate Resilience Toolkit, 2019

With the vulnerability analyses, the most vulnerable natural/cultural assets or people will be identified. Numerous vulnerability analysis reports will be evaluated in the adaptation planning process. Sensitivity and adaptive capacity values are used to make the final decision and classify the vulnerabilities of natural/cultural assets.

Sensitivity is the state of a population or asset being resistant or unresistant against the effects of climate events (Bierbaum et al., 2014). Sensitivity of every asset may be classified as very high, high, medium or low.

Adaptive capacity, on the other hand, is defined as the state of a system to cope with stress or new conditions (Brooks and Adger, 2004). For example, plant and tree species which are resistant to drought keep living under drought conditions without being damaged; this shows these plants have high adaptive capacity. Adaptive capacity of the said natural and cultural assets and be classified as high, medium or low, similar to the sensitivity level. These values are marked in the relevant columns of the matrix (Table 4).

Table 4: Example of matrix for sensitivity and vulnerability classification of natural and cultural assets

Assets	Climate hazard	Potential or His-torical Consequences	Sensitivity (Low/Medium/ High)	Adaptive capacity (Low/ Medium/ High)	Vulnerability (Low/ Medium/ High)
Metro station	Flood	Flooded Station, interruption of transportation services			
Forest eco-system in the vicinity of the city	Prolonged high temper-ature	Forest fires			

Source: US Climate Resilience Toolkit, 2019

The values in the table, related research, results and notes will be re-evaluated altogether and vulnerability rates of each natural and cultural asset will be determined. In general, vulnerability is high when sensitivity is high and adaptive capacity is low. In other words, the potential to reach the tipping point is high.

By taking into consideration the values in the matrix the asset or assets that have the lowest vulnerability, therefore that needs protection the most are determined.

In the next stage, the climate risks that affect the natural and cultural assets with high vulnerabilities need to be predicted. For this purpose, a matrix will be prepared, an example of which is given in Table 5. In order to define the risk, predictions will be developed for factors such as probability of loss and magnitude of loss.

In determining the probability of loss and magnitude of loss, records will be utilized showing how often this threat occurred in this region in the past and what socio-economic losses were experienced. It will be assessed whether the climate change affected its frequency and/or severity and, based on the obtained findings, the probability of loss and magnitude of loss can be classified as low, medium, high and very high.

Table 5: Example of matrix for assessment of climate risks of natural and cultural assets

Most vulnerable natural/ cultural assets	Probability of loss (1-Low/2-Modearate /3-High/ 4-Very high)	Magnitude of loss (1-Low/2-Modearate /3-High/ 4-Very high)	Risk
	high (3)	very high (4)	

Source: US Climate Resilience Toolkit, 2019

Expressing the potential consequences of climate risks on natural and cultural assets with a numerical value facilitates the comparison of the risks. For this purpose the following equation can be used for risk assessment:

Climate risks will be marked in the natural and cultural assets risk identification matrix (Table 6).

The following question will be asked at this stage: `Is the climate risk on the asset acceptable? (Yes/No).

If the answer is no, then investigation of options stage will be initiated. If the risk is acceptable, work can be started for other problems.

Table 6: Risk characterization matrix example

Probability of loss			
	Magnitude of loss		

Source: US Climate Resilience Toolkit, 2019

2.5. Understanding the role of surrounding areas in adaptation

Climate effects occurring in a region may indirectly affect another region. For this reason, the climate effects around the area or region being considered for adaptation planning must also be evaluated.

2.6. Identifying main adaptation concerns and defining objectives

At this step, it is intended to develop a strategy for adaptation planning based on the assessment of risks and vulnerabilities related with climate.

The analyses defining the severity of the effects and present disaster risk mitigation strategies, plans and management structure will be taken into consideration to identify the basic adaptation concerns (for example, which sector or which climate effect should be handled first). In view of the extensive nature of the climate change risks and opportunities, it is recommended to make this prioritization with full participation of the stakeholders.

2.7. Assessing climate change risks and vulnerabilities: self check

It will be evaluated by using checklists whether the conditions targeted at the stage of identifying the climate risks and vulnerabilities are achieved or not. The stages where expected progress was not made will be reviewed and new solutions will be developed. Afterwards the stage of identifying adaptation actions will be started.

3. IDENTIFYING ADAPTATION ACTIONS (INVESTIGATING THE OPTIONS)

A detailed action plan specifying how, when and by whom the adaptation actions will be implemented is very important for local adaptation. Identifying potential adaptation options and narrowing down is important for developing the action plan (at this step).

Also, adaptation options may allow benefitting from positive opportunities caused by climate change. Adaptation options may vary from soft adaptation actions such as activities creating adaptive capacity (for example, generating information and sharing information, forming supportive institutional framework) or management systems and supporting mechanisms (for example land management planning , insurance mechanisms) to soft adaptation actions such as frequently used ecosystem/ nature based solutions implemented at local scale. The steps to be followed in this process can be defined as follows:

3.1. Creating a catalogue of relevant adaptation options

When starting to compile the adaptation options catalog, general approach and goals of the adaptation planning must be taken into consideration. In general, one or more of the following is intended to be achieved with the adaptation options:

- Acknowledging the climate effects and risks,
- Mitigating losses by sharing risks and losses,
- Avoiding exposure to climate risks by developing climate resilience,
- Utilizing new opportunities.

Also, soft and hard adaptation solutions may be considered. After the priority risks are identified, methods will be investigated to develop solutions for these risks at the same time.

Strategies must be developed to mitigate all risks. In order to prevent the stakeholders' approach of prioritizing their own sectors, preparing a list giving a wider angle of view may facilitate the functioning of the process.

Even if the stakeholders have their own solution proposals for the problems, discussion and evaluation of the proposals by the team will develop new points of view. A table may be prepared for potential solutions and strategies.

The following questions may help to develop innovative and creative solutions:

- What could have been done if the budget were not a restricting factor?
- Could there be a solution that can be applied partially at the moment and applied in entirety afterwards?
- What are the measures that can increase the resilience without spending more money?
- Can social education campaign be a risk mitigating factor by increasing awareness?

Learning from experience on similar risks will facilitate the design and implementation of resilience projects. Comparisons can be made with case studies prepared for similar purposes to evaluate the effectiveness and suitability of the developed solution proposals. By this means, potential solutions and strategies can be identified.

First of all, it will be appropriate to list all applicable solutions for every risk. Then, two options will be considered in more detail at the next stage. These are not to be defenseless against the risk and to increase the adaptive capacity. The purpose is to prevent damage to people and natural and cultural assets to be protected.

Afterwards, work will be conducted to identify the most applicable solution among the potential solutions. Answers to the questions such as the following may help identifying the applicable actions:

- Would this solution have changed the consequences in the past?
- Is it strong enough to cope with the climate risks predicted to occur in the future?
- Can it create new opportunities?

Solutions may include options to move the assets to be protected to somewhere else or to make changes in the landscape for keeping the damage at a certain place.

In some cases, the most appropriate solution could not be implemented because of budget or capability restrictions. On the other hand, some applications may result in unwanted consequences. It would be appropriate to classify the possible solutions as applicable, potentially applicable and non-applicable among them.

It must be reviewed at this stage how much progress in made in the process with the information obtained in this process. It must be assessed whether the solutions developed for the problems are suitable or not. It must be investigated whether it is required to re-shape the framework and include other stakeholders in the process. Increasing of adaptive capacity can be achieved with applications implemented in the short term and solutions based on long term planning.

As a result of these evaluations, the list of solutions approved by the stakeholders will be obtained.

3.2. Finding examples of good adaptation practices

Even if though is possible to define numerous options for applicable adaptation actions, there may not be enough information available on the effectiveness of these actions. For this reason, it is important to identify the adaptation actions applied under similar conditions and obtain information about the success levels of these examples. Sharing the success of adaptation actions will raise the reliability of these actions.

3.3. Identifying adaptation options: Self check

It will be evaluated by using checklists whether the conditions targeted at the stage of identifying the adaptation actions are achieved or not. The stages where expected progress was not made will be reviewed and new solutions will be developed. Afterwards the stage of evaluation of adaptation actions will be started.

4. ASSESSING AND SELECTING ADAPTATION ACTIONS (IDENTIFYING THE PRIORITIES) AND PLANNING

After the potential adaptation options are identified, the next steps are evaluating the options according to detailed information and criteria and prioritize them. Proposed options must be evaluated to determine the suitability of adaptation solutions for local conditions and their effectiveness in mitigating climate vulnerabilities or increasing flexibility.

Selection of the adaptation options preferred to prevent maladaptation must be made together with all actors and stakeholders affected by the adaptation process.

The steps to be followed in this process can be defined as follows:

4.1. Choosing an assessment framework for adaptation options

In order to compare different adaptation options properly, it is necessary to evaluate every adaptation option according to certain criteria.

There are many criteria that can be used to evaluate the appropriateness of possible options; for example, effectiveness to mitigate vulnerability, effect on sustainability or cost. In order to prevent conflict among the sectors, all actors must actively participate in the evaluation stage of the adaptation options.

It is preferred to focus on win-win and no-regret solutions when making decisions. Win-win solutions are adaptation actions that mitigate climate risks and also make significant contribution to other social, environmental or economic goals by utilizing potential opportunities. No-regret solutions on the other hand, define actions that provide benefit regardless of the scope of the climate change.

In the evaluation of the adaptation options, it must be taken into consideration to what extent the options will provide benefit to reach the adaptation goal and what would be the social and environmental effects at a larger scale.

4.2. Conducting a cost-benefit analysis of adaptation measures

Benefit/cost analysis is an effective tool in determining the best adaptation strategy for adaptation actions. There are three commonly used approaches for evaluating the benefits and costs of the adaptation options. They are; Cost-Benefit Analysis (CBA), Cost-Effectiveness Analysis (CEA) and Multi-Criteria Analysis (MCA).

It may be necessary to produce adaptation solutions for problems that have strong effects in the short term. However, the solutions developed today must be flexible enough to be adaptable to the solutions to be produced in the future.

Before implementing the adaptation actions, it must be evaluated whether the investments made on it will mitigate the risk or not. In order to define the solutions effectively, they are expected to lower the severity of the losses in addition to decreasing the probability of occurrence of the losses.

At this stage, risk management consultants can be consulted to provide contribution to the process. For the purpose of deciding whether any action considered for solution is useful or not, implementation cost can be compared with the expected value of the benefit. If the total value of the mitigated risk, increased flexibility and common benefits is comparable to the implementation cost or is expected to have a higher value, then the expected value is positive.

Among the implementation alternatives, the ones that are worth to make investment with the existing budget will be determined by looking at the benefit/cost ratios. It will be investigated whether additional resources can be provided or not.

The implementation cost of every adaptation solution should be compared with the expected value of the benefit it will provide. It should not be forgotten that estimating the potential benefits of non-material things such as the ecosystems will result in numerous expected values. Furthermore, in some cases an adaptation option may have suitable cost because of the reason that it delays the occurrence of the risk. This type of situations must be taken into consideration in this process.

For adaptation actions that do not yield a positive expected value, the previous steps will be repeated to develop another solution.

4.2. Prioritising adaptation options

The optimal adaptation options will be identified based on the evaluation of possible adaptation options. In practice, each compliance measure performs differently on multiple conflicting criteria that should be evaluated in decision-making processes.

A checklist will be made to determine which adaptation option will be the optimal one (Figure 3). Adaptation alternatives will be evaluated in the list regarding the following criteria:

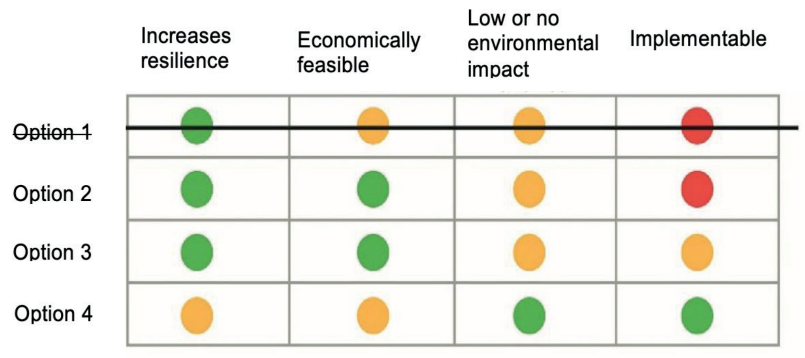
- Increases resilience?
- Economically feasible?
- Low or no environmental impact?
- Implementable?

Success criteria for adaptation options can be evaluated as yes, no or maybe.

It should be ensured at this stage that the services required after the risk occurred (ambulance, search and rescue, etc. technical services)

In cases where the budget is not sufficient to develop feasible solutions, it is investigated whether the most effective solutions can be realized in a few steps.It may be more economical to implement more than one project at the same time than to implement the projects one by one.

Figure 3: Checklist example



Source: US Climate Resilience Toolkit, 2019

4.3. Assessing and selecting adaptation options: Self check

It will be evaluated by using checklists whether the conditions targeted at the stage of prioritizing adaptation options are achieved or not. The stages where expected progress was not made will be reviewed and new solutions will be developed. Afterwards the stage of implementation of adaptation actions will be started.

5. IMPLEMENTING ADAPTATION (TAKING ACTION)

Implementation of adaptation actions is generally guided by the adaptation strategy and the action plan. Alternatively, a plan may be developed to spread the adaptation to existing related policy fields.

Participation of all stakeholders in implementation of adaptation actions within the scope of identified schedule will increase the success of the process. Political, scientific, technologic, social and economic supports in the implementation process also provide advantage. Obtaining support from non-government organizations and prominent persons is one of the factors that increase awareness. The steps to be followed in this process can be defined as follows:

5.1. Designing an effective adaptation action plan

After the climate risks and vulnerabilities are evaluated and adaptation options are identified, a framework will be produced for the implementation of the adaptation action (strategy and action plan).

When implementation of the actions is not entirely incorporated into existing sectoral policies, they are generally guided by a special adaptation strategy and an action plan accompanying it. Adaptation strategy summarizes the vision and direction of the adaptation actions and the expected results. Action plan identifies what needs to be done to convert the selected adaptation options to actions.

5.2. Finding examples of adaptation action plans

It will be beneficial to examine the adaptation action plans prepared by other countries and cities at the stage of preparing the adaptation action plans. This will also help to strengthen the communication network.

5.3. Mainstreaming adaptation in urban policies and plans

Adaptation should not be considered apart from the present political framework covering sectoral policies, strategies, practices, management processes and organization structures. Present political structure extension strengthens the adaptation profile. It may allow more efficient use of the resources, help decision makers find their synergy between development and adaptation and decrease the conflicts between policies. Climate adaptation must also be extended to sectoral policies. Spatial planning, risk management and budget are also quite important.

5.4. Addressing climate change through adaptation and mitigation

Adaptation and mitigation are two complementary elements. In order to achieve global adaptation goals, they need to be integrated into adaptation actions together.

5.5. Implementing adaptation: Self check

It will be evaluated by using checklists whether the conditions targeted at the stage of implementation of the adaptation actions are achieved or not and the stage of monitoring and evaluation of adaptation actions will be started.

6. MONITORINGING AND EVALUATING ADAPTATION

In order to determine the adaptation actions' level of success in creating or increasing climate resilience, it is required to monitor and assess the adaptation actions in regular intervals. The obtained benefits and achievements must be shared as effects of creating climate resilience with the direct and indirect beneficiaries and stakeholders. Successes create opportunities for finding new funds and obtaining support from major investors.

At this stage, answer to the question "Did the implemented plan increase the climate resilience?" will be sought. If the answer is yes, then the goal has been reached. Results must be monitored, and small changes must be made when needed. If the answer is no, the results are below the expectations. It is required to go back to the steps of defining potential risks and producing solutions and new solutions must be produced as soon as possible, to improve the process.

Monitoring also allows detecting whether adaptation actions cause any unwanted effects or not. The most important elements of monitoring and evaluation are selection of the proper criteria and using the assessment results for developing climate adaptation actions. The steps to be followed in this process can be defined as follows:

6.1. Developing the monitoring and evaluation approach

In order to determine the effectiveness of the adaptation process in time and ensure its continuity, a monitoring and evaluation plan or strategy will be determined in the adaptation strategy and action plan.

It is intended to determine whether the proposed adaptation actions were implemented or not, whether the implementations met the expected results and whether the applied precautions attained their goals or not.

In order to establish an effective monitoring and evaluation method, it is necessary to define strong indicators, to have successful information management process and to ensure the active and continuous participation of all stakeholders.

6.2. Defining monitoring indicators

Measurable indicators and metrics are preferred because they provide "evidence" for the effectiveness of adaptation actions.

6.3. Finding examples of adaptation monitoring indicators

When defining the indicators for monitoring the adaptation actions, it would be appropriate to examine indicators and metrics developed for the same purpose.

6.4. Using monitoring results to enhance the process of adaptation

An effective monitoring and evaluation framework defines the monitoring data and how this data, monitoring result, will be processed. Monitoring the results of adaptation actions provides information to the decision makers about the effectiveness of the monitoring systems and whether the adaptation actions need any modification or not. Answers to the following questions will be sought in the monitoring process:

- Have the adaptation goals (short, medium and long term) been reached?
- Have ecologic, social and economic vulnerabilities been mitigated?
- Is the process being managed successfully?
- Are the adaptation process and investments transparent?

- Were there any unforeseen problems in the process?
- Should the process be continued? (GIZ, 2011).

Monitoring will be done in varying periods according to the type of the adaptation action. It is useful to define the baseline when creating the monitoring framework, this way, it will be easier to determine if the expected results of an adaptation action have reached or not.

6.5. Monitoring and evaluating adaptation: Self check

It will be evaluated by using checklists whether the conditions targeted at the stage of monitoring and evaluation of the adaptation options are achieved or not.

The success of adaptation plans is directly related with whether they have the flexibility not to be seriously affected by uncontrollable factors such as economic crisis, epidemics, etc. that may affect the project outputs and with the measurement of effectiveness of every step before advancing to the next step.

Opportunities must be sought to correct any wrong step and approaches must be modified. If needed, previous steps must be checked for wrong calculations. In such a case, possibilities must be reviewed to reach the goals and additional actions must be identified.

Climate adaptation planning is a learning process. Feedbacks and modifications are needed based on time and conditions. There may be successful and unsuccessful strategies in this process. In order for other experts to benefit from these experiences, the project process should be published as a case study for accessible sharing; this will contribute to the support of adaptation endeavors.

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THE ADAPTATION OF LOCAL GOVERNMENTS TO CLIMATE CHANGE - VISION OF A CLIMATE RESILIENT SOCIETY

Prof. Dr. Elif Çolakoğlu

1. INTRODUCTION: HOW DOES CLIMATE CHANGE AFFECT THE CITIES?

Changing climate is turning the cities into unsafe living spaces. Resulting security risks can turn into humanity crises, even if they vary depending on the development level of the countries. In the last 150 years, the rise in global temperatures reached a level that can be called a record, with 1,14 °C (NOAA National Centers for Environmental Information, 2020) (McElroy, 2002). As a natural consequence of degradation of the functioning in ecosystems, this rise causes warming up of the oceans, rising of sea levels, decreasing precipitations and melting of the ice. However, it is foreseen that the situation will be even worse in the future because of this state of affairs. Beyond the commitments made in Kyoto Protocol, even if the level of development became different since 1990's to today, it has been observed that all countries have increased their carbon dioxide emissions by more than 50% (IPCC, 2018). Furthermore, according to IPCC (2013), the highest temperature of the last 30 years has been recorded. To a great extent (75%), cities are responsible for this rise (UNEP, 2020). Cities are the main source of greenhouse gas emissions and they make a significant contribution to the climate change.

Despite this, urban living spaces are the ones that are most affected by the effects of the climate change. As a natural consequence of the rise in sea levels with the melting of the glaciers due to the rise in the global temperatures and warming atmosphere, security risks emerge especially in coastal cities. It is reported that the rise in sea level in some ocean basins have reached 15-20 cm since 1993. The fastest rise in sea level in USA occurs in the Gulf of Mexico, for example. Sea level drops at some places in Alaska and Northwest Pacific, but as this trend continues, the possibility of reversal becomes higher due to greenhouse gases. While this is the situation, about 40% of the population in the country lives in coastal regions with high population density that are open to hazards due to flood, coastal erosion and storms caused by the rise of the sea level. For this reason, critical urban structures such as roads, bridges, metros, water resources, oil wells, power plants, sewerage treatment plants, storage areas sustain damages as a consequence of the disasters that occur at certain periods in the country (Lindsey, 2019). Even though years have passed after it, because of the humanity crises it created, Hurricane Katrina is a striking example, which covered seven states of the country and caused the deaths of about two thousand people, because the cost of this hurricane to the country is 156,3 billion US Dollars in total (CRED & UNISDR, 2018). In the region where extraordinary situation was declared, only the city of New Orleans was flooded almost entirely (Haddow et al., 2011). All critical infrastructures including oil and natural gas pipelines were damaged (Amadeo, 28.01.2020). In the life of USA, these kinds of hurricanes are accepted as a reality of the country because of the geographical structure. However, changing climate is increasing the number of these hurricanes as well as their intensity and duration every day. A total of 103 hurricanes occurred in the country since 2005 including Hurricane Katrina (Insurance Information Institute, 10.02.2020). It is claimed that Hurricane Sandy in 2012 is the second lethal hurricane after Hurricane Katrina. It caused the deaths of 44 people in New York metropolitan area in one day and caused huge financial losses (53,5 billion US Dollars). It is also reported that 88.700 buildings were left under flood waters and about 2 million people were affected by being without electric power for days (Rosenzweig and Solecki, 09.06.2016; Çolakoğlu, 2016; CRED & UNISDR, 2018). In addition to New York, the city of Los Angeles, which is among the largest 8 coastal cities of the world , is also under the same risk. It is reported that 136 cities with a total population of 400 million are under this risk because of coast floods (Mobjörk et al., 2016).

In addition to storms and hurricanes, floods also happen in cities as a consequence of extreme rains. It has been recorded that 157 thousand people died and 2,3 million adversely affected because of floods between years 1995-2015. However, it is indicated that 56% of these floods are related with the changing climate. Cities in Asia and Africa are the regions where the cities most affected by this situation are located. For example, it was stated that in South America, 560 thousand people on average are affected every year by floods between years 1995-2004, but this figure increased about fourfold in subsequent years and reached 2,2 million people (CRED

& UNISDR, 2016). Of course, as the countries' level of development and welfare goes down, the effects of extreme weather events such as this can be more fatal and graver. Only in Pakistan, approximately 20 million people were affected and 2 thousand people died because of the floods caused by extraordinary extreme monsoons (2011). It is said that in Bangladesh around 64 to 100 thousand people are left homeless every year because of river bank erosion. In Bangladesh, which is one of the poorest countries of Asia, 320 floods occurred, 2,5 million people died and 450 million people were adversely affected since 1990. Compared to other disasters of climate change origin in the same period in this country, the ratio of floods and landslides is reported to be 32% (CRED Crunch, 2020). Problems could also be encountered that turn into internal unrest and protests. In Thailand, 2 million people were affected by the floods caused by intense monsoon rain in 2011 and this triggered anti-government protests (Çolakoğlu, 2019; The German G7 Presidency, 2015). An economic loss of 1,891 trillion US Dollars was caused because of the floods in this period (CRED & UNISDR, 2016). It is possible to increase the number of these examples. In Africa, 64% of the disasters that occurred between years 2000-2019 consist of floods (CRED Crunch, 2019a).

However, even though only 26% of the disasters that occur in the world happen in low-income countries, the number of deaths in these countries is higher (89%) compared to developed countries (CRED & UNISDR, 2016). Although the level of intensity may be the same, the high level of development of the said countries and their strong and resilient urban infrastructures enable them to combat more strongly against similar situations and take these disasters under control as much as possible. For example, as a consequence of pouring rains in Copenhagen in 2011, houses were flooded, railroads, highways and metro transport network and drainage and sewerage structures of the city were heavily damaged (BBC News, 03.07.2017) and only 894 million Euros of damage was suffered over the country (The Nordic Insurance Associations, 2013). These extreme rains may cause landslides on mountains and hills outside the cities. This, in turn, cuts off roads, disrupts the transportation and communication, and hinders the distribution of emergency situation needs such as food in disaster situations. In the flood disaster in Liguria region of Italy (2014) more than 100 landslides occurred, 70 people lost their lives and more than 200 people were forced to leave their homes (Klizista-hr, 22.06.2018). However, it is claimed that almost all of the present Italian municipalities are under the risk of flood and landslide and the cost of these natural disaster between years 2006-2016 to the country is approximately 15 billion US Dollars (DW, 26.11.2016; Çolakoğlu, 2019). While Italy and Hungary are the two countries that are affected the most by floods in Europe, the population living in such areas corresponds to 11% (6.7 million people) of the total population in Italy and 18% (1.8 million people) in Hungary (FloodList, 2016).

Urban heat islands compounded by heat waves increase the hot air pollution and aggravate cardiovascular and respiratory diseases, they may even cause deaths. In 1995 in Chicago 739 people, most of them elderly, lost their lives because of increased temperatures and it was recorded that more than 3 thousand people were hospitalized (Whitman et al., 1997). It is foreseen that the number of deaths in this city between years 2081-2100 may be 166 to 2,217 per year (Basu, 2015). The reason for this is that, even though every measure is taken since 2000, the number of death incidents is seen to rise continuously. Serious increases are also observed in the cities of European countries. Only in the summer of 2003, more than 70 thousand people died and more than 300 million people were recorded to be taken ill because of diseases such as asthma (WHO, 2018). There are also death incidents that occur due to extreme cold caused by the changing climate. In a study conducted in 13 countries (Gasparrini et al., 2015) with more than 74 million death records between years 1985-2012 obtained from 384 settlement areas, it is claimed that the number of deaths occurring in moderately cold weathers is higher than the number of deaths occurring in moderately hot weathers (Kiraz, 2019). People of advanced age and people suffering from ailing health condition are significantly affected by both situations.

It is claimed that the earthquakes and volcanic activities that increased in frequency in recent years is a natural consequence of the climate change. According to reports, between 1998-2017, geophysical disasters of climate origin killed 1,3 million people, an additional 4,4 billion people were injured, became homeless, displaced or needed emergency assistance. 563 earthquakes (7,8%) and 99 volcanic activities (1.4%) were found to be related with climate in this period. These earthquakes caused the deaths of 747 thousand people only in this period and also caused material damage of 661 billion US Dollars (23%) over the world. Even though their effects are less severe compared to earthquakes, it was declared that due to volcanic activities combined with fires that are difficult to extinguish 1,648 people died, 5,8 million people were affected and 41 billion US Dollars of damage occurred (CRED Crunch, 2019b). Droughts are one of the consequences of climate change and they cause more losses to be suffered in the economies of countries compared to other disasters. In fact, they constitute only 4% of the disasters caused by the climate, but it is indicated that they result in significant losses from economic point of view. Only 40% of the droughts cause losses of almost 0,5% of the GDP of the countries they occur in and this ratio is taken as the critical threshold determined by IMF for an economic disaster. The reasons for this are that, especially in economies of countries dependent on agriculture, drought causes food insecurity due to inadequate production and political and socio-economic unrest such as immigration and conflicts (CRED & UNISDR, 2018; FAO, 2018).

In short, because of natural disasters due to climate such as these, not only the people themselves are injured but the transportation networks in the cities that constitute their living spaces, energy, water and sewerage transport lines, food distribution systems and similar infrastructures get damaged. For this reason, it is of great importance to make the cities an integral part of the solution in the fight against this problem. Today, many cities are utilizing various reduction and adaptation tools for a long time by using renewable energy resources, cleaner production techniques and regulations or incentives to limit the industrial emissions. It is clear that eliminating the pollution caused by industry and transportation for the purpose of reducing emissions in cities will improve the urban air quality and health of the cities. However, it is very difficult for the cities to be successful by themselves alone at local level in combating this problem of global scale. For this reason, cities are active at global, regional and national level with a coordinated approach and action. The aim of this study is to describe the combat given by climate change resilient and low carbon cities and managements in urban planning actions and strategies in general. In this context, it is taken into consideration how the city managements, in other words, local administrations, incorporate the climate policies they have decided into sustainable development strategies and the policies in sectors such as energy, transportation and agriculture with less emission. The data related with the study, although up to date, relies on the information obtained from various studies of the author based on her experience especially about the last ten years (For some of these studies, see Çolakoğlu, 2019; Çolakoğlu, 2016; Çolakoğlu, 2018; Çolakoğlu, 2017; Çolakoğlu, 2013; Algan and Çolakoğlu, 2017)

2. BECOMING CLIMATE RESILIENT CITIES AND COMMUNITIES

Today, more than half of the world's population (3,9 billion people) lives in cities. In addition to this population movement, cities have transformed into places where production and consumption, service and capital activities have intensified. However, this transformation has brought on the agenda many problems that are related to the management of the cities, interconnected and complicated such as environment, education, health, accommodation, infrastructure, access to basic public services. It is seen that especially developing countries are affected by the said problems more due to financial difficulties and institutional deficiencies (United Nations, 2014). However, these problems also cause the cities to become defenseless against natural disasters of climate origin. Especially in coastal cities, in addition to the increase in severe weather events such as flood, storm, drought, earthquake, volcanic eruption and heat waves, these events also make serious effects on infrastructures of these settlements such as transportation networks, energy, water and sewerage systems and food distribution systems and result in more than one security risk. Every city in the world is being affected by these security risks, although at different levels, and development levels of the countries does not have any importance against this situation.

Cities are responsible for 60-80% of the energy consumption (UN Habitat, 2016: 16; Le Quéré et al., 2013) and more than 70% of greenhouse gas emissions (IPCC, 2014), therefore their combat with climate change gains importance. However, the issue of to what extent the countries are willing to make sacrifice on their economic growth rates emerges as a subject of discussion. While only largest 40 cities of the world are responsible for two thirds of the present fossil fuel CO_2 emissions (NASA, 2014), it is not possible for them to avoid the responsibility and liability of adapting to the changing climate of the urbanizing world. Climate change is a "common" problem and the cities and city managements are expected to support this combat as much as they can in line with their capacity, even at different levels. Even if the goals adapted in Paris Climate Agreement (2015) are achieved, cities of today will still be affected by the adverse effects of the changing climate, despite all reduction and adaptation measures taken at international level. For these reasons, there is a requirement to harmonize the infrastructures of the cities where effects of the changing climate appear directly with the services provided by the urban managements. By virtue of this, they will be able to protect their own living environments, ecosystems and cities against all these adverse effects of high temperatures, changes in the levels and forms of precipitation and severe weather events, even if the floods and droughts occur more frequently and severely.

The world has no other option that adapting to the climate change, therefore many of its cities have already adopted their own adaptation strategies, policies and precautions and implemented them. As examples of good practice, with the precautions, preparations and plans including combat standards and infrastructure investments, the executives of these cities are able to protect their living spaces from the hazards of the climate change as much as possible and protect their cities against the extremely warming or cooling world. These cities are defined in the literature as “resilient cities”.

The importance of resilient cities has been underlined within the scope of United Nations’ 2030 Sustainable Development Goals (SDG), in the context of sub-goals. A goal has been adopted (Goal 1.5) to reduce the exposure of the poor and defenseless people to extreme weather events related with climate change and other economic, social and environmental crises and disasters and to reduce their defenselessness against these. According to this declared goal, natural disasters hinder socio-economic development and increases poverty. An economic loss of 3 trillion US Dollars was incurred between years 1998-2017 due to natural disasters. It is indicated that 77% of these natural disasters are of climate change origin and adversely affected 1,3 million people. While almost all of the reported deaths took place in middle- or low-income countries, the material losses incurred by these countries due to disasters have significantly affected their economies (Sustainable Development Goals Knowledge

Platform, 2019; UN ECOSOC, 2019). Also, parallel to the main goal of making the cities' comprehensive, safe, resilient and sustainable (Goal 11), sub-goals have been adopted in accordance with The Sendai Framework for Disaster Risk Reduction 2015-2030 to increase the number of cities and human settlements that adopt and implement resource efficiency, reduction and adaptation to climate change, resilience against natural disasters, development and implementation of integrated disaster risk management; and also to provide support to developing countries, including financial and technical assistance, to build sustainable and resilient buildings using local material by year 2020 (Sustainable Development Goals Knowledge Platform, 2015). In line with the basic goals adapted in Sendai Framework for Disaster Risk Reduction 2015-2030, which is in the form of a guide, the necessity of predicting the disaster risk in advance, planning and reduction and increasing the resilience of the critical infrastructures during and after the disaster has been emphasized for protecting the cities against natural disasters and increasing their resilience. Seven goals and four action priorities included in this document are considered as the first great agreement of post-2015 development agenda (PreventionWeb, 2020). In the text of the New Urban Agenda, which was presented after Habitat III summit, countries have committed themselves to improve the resilience of their cities against natural disasters and climate change including flood, drought risks and heat waves. In this framework, it was indicated that the countries shall support international, national, sub-national and local climate actions including adaptation and reduction; the efforts of the cities, human settlements and all local stakeholders as important implementers and the countries shall also incentivize emission reduction and resilience building in all sectors (T.R. Ministry of Environment and Urbanization, 2020).

Thanks to the resilient cities, it is on the agenda of the countries to put up defense against crises of climate change origin in the future and the damage these crises cause on social, economic and technical systems and infrastructures and to provide solutions by improving their capacities in order to protect similar functions, their systems and identities against these crises. Increasing the resilience of the cities will only be possible by placing the basic structures of the cities under protection and restoring them. In this direction, deficient aspects of the cities against all kinds of disaster situations are being identified and capacity increase is being implemented by decreasing climate change related risks (European Union and Foreign Relations General Directorate, 2020). A city's being resilient against natural disasters will enable the communities in that city to resist against disasters, to adapt and to move easily. In addition to a good urban planning and infrastructure, this resilience requires a local administration committed to a generally sustainable urban planning and common efforts of the community. This way, possible losses of lives and property and other disaster related problems will be prevented to a large extent in case of disaster situations.

2.1. Solutions for climate change based on "resilient cities"

Most of the cities in the world are defenseless against natural disasters caused by the climate change regarding their structures. In order for these to resist against these disasters and increase their strength, a transformation is required that will be realized with comprehensive public policies and common solidarity encompassing all parts of the society. Certain cities that are aware of this requirement and were exposed to disasters come to the forefront with successful example practices even today. For the purpose of keeping the greenhouse gases at the level that will allow the climate system to operate properly in settlement areas, the cities of today made inventory of their greenhouse emissions and are planning their energy, agriculture and water resources in line with the identified reduction goals and manage the living spaces accordingly. These cities aim to create sustainable, liveable and resilient cities and communities with their new urban infrastructure arrangements.

Even though these cities resemble each other in general, it is observed that the methods they use vary according to their physical infrastructures, economies, climate conditions and other characteristics. Every urban management comes to the forefront with rationalist solutions against disasters directed at living spaces. As they aim to make less carbon emission, these city managements support energy efficiency with their energy efficient practices that emphasize clean and renewable energy use and implement sustainable environment and infrastructure policies (European Union and Foreign Relations General Directorate, 2020).

What needs to be done here is to determine the observed and direct effects of climate change with correct and scientific methods in cities that are left behind these successes, ensure the precautions to be taken against possible risks by city dwellers, buildings in the living areas, critical infrastructures such as water, sewerage, energy distribution transmission lines and other systems (such as education, health) are implemented according to related sectors, to coordinate this well and make necessary inspections.

The cities that update their infrastructures by this way, can also integrate their climate problems into new infrastructure decision making processes. However, taking the cities with into account from the aspect of resilience has more to do than defining certain climate change effects and acting accordingly. The reason for this is that it is required to examine the complicated and intricate infrastructure of every city and performance of its institutional systems in reciprocal dependence between multiple sectors, levels and risks in a dynamic physical, economic, institutional and socio-political environment. Considering the resilience for the cities, in addition to mutual dependence between different sectors, certain system characteristics need to be taken into account such as flexibility, redundancy, response capability, learning capacity and safety against malfunction (Revi et al.,, 2014). For this, the executives who run the city at local level must organize very well within strong urban plans that take into consideration all sectors of the city's critical infrastructures such as energy, housing and transportation and must become coordinated. In line with this, it is expected that the action plans prepared with reference to greenhouse emission inventory of the related city to include greenhouse mitigation and adaptation action strategies based on geographical, economic and political subjective conditions of that city in a manner such that related sectors will complement each other. These action strategies must include goals for protection or increasing of carbon sinks, popularizing the use of renewable energy resource for the purpose of reducing fossil fuel consumption and energy efficiency, mitigating the greenhouse gases that cause climate change on the one hand and mitigating the existing adverse effects of the climate change such as making the urban infrastructure resilient against disasters or increasing the green areas that protect the urban infrastructure from heat waves. Especially adaptation strategies cover the steps to be taken to protect the city dwellers from the effects of the climate change, which became almost a crisis for today (Baysal, 2019). This way, rather than restoring the old situation after the crises and pressures created by the climate change, the systems in these cities enable access to the "new" situation which is considered normal, make the cities prepared for problems, hazards and disasters encountered by the cities such as economic crises, demographic changes and epidemics, enable them to respond to these and to increase their adaptation capacity (Tuğaç, 2019).

2.2. Examples cities and practices for resilience against the effects of climate change

Certain cities that combat against climate change come to the forefront with their successful practices. With the precautions they take in accordance with their geography and climate conditions and energy efficient practices they take their living spaces under protection. On the one hand, these cities raise the city dwellers' quality of life by providing higher quality in the services they offer every day and on the other hand they ensure the continuity of their growing economy by protecting their environmental values. There are many cities that implement policies for adaptation to climate change and mitigating its effects successfully.

2.2.1. Increasing temperatures, rising sea level and city of San Francisco fighting fires

The city of San Francisco, situated at the west of the State of California, is one of the most important finance, technology, tourism and culture centers of the country. Economy of the city is dependent on these sectors. The fact that it is a port city enabled the city to come to the forefront in this sector for many years in the past and transformed the city to a transportation and production center. However, even though this feature of the city is faded out in recent years due to increased competition and emergence of the ports of other regions of the state, it continues to be a prominent finance and business center. It clearly plays a key role in information technology only with the Silicon Valley located at the southern region of the city. At such locations the city accommodates significant hardware and software innovators such as Apple Computer, Inc., Cisco Systems, Inc., Hewlett-Packard Company, Netscape Communications Corporation and 3Com Corporation and also biotechnology leader companies with high technology such as Genentech, Inc. (The USAonline.com, 2020). The critical infrastructure security of the city gained value because of this reason; adaptation of this city to the conditions of the changing is perceived not only as the security of the individual, but also as the security of the economy and the natural resources; it is considered that this struggle is an important part of the city's sustainability.

In fact, the city of San Francisco began combating the climate change much earlier than the other cities of the country. The disasters that threaten the security of the country have significant impact on this. In general, even though the State of California where the city is located in is affected by hurricanes and storms in every winter season, the bay area where the city is located in it is also affected by floods and overflows, which became a natural part of the daily life. In line with present trends, it is predicted that the sea level will rise from 11 cm to 19 cm by year 2050 and from 30 cm to 55 cm by year 2100. This situation threatens the main transportation arteries, coastal areas and parks which have an important place in the economy and transportation of the city, such as runways of San Francisco International Airport, which is used frequently in the country, and Expressway 101. According to another scenario, any rise in the sea level will cause the city to suffer an infrastructure damage of 62 billion US dollars (NRDC, 2017). Among other natural threats at the same level are earthquakes, landslides and wildfires. It is claimed that, in connection with the changing climate, an earthquake of 6.7 magnitude may occur in the city in the next 30 years. The Rim Fire that broke out in 2013 is one of the most concrete examples. This fire is the third largest fire in the history of the state and it destroyed approximately 250 thousand decares of area. It also caused more than 70 million US dollars of damage in the city (City and County of San Francisco, 2017). Furthermore, the dwellers of the city may be exposed to the adverse effects of three or four extreme hot air waves resulting in deaths by the middle of this century (San Francisco Department of Environment, 2013). With a population of 8,7 million (World Population Review, 2020) it is one of the largest cities of the country; there are more than 45 communities in the region close to the bay coast stripe and the surrounding area where there are a large number of people, residences, businesses and critical infrastructures and the danger continues to exist for the people of this area (AECOM, 2016).

The city of San Francisco is surrounded from three sides by the cool waters of the Pacific Ocean and the bay and it has a climate which is mild, rainy and cool in the winter and dry and hot in the summer. However, as mentioned above, rising sea level, diminishing snow cover on Sierra Nevada Mountains, increasing fires and extreme and severe weather conditions consisting of hot air waves and violent rains creating floods affect the life and economy in the whole Bay Area where the city is located. In view of this situation, the city management of San Francisco started the adaptation and mitigation works for climate change years ago. These works are inspected by The Public Utilities Commission and Planning Department in cooperation with The Department of Environment. San Francisco Climate Adaptation Working Group consists of the representatives from The City Administrators Office, Port, San Francisco International Airport, The Department of Public Works (water, energy and sewerage), The Municipal Transportation Association, The Department of Public Health and The Department of Recreation and Parks. The Department of Environment works under the responsibility of the Environment Commission, which advises the Mayor and the Inspection Board about the environmental programs and policies. Seven members of the Environment Commission are assigned by the Mayor (Environment and Energy Division City of Toronto, 2017). In addition to these state and federal councils, residents, businesses and community organizations are involved in the process for establishing innovative programs and policies in the city.

San Francisco city management ratified and implemented the Global Covenant of Mayors for Climate and Energy, committed to reduce the carbon emissions at least by 80% by year 2050 and showed its determination on this subject (The Global Covenant of Mayors for Climate & Energy, 2017). Until today, the city management managed to make a reduction of 14,5% (5,3 million tons in total) in the emissions made from the buildings, transportation and waste sectors in the period between the years 1990 and 2010. Even though the general electricity consumption in San Francisco increased by 11% between the years 1990 and 2010 with the increasing city population, a net decrease occurred in the grid electricity greenhouse emission level. San Francisco achieved a great success among the other cities of the country in 2010 in recycling of the wastes at the ratio of 80%. The success of the city's recycling and composting programs means that the greenhouse emissions generated by the wastes sent to the storage areas fell almost to half, compared to the level in 1990's. emissions of personal cars increased by 4% since 1990's as the city dwellers traveled more worked with longer distance. The developments in vehicle fuel economy show a positive trend – from 18 miles per gallon twenty years ago to 25 miles per gallon level in 2010. However, it served to slow down the growth in the emissions from transportation activities (San Francisco Department of Environment, 2013). Despite this, The Municipal Code of San Francisco requires significant reduction in greenhouse gases. According to this, it is required to achieve reductions of 25% of 1990 levels by 2017, %40 by 2025 and the whole commitment by 2050 (Energy.Gov., 2018). Even though the city population increased by 22% and its local economy grew by 166% since 1990's, this city made a reduction of 36% as committed (SF Environment, 2020a). This result constitutes clear evidence that the city fulfilled its commitments while realizing its sustainable development. The reason for this is that only since 2019 the use of natural gas in renovated buildings was prohibited, a regulation was passes recyclable or compostable prepaid bags, The Bay Area Regional Energy Network was established for small and medium scale businesses operating in the Bay Area, Waste Separation Conformity Regulation was passed to reduce the recyclable or compostable material sent to regular storage areas, a legislation was passed that requires the use of entirely renewable energy in all commercial buildings by 2030, a plan was published containing more than 90 strategies for increasing the resilience of the city against climate change (The Hazards and Climate Resilience Plan), The Single-Use Plastics, Toxics and Litter Reduction Ordinance was put into effect and similar activities were performed (SF Environment, 2020b).

2.2.2. Copenhagen, floods and climate adaptation plan

The capital city of Denmark, Copenhagen, is the largest city of the country with a population of approximately 1,331 thousand (Statistics Denmark, 2020), it is shown as one of the most sustainable and green cities of the world. This city has been working on adaptation to climate change and conducting activities for strengthening its infrastructure to enhance urban development.

These precautions taken against the changing climate is basically based on the previous developments in the climate. Material losses of millions of dollars caused by the floods after the storms in 2010, 2011 and 2014 are among the most important reasons of this comprehensive change. Only in the flood caused by the worst rain ever in 2011 a loss of 1.04 billion US Dollars was incurred (Gerdes, 2012; The Local, 2017), insurance companies provided a relief of 800 million Euros to the building owners in the city. Within a period of less than three hours, properties of 61% of the inhabitants of Copenhagen were affected by sewerage water (Kilhof, 2014). In fact, changes were made earlier in the city based on the predictions of the Intergovernmental Panel on Climate Change for 30 or 40 years into the future. However, when it was seen in these two flood events that the present predictions are not adequate, the said city management adopted a new strategy based on future climate projections and made a more detailed plan for all large urban water catchment basins in the city. In this context, Copenhagen Climate Adaptation Plan was accepted with a decision taken in the same year of 2012. It is claimed that the region of Copenhagen will be protected from floods if this plan is fully implemented. However, even under the most optimistic conditions the implementation of the plan will take a few decades and if extreme rain frequency remains relatively low, it cannot be foreseen if the political awareness will be the same; so, the experts state that the results are not yet definite at this point (Arnbjerg-Nielsen et al., 2015).

Based on the strategy adopted in Copenhagen Climate Adaptation Plan as soon as any problem appears in connection with climate, a mechanism of flexibility has been adopted that can combat uncertainties by integrating the new information with the developed technology. According to this, it has been stated that if the damage hazard is high then actions must be urgently implemented such as building levees, constructing buildings higher than the sea level and expanding the capacities of sewerage and waste water discharge systems. It was also expressed that if it is not possible to prevent the damage, then it is important to minimize it, that is, to construct early warning systems, water-tight basements and rain water storage sites. In addition, it is indicated that the resilience of the city must be enhanced. The precautions such as having fully equipped basements and keeping pumps ready to operate in order to cope with the floods are being mentioned (Miljø Metropolen, 2011; Gerdes, 2012). By taking these precautions, it is aimed to make Copenhagen 2025 the first zero-carbon city of the world in year 2025.

A series of precautions were taken in line with this city plan. It was brought onto the agenda to separate sewerage from the rain water in the city or establish a Sustainable Urban Drainage System, or as a B plan, to divert the excess rain water to places where it will not cause any damage or cause less damage. In this context, an early warning system called SURface Flood Forecast was made operational. This system is a map based on a terrain model that covers both the sewerage systems and the areas comprising separate sewerage having high and low building densities and shows the floods. The data of this map is updated every hour and is published at a website. Results can also be communicated SMS, e-mail or social media. After this system that controls the waste water networks and treatment facilities according to weather conditions, waste water flooding cases decreased by 90% between years 2013-2014. Also, the energy required for water treatment decreased by 10-15% and greenhouse gas emission fell by 10-12% (Baltic Smart Water Hub, 2017; Veolia, 2020). Even the flood of 2017 was got away with less damage than the previous years (Davies, 2017). After these flood incidents, the city management decided to make the asphalt areas and parks compatible with the climate (Cathcart-Keays, 2017). They intend to achieve savings of 70% compared to conventional methods by installing a new heating system in the city. It is desired to protect the existing green areas and build new ones with a good planning to protect the city from heat island effect (Miljø Metropolen, 2011).

The implementation of Copenhagen Climate Adaptation Plan Copenhagen was started from St. Kjeld square. In the project, which began in 2012, steps were taken to make the said neighborhood sensitive to climate change and produce innovative and effective solutions. Afterwards it was implemented in Tasinge Square and Bryggervangen. In St. Kjeld square, it is planned to transform 20% of the built-up area to green areas on the one hand, and to use 30% of the rain water before reaching the sewerage on the other hand. In this context, it is planned to replace the asphalt covered roads in the square with walkways containing grass patches, transform small park areas in the neighborhood to water pools and to turn the streets around it to channels when flood or severe storm occurs and divert the rain water from the squares to the port (Klimakvarter.dk, 2015). With this ambitious project of Copenhagen Municipality that covers an area of 105 hectares, it is also intended to decrease of the area allocated to road traffic by 20% (Mezzi, 2015). This project won Guangzhou prize in 2016 (The Guangzhou International Award for Urban Innovation, 2016). Tasinge square in Copenhagen was transformed as of year 2014. While creating an active and recreational urban area, green areas were used successfully (State of Green, 2018).

2.2.3. Stockholm as an example of success that came with political determination, trust and inspection

Stockholm, capital city of Sweden, is another city that combats the consequences of changing climate successfully. While the shares of the city executives cannot be denied in this struggle, in fact there is the fact behind the political determination of the country as a whole, in other words, transformation of the climate change problem to a real national security issue and accepting as a policy over the parties (high policy). In fact, as a country that achieves sustainable development, Sweden signed the Kyoto Protocol dated 1997 right the next year and ratified it in 2002. This country is among the countries with the least greenhouse gas emission among both the European Union and OECD countries. It also applies the carbon tax since 1995 (The Swedish Institute, 2017).

On the other hand, it is seen that the responsibility on this matter belongs to the municipality and all risks related with meteorology in this implementation and all management responsibility for public works is on these local administrations. In The Planning and Building Act of 1987, it is indicated that the municipalities must take environmental risks such as floods and landslides into consideration in development plans. According to this, while The County Administrative Board acting at regional level oversees the local planning and procurement data and provides advice, municipalities determine the suitability of various settlements. The Board only protects and coordinates especially the national interests in the planning processes. Furthermore, at the national level units such as; The Swedish Rescue Services Agency, The Swedish Meteorological and Hydrological Institute, The Swedish Geotechnical Institute, The National Board of Housing, Building and Planning provide data input for risk management and planning and state financing for preventive measures. However, the central government does not have official authority to directly influence the local planning and risk management activities of these units (Storbjörk, 2007; Boverket, 2006). In short, municipalities have strong authorities and responsibilities in the planning of cities' futures according to the changing climate conditions.

The city of Stockholm began its struggle with Hammarby, which is an old industrial area. In this area, which was planned to be transformed into a new settlement zone with zero fossil emission, many successful sustainable city management tools were implemented, from smart electric grids to public transport (The Swedish

Institute, 2017). Hammarby Sjöstad (Hammarby Lake City) project was started in 1990's for the purpose of providing for the housing and infrastructure needs of the city's growing population. With this project, which is almost completed (Ország, 2018); it was intended to provide approximately 12 thousand residences. Over the city, it is planned to build 140,000 new houses by 2030 (Stockholm – The Capital of Scandinavia, 2017). In 1995 the city of Stockholm decided to build the first urban national park of the world and protect the green areas. It re-built and renewed the old industrial areas as efficient, low-energy residences. This project produces environmental solutions for waste, energy, water and sewerage, such as transformation of deserted industrial regions, creation of green areas, incentivizing of public transport and carpool, popularizing bicycle lanes, use of environmentally sensitive material in the buildings, use of renewable energy resources, re-use of biogas and wastes, constructing energy saving buildings and re-use of drainage water (GlashusEtt, 2017). It is stated that the total cost of the project is approximately 4.5 billion (Freudenthal, 2017). Also, Stockholm's beltway (Förbifart Stockholm), which is one of the biggest infrastructure projects of Europe, is still in progress in the city. It is said that it will be one of the longest road tunnels of the world with a construction budget of 3.1 billion Euros (Stockholm – The Capital of Scandinavia, 2017). Tram routes of the city were enlarged. In Stockholm, approximately 850 thousand people use public transport. All underground system runs on (green) electric power and since 2017, all buses run on renewable fuels, in line with 2025 goals (Sweden, 2020). In addition to providing electric vehicle charging devices near the city park of Stockholm, at Stockholm Royal Seaport, with a value of 2,2 billion Euros, started in 2011 (Stockholm Stad, 2020), an old gas factory is being used to build thousands of environmentally friendly houses completed with biogas produced from food wastes. But, it is indicated that the real innovation is related with energy saving. The reason for this is that Stockholm Royal Seaport, energy companies, universities and home owners globally formed a test environment together for an innovative smart energy network. Even though energy use in Sweden is three times the global average because of the high technology used in the country in addition to its cold climate, the use of energy this efficiently with all these practices only in Stockholm provides benefit to the country and brings the awards. Stockholm, which intends to become a zero carbon city by 2050, received the first The European Green Capital Award of the European Commission in 2010. (C40 Cities, 2017) This city won the World Smart Cities Award in 2019 because of the GrowSmarter project, which is considered "innovative, transparent and connected" (Sweden, 2020; Cities Today, 2019; GrowSmarter, 2020).

In this context, as a prominent member of C40 Cities, the city of Stockholm makes contribution to The Global Protocol for Community Scale GHG Inventories as a pilot city of this network. Also, the mayor of this city signed the Covenant of EU Mayors, thus committed to decrease the greenhouse gas emission in the city and inform EU regularly about the subject (Jones, 2018). In addition, he declared that he will eliminate all coal, petroleum and other fossil fuels by year 2040 (Goering, 2017). By this means, the city of Stockholm is one of the first five green cities of Europe regarding energy and carbon emission, transportation, water, air quality, land use and buildings, wastes, sanitation and environmental governance and comes forward as one of the most liveable cities of the world (Jones, 2018).

3. THE IMPORTANCE OF PUBLIC PARTICIPATION IN LOCAL CLIMATE CHANGE ADAPTATION PLANNING

The participation of public in the decision-making processes is quite important in combating the global climate change. More city dwellers are affected by the natural disasters caused by the climate every year. While these dwellers were more than 60 million in 2018 (CRED & UCLouvain, 2019) it increased by 61% and reached 98 million the next year (Kihl, 2020). Not only the city executives but also private sector, universities, non-government organizations and real owners of the city, city dwellers will be involved in all decisions related with the future of the living spaces and will be of help to make the decisions and implement them in later processes. It is important that these actors develop their activities and strategies for cooperation, of course that powerful political will and government policies create a willpower in this direction and especially the local administration be involved in this process for building the resilience of the city as the actual implementer. It is expected to provide coordination and active participation of all actors of the society in all processes that include the determining and planning of urban policies to combat climate change, decision making and implementation. The reason for this is that municipalities affect the adaptation requirements and options of the city dwellers in all processes including emergency situation management, rain water planning and land use. This way, in addition to the legitimacy of all decisions in the city, they will be accepted by the people and successfully implemented.

Strong support of citizens of New York City for their mayor because of the policies executed in this city since 2002 and the achieved successes shows an example of this. The most concrete reflection is seen in the election processes. As known, the effects of Hurricane Sandy, which started in Atlantic Ocean in 2012, were devastating. However, the city dwellers were able to protect themselves from the adverse effects of the hurricane with the precautions taken at every stage with the participation of the citizens. As the critical infrastructure of the city was strengthened against multitude of climate change effects from rising sea level to hurricanes for many years, the effects of this hurricane was considerably mitigated. During the period of his mayorship, Michael Bloomberg (2002-2013) was rewarded for increasing the resilience of the city aimed at adaptation and mitigation policies and his position as mayor was supported by the people for three terms. It is observed that the present mayor of the city maintains the same policies and plans both during and after the election campaign. Today, the city of New York comes to the forefront as a leader city and driving force in the combat with climate change and planning of the city in a sustainable manner. This city has been the city that has made the most investment for increasing the urban resilience in the world in 2018 (Savills, 2019). In short, New York became a more resilient city with the powerful decisions, good planning and organization.

Citizens may also be part of the struggle against the effects of the climate change individually. Behind the successes of good practice examples described above, here is the consistency and support of the citizens with the decisions of their executives with their own conscious behavior. When individual precautions are practiced by millions of residents, significant savings and economic gains will be made, but also natural resources will be better protected and their sustainable use will be possible. As seen in good practice examples, cities can achieve the reduction goals adopted for themselves to increase their resilience better with the citizens. Inhabitants can achieve this success with individual behaviors such as providing information, planting trees, energy saving, traveling less and at shorter distances, using renewable energy, less consumption, re-use, recycling and providing heat insulation in houses (European Union and Foreign Affairs General Directorate, 2020). In fact, people are responsible for their behaviors and protecting their properties before, during and after extreme weather events such as flood, storm and earthquake that affect basically their personal safety and adaptation (Brink and Wamsler, 2018). Therefore, the possibility of these processes to be successful without the involvement of the citizens is very low. Involvement of the citizens in all processes where social requirements are determined with socio-political participation among the actors and being part of these processes increase the interest in the decisions, consistency and legitimacy. Residents are the main elements of the combat against climate change and it is their basic right to be involved in the said processes as the real owners of the city.

People's involvement in these decision processes is important for the local administrators to benefit from their experiences, establishing a medium of dialog between stakeholders and finally to understand what kind of pressure elements the city is against and to develop its resilience (Özer, 2017). The risks that the city is exposed to and the natural disasters it has fought since the past until today is best known by the people who live there; so this point must be taken into consideration by the local administrations. In this context, an approach should be adopted where all segments of the society are welcome and a multi-stakeholder, participative governance process is implemented. However, this approach that gains importance for urban resilience will make sure that consciousness of all segments of the society will be provided against the risks they are against and an awareness increase will be achieved (Tuğaç, 2019).

4. CONCLUSION

Even if their development levels differ according to economic, social, cultural and political fields of today, living spaces of all world countries are affected by urbanization and industrialization processes. One of the factors that determine these processes is certainly the population factor. This trend that gained continuity brought about many problems related with the critical infrastructures of cities from accommodation to infrastructure, especially education and health that are related with the management of the cities, interrelated with each and are complicated. Among these problems, the effects of the climate change continue to exist with increasing severity, which vary from floods due to rising sea level to extreme weather events such as hurricanes or extreme drought, decreasing of water needed for agriculture and food and emergence of tropical diseases ore frequently and that directly affect the life and safety of the citizens. However, especially the underdeveloped or developing countries are affected more severely by these problems because of their deprivations from technical and financial difficulties to institutional deficiencies. For this reason, there is the discussion of what kind of an adaptation process we can put through our living spaces to make them safer and more resilient against this situation and how we can protect ourselves from its adverse effects.

The efforts and successes conducted in recent years were achieved to a large extent at local level. Cities such as San Francisco, Copenhagen and Stockholm that implemented reduction and adaptation policies successfully made their own greenhouse gas inventories and re-established their urban plans for all critical infrastructures, especially based on energy efficiency, in line with defined adaptation and reduction goals. It is clear that they are leaders in this field with the success they achieved. Even though there are many cities in the combat against climate change and their number increases every day, country's support for the struggle of these cities at national and international level will make them stronger. Even if the countries are not very willing in the implementation of the policies at this level due to the level of development among them, they began to participate in platforms such as Habitat III more frequently and influence the decisions by forming pressure groups among themselves (Çolakoğlu, 2019).

It is important for the real owners of the cities, i.e, city dwellers, to take part in decision making processes in the struggle against climate change because they are the ones who are affected more and more every year by the natural disasters caused by the climate change. In addition to being a part of the struggle against the effects of the climate change individually, the city dweller will take active part in these processes implemented by local administrations and thus ensure their own legitimacy.

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EU AGRICULTURAL POLICIES MITIGATION AND ADAPTATION STRATEGIES

Prof. Dr. Zeynep Zaimoğlu

1. INTRODUCTION

Climate change is an important and growing threat to food security. It affects the already vulnerable population in many developing countries and is expected to affect more people in more places unless action is taken today. Current scenarios for agriculture as usual under climate change increase food security challenges by 2050. The worst-case would be in the underdeveloped regions of the world where food insecurity is already a problem and populations are vulnerable to shocks. Advances in agricultural technology and management are expected to increase food security, but if we do not address climate change, climate-related losses in crop and livestock productivity will reduce these gains. As the Conference of the Parties (COP22) has widely recognized the role of agriculture as a key element in reducing emissions, the European Union countries are trying to identify appropriate policies to reduce the impact of climate change on food security with these tools.

2. CLIMATE CHANGE AGRICULTURAL POLICIES

European Union countries, like other countries, are vulnerable to major climate change impacts. Although it may have positive consequences for some northern European regions, climate change has mostly negative consequences in regions already damaged by climate change due to drought and extreme rainfall and unfortunately will continue to do so in the future. In many regions, these negative effects will increase even more if several of these effects are felt together. Agriculture will be most affected in the south and south-east European Union regions (Türkeş and Kılıç, 2004).

The EU common agricultural policy (CAP), which started to be implemented in 1962, is a partnership established between agriculture, society, Europe, and its farmers. The main objectives of the policy are to increase agricultural productivity and provide a reasonable livelihood for EU farmers in order to ensure that consumers have access to affordable food at all times.

CAP is a common policy that applies to all Member States of the European Union. The policy is managed and financed at the EU level, with resources from the EU annual budget. After 50 years, the EU has to deal with other problems. The first of these problems is food safety. At the global level, food production needs to double in order to feed the world population, which is estimated to reach 9 billion by 2050. Other issues can be listed as climate change and sustainable management of natural resources, the management of countryside in the EU, and keeping the rural economy alive (https://www.avrupa.info.tr/tr/tarim-ve-kirsal-kalkinma-113).

The European Union Common Agricultural Policy (CAP) offers several tools that can support climate change challenges for sustainable European Union agriculture and mitigation and adaptation efforts. These tools are;

- Supporting sustainable production practices in agricultural activities with increasing pressure on natural resources;
- Supporting farmers to adapt to climate change challenges and take steps towards mitigation and adaptation (eg becoming more resilient to natural disasters from floods, droughts, and fires).

The support provided by OTP generally covers these two main points given above.

One of the three main objectives of OTP is sustainable use of natural resources and climate actions. Sustainability will be improved as a result of the effects to be obtained as a result of using different tools together.

Primarily, consensual and simplified, environmental conditions and requirements represent the basic condition for the producer to obtain full OTP financing.

Secondly, since 2015, CAP has started using a new political tool; Green Direct Payment, the so-called 'green payment', is made available to the producer with three mandatory implementation conditions;

- Protection of biodiversity
- Observing water and soil quality throughout production processes
- Protection of carbon sink areas and creation of areas that can serve this purpose.

This Green direct payment financing represents 30% of the support budget. Green Direct Payment represents beneficial and sustainable production in the majority of the agricultural land in use as it is compulsory to comply with the conditions.

Thirdly, in addition to these essential elements, rural development plays an important role in achieving the objectives of the CAP and in combating climate change.

Rural development policy has some priorities at the European Union level. Two of these goals are directly related to environment and climate change:

- 'Development, protection, and renewal of the ecosystems of agricultural and forest areas'
- 'Supporting the transition to a climate-resistant and low-carbon economy in the agriculture, food and forestry sectors and aiming efficient resource use'
- Research studies,

Climate change and the environment have occasionally overlapping objectives within the European Union's rural development policy, so simultaneous observance of these three goals should be taken into account in Member States' strategies and tool choices.

It can be understood that the European Union rural development policy is focused on sustainability since at least 30% of the rural development program is allocated to the measures to be taken to support the environment and climate change mitigation and adaptation strategies.

In the agricultural policies of the European Union, it is aimed that the farmers who are producers in the agricultural sector, training programs, and other support mechanisms, as well as all the tools within the policy, R&D partnerships, and conducted researches, are aimed to help the farmers reach solutions that can be used. One of the nine main objectives that the CAP will be based on in the future is combating climate change and includes planning accordingly.

The European Commission has prepared a roadmap on the importance of new agriculture and tillage techniques in reducing the threats posed by climate change to agricultural practices and agricultural emissions.

3. RESULTS OF THE EUROPEAN UNION AGRICULTURAL POLICIES

Making agriculture sustainable is a global problem. In the European Union (EU), the Common Agricultural Policy (CAP) fails in terms of biodiversity, climate, soil, soil degradation, and socio-economic challenges.

The European Commission's post-2020 CAP proposal provides a proposal for increasing sustainability. However, it also allows the Member States to choose ways to implement these policies. This flexibility present weaknesses in terms of climate change mitigation and adaptation. For this reason, it is necessary to correct the systemic weaknesses in CAP and to use the breadth of available scientific evidence and knowledge in the future planning of European Union agricultural policies, taking into account the sustainable agriculture demands of producers (Pe'er, et al.,. 2020).

4. CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES IN THE AGRICULTURE SECTOR

Climate is an important determinant of agricultural production with its regional and temporal variability. All agricultural production is related to the performance of (cultivated) species subject to certain environmental conditions. As climatic conditions change, production conditions may also change with possible positive or negative effects on agricultural production (Rosenzweig and Parry, 1994; Olesen and Bindi, 2002; Lobell et al., 2008). Although agriculture provides humanity with essential products (ie food, feed, fiber, or biofuels), agricultural management also affects important ecosystem services such as clean water or soil conservation (Foley et al., 2011). It is important to anticipate future changes in the agroecosystem in order to be able to adequately respond and maintain functionality regarding multiple ecosystem services. If it is known that climate change affects the functioning of the agro-ecosystem, measures can be planned to adapt agricultural management to prevent the adverse effects of climate change and to exploit new, emerging potentials.

Table 1: Challenges in Climate Change Mitigation and Adaptation Policies

	Challenge	Possible Impact of Climate Change
Natural resources	Precipitation is highly variable in arid and semi-arid developing regions. Water is vital to increasing production in Asia, but opportunities are more limited in Africa and future agriculture will depend mostly on rain-fed systems. Degradation of natural resources and increase in soil pollution	Increased precipitation variability Increased competition in the water use, especially between agricultural production and non-agricultural areas. Less water will have to be used in agriculture.

	Challenge	Possible Impact of Climate Change
Population	Agricultural development is carried out with limited opportunities in places with low population and small markets. HIV / AIDS and recently Corona reduce agricultural production	Increasing migration and changing population densities in different parts of the world Limitation of adaptation by not passing on local knowledge and adaptation / coping methods to new generations
Transport / Infrastructure	Inadequate logistics infrastructure restricts many farmers' access to the market High shipping costs due to high export prices in most African countries	The infrastructure is in danger as a result of natural disasters, Increase in transportation charges due to mitigation measures Effects on global and local competition
Product Prices	Product costs are increasing Investments to be made to increase production is affected by fluctuations in prices.	Global product prices may rise, but significant regional differences will occur Product price fluctuation will increase
Access to the Market	Product standards set by supermarkets prevent small producers from accessing the market. High-priced agricultural products (e.g. horticulture, floriculture) offer opportunities but small producer gains less than market share	Phytosanitary standards may increase due to the spread from pests caused by climate change Access to supermarkets may be reduced with changing consumption habits and increased transportation
Agriculture - Development Links	The relationship between broad development and agriculture may not be as strong as during the Green Revolution.	Rising global transport prices and changing consumer demands can increase local diversity and connections
Role of the Public and Policy Makers	Financial imbalances in many developing countries prompted governments to reduce/cut support for agriculture, replaced by private businesses, many of which failed	Climate change requires governments to make successful adaptation and mitigation efforts In climate change projections, public expenditures are required in different areas and in increasing amounts on agriculture.

Resource: Slater et al., 2007

4.1. Adaptation to Climate Change in Agricultural Production Systems

As the most important component of agriculture, the soil is one of the main sources that can cause greenhouse gas emissions, especially due to industrial agriculture techniques, while at the same time providing carbon sequestration in the atmosphere. Changes in land use or small adaptations to agricultural techniques used can be effective in both mitigation and adaptation for the agricultural sector ((Batjes, 1996), (Houghton, 1999)).

In the UN Sustainable Development Goals, officially published in the past 15 years and approved by the UN, the need for an “emergency action plan to combat climate change and its effects” is on the agenda. Within the framework of these action plans, strengthening the capacity to adapt to climate risks and natural disasters is of special importance. In the context of adapting to climate change in agricultural systems, the subjects of "ending hunger, ensuring food security, improving nutrition and promoting sustainable agriculture" also include sustainable food security in line with the first goal. The objectives of achieving this goal are to “provide sustainable food production systems, promote durable agricultural practices that increase productivity and production, help protect ecosystems, strengthen the capacity to adapt to climate change. As a summary of these goals; it is clearly stated and acknowledged that “the desire to maintain and improve productivity while promoting synergy with other functions of the socio-ecological agroecosystem must be implemented in international platforms”.

In the international and national agendas, climate change adaptation is also indisputably necessary for the interests of individual farmers or farming cooperatives, based on income from agricultural production.

In achieving these goals, first of all, the measures that can be taken from local to national and from short to long term and the solutions to be implemented should be considered in sustainable agriculture and food production (Domínguez et al., 2016). In this framework, agricultural enterprises and the measures that can be applied are listed below.

Short and Medium Term Solutions to Adapt to Climate Change in Small Agricultural Enterprises:

- Adjusting sowing, harvesting, and other maintenance times according to climate data and forecasts,
- Protection of gardens against frost damage or improvement of air conditioning systems such as ventilation and cooling in animal shelters (technical solutions), Selection of product varieties suitable for the expected growing season and existing irrigation possibilities, and resistant to new temperature and humidity conditions. (review of product pattern),
- Adapting to climate change with the help of biotechnology opportunities and available genetic diversity,
- Improving pest and disease control through practices such as better monitoring methods, diversified crop rotation or integrated pest management (proactive plant protection measures),
- Reducing water losses, improving irrigation practices and recycling and storing water, and using water more efficiently (sustainable water management), Increasing water holding capacity, improving soil management,
- The use of heat-resistant livestock in small and sheltered enterprises with air conditioning (Yücel, 2016; IPCC, 2019).

Things That Can Be Done to Adapt to Climate Change in Industrial Agricultural Enterprises:

- Defining vulnerable areas and sectors, evaluating different product types to be selected depending on climatic changes and the requirements and opportunities for product change,

- Supporting agricultural research and experimental production for the most suitable product selection and production for new conditions,
- Strengthening their adaptability by raising awareness about farm management and providing useful information. (Making agricultural extension services functional),
- Considering the relationship between rainfall, irrigation, and yield in the context of industrial agriculture, planning appropriate irrigation investments since higher yields may require more irrigation,
- The relationship between expected yield and irrigation requirement as the consequences of climate change will affect the crop pattern, and this will affect crop prices as a result of the supply and demand balance. This interaction is the parallel follow-up of economic and climate parameters of large enterprises engaged in industrial agriculture (Yücel, 2016; IPCC, 2019).

Apart from these main topics, the most discussed topic in recent years is organic production and its place in combating climate change.

4.2. The Impact of Organic Agriculture on Adaptation and Mitigation to Climate Change

The negative effects of climate change such as climate waves, droughts, heavy rain, and other extreme weather events will inevitably increase in the future. Climate variability and overall production risks will increase when average winter temperatures are set to rise. Likewise, pest and disease pressure will increase. Farming systems must adapt to these adverse effects to ensure durable food production. Organic farms generally have higher species diversity and these are locally adaptable species. Studies have shown that the production systems established in organic farming facilities are more resistant to extreme drought conditions, and they adopt measures such as organic cover to reduce water consumption and permaculture. As a result of measures such as restorative agriculture and organic cover related to agricultural drought, which is one of the negative scenarios of climate change in organic farming enterprises, it has been determined that groundwater feeding is 15-20% higher than the enterprises engaged in industrial agriculture. In addition to underground water recharge, the water holding capacity in soils in organic farms can be up to 100% higher than in agricultural soils in industrial farms. To summarize, organic farming systems are more resistant to changing weather conditions such as extreme drought and excessive rainfall (Tuck et al., 2014).

When we look at organic agriculture in terms of climate change and adaptation, we have to consider the distinct differences in biological diversity. Organic farms have about 30% more biodiversity than traditional farms, as demonstrated by about 94 scientific studies conducted over the last 30 years. In addition to farm management practices, landscape, climate, and plant species also play an important role in the effects of organic agriculture on biodiversity. Studies have revealed that wild species are also included in the fields of organic enterprises and prevent both biodiversity and evaporation. In particular, the biodiversity of the agricultural products grown is 70-100% higher, due to the adoption of sister plants and holistic agriculture in organic farms (Lampkin, 1996).

The opposite view regarding the climate-friendly nature of organic agriculture is that it is ultimately not climate-friendly due to the claim that larger agricultural areas are needed, as organic agriculture tends to yield lower than industrial agriculture, and therefore more areas are needed to produce the same amount of product. This view ignores the fact that resource use is very intensive in order to increase the efficiency of agricultural production in Europe and this overcapacity production planning exceeds the capacity of local environmental resources (Müller et al., 2016).

Organic farmland also offers a natural ecosystem service where biodiversity, pollination, pest control, and nutrient cycle occur simultaneously.

European countries have designed natural habitat for landscaping, based on the fact that the protection of semi-natural habitats is of vital importance to maintain high species diversity in landscape areas. Landscaping works and holistic practices to be carried out by protecting natural habitats in landscapes in our country will also be the right step for adaptation.

As a result; organic agriculture is a role model for sustainable agricultural production, and using at least similar holistic practices for traditional production can be an opportunity for sustainability and harmony. However, the holistic agriculture approach has to focus not only on production but also on consumption patterns and optimal resource utilization. Thus, organic agriculture, reduced concentrate feed, and animal products, and reduced food waste provide optimum sustainable and climate-friendly agricultural production and food system.

4.3. Reduction in Agricultural Production Systems

When it comes to eliminating the effects of climate change by reducing greenhouse gas emissions, we can address the issue from two different perspectives, the first is to reduce the emission of carbon and equivalent gases as a result of technical measures, and the other is the reduction in carbon dioxide and equivalent gases as a result of political measures. In this reduction process, the priority agricultural suggestion applied and recommended all over the world; is the preservation and improvement of the current status of forests, wetlands, marine and coastal ecosystems, meadows, agricultural lands, and peatlands that have the ability to capture and store carbon (Dudley et al., 2010).

4.3.1. Technical Mitigation Measures That Can Be Used in Agriculture And Forestry:

- Conservative agriculture: This measure covers a variety of elements. These include reduction of land handling, residue management, and crop rotation. Less mechanical cultivation of soils creates a soil layer rich in vegetative matter, including dead animals and plants, increasing the carbon retention rate of the soil. In addition, as less use of agricultural machinery (tractors, plows) is required, the use of fossil fuels is reduced with less cultivation of the soil.

- Land Change: Degraded land can be converted into a carbon-holding sink area by appropriate modification, for example by terracing a previously eroded hill. In this way, the soil accumulates in the previously barren land and the carbon is stored in the form of soil and vegetation.
- Rangeland management: The carbon content of the soil depends on how often the excess of vegetable matter is removed. The best-known way to do this is grazing animals. The total amount of carbon can be increased by improving pasture management. While overgrazing pastures are allowed to grow again, if the amount of grazing is increased in low-grazed pastures, the rate of plant growth and carbon "sink area" can be maximized.
- Biogas: Converting agricultural waste to bio-methane gas can provide additional abatement, replacing conventional natural gas and other fossil fuels. The main limitation here is the economic viability of using bio-methane. Options include direct on-site combustion (usually in agricultural activities such as food processing), the use of on-site electricity generation, or the incorporation of "upgraded" biomethane into the gas grid. Here, electricity generation appears to be the most accessible option.
- Although it is known that the use of reduced fertilizers is not very effective, it is thought that fertilizer production processes will release less with the decrease in the amount used.
- The reduction of enteric emissions is also possible to some extent with holistic farm management.
- Forest management should prevent the reduction of sinks by increasing the carbon capture rates of existing forests (Yücel, 2016).

4.3.2. Political and Managerial Mitigation Measures That Can Be Used in Agriculture and Forestry:

Providing support to farmers in good practices for the climate and environment.

The improvement, protection, and development of ecosystems, as well as the harmonization of resource efficiency and low-carbon climate-resistant, production techniques with economic measures (IPCC, 2014).

Measures that will contribute the most to these priorities,

- Agricultural environment-climate payments,
- Supports for organic and holistic agriculture,
- Annual support for forestry activities, review of the arrangements that can be made for mountainous areas, natural and other regions facing specific constraints.
- In addition, reviewing rural development measures related to knowledge transfer and innovation, soil protection law, and increasing sanctions for conservation of wetlands of sinks and forests with legal restrictions.

4.3.3. Potential Barriers to Adoption of Mitigation Options

Unfortunately, there are many constraints and implementation difficulties in a wide range from biophysical constraints to cognitive and behavioral perceptions of farmers. Among the social and institutional factors, the application of new technologies that may be effective especially in the name of reduction and the adaptation of production to new systems, the necessity of conventional agriculture for feeding the world population appear as constraints on reduction (Weiner 2003; Wreford, 2017). The first important step in this regard is to know the real conditions in the soil and to adjust the climate measures to local needs. Simple awareness raising can already help farmers understand or gain better knowledge of these issues. Behavioral experiments can also increase the farmer's awareness and make them volunteer to practice.

In this regard, awareness-raising and awareness studies of agricultural extension organizations and the support of policymakers are extremely important.

5. CONCLUSION

Disasters and definitional difficulties caused by climate change will, unfortunately, affect not only a region or a continent but the whole world.

Unfortunately, there is no time and delay in combating climate change for these agriculture-oriented policies. Therefore, focusing on investing in developing countries in terms of development assistance in the name of adaptation and adaptation in agricultural production in the next decade should be among the priorities of developed countries. Improved coordination is needed to tackle climate change on behalf of the agricultural sector. Modelers, agricultural economists, and agricultural policymakers must move forward with more effective policies and work with each other to integrate climate change issues into existing agriculture.

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SECTOR-SPECIFIC ADAPTATION STRATEGIES: TOURISM

Prof. Dr. Mehmet Somuncu

1. INTRODUCTION

Due to reasons such as the rapid increase in the share of the tourism sector in the economies of countries, the high employment opportunities it provides directly and indirectly, its interaction with many sectors and its multiplier effect on those sectors, tourism sectors is a major source of foreign exchange for most developing countries and critical to their economy. According to the data of the United Nations World Tourism Organization (UNWTO), despite the emergence of negativities that may affect tourism from time to time such as wars, economic problems, epidemics and political problems between countries, since 1950, the number of participants in international tourism and expenditures and investments for tourism increased continuously. Accordingly, the tourism industry has developed greatly.

While the number of people participating in international tourism was 25 million in 1950, this figure reached 1,4 billion in 2018. While international tourism expenditures were only 2 billion USD in 1950, it was 1,4 trillion USD in 2018. In addition, with international travel expenditures of 256 billion USD, international tourist expenditures reached 1,7 trillion USD or a daily average 4,65 billion USD in 2018.

International tourist expenditures in 2018 accounted for 7% of world exports and 30% of world services exports in the same year (UNWTO, 2019). While tourism revenues rank first in 60 countries in the world, it constitutes one of the top five export revenues in more than 150 countries. Tourism is also the main source of foreign exchange for a third of developing countries and half of the least developed countries. This development in tourism has made the sector an important employment area. The tourism industry employs approximately 277 million people per year, directly or indirectly, around the world, and 1 person out of every 11 people working globally is employed in the tourism sector. It is estimated that the number of people participating in international tourism worldwide in 2030 will be 1.8 billion (UNWTO, 2015). These data are only macro level indicators reflecting the economic and social dimensions of international tourism.

The dimensions of domestic tourism that take place within the borders of the countries in the world are even greater than international tourism. The number of people participating in domestic tourism as of 2014 is estimated to be 6 billion people (UNWTO, 2015). When the expenditures made in domestic tourism are added to the international tourism expenditures, it is indisputable that the economic size that will emerge will be much higher. The calculations made by the World Travel & Tourism Council (WTTC) confirm this situation. According to data from WTTC, travel and tourism contributed 8,9 trillion USD to global GDP in 2019. This figure accounts for 10,3% of global GDP. The sector has provided employment to 330 million people directly and indirectly, which means that one in 10 jobs on a global scale belongs to the tourism sector. In addition, visitor expenditures in the tourism sector are 1,7 trillion USD, which constitutes 6,8% of global total exports and 28,3% of service exports (WTTC, 2020). According to the data and forecasts of both UNWTO and WTTC, depending on the development in tourism, the share of the sector in the world economy is expected to increase further in the near future.

The existence of such a picture economically makes tourism important. Tourism is an important source of foreign currency and a development tool especially for developing countries. However, tourism is a sector with a very high sensitivity to climate. Climatic conditions play a role in determining many factors such as the suitability of the locations for touristic activities, the tourism season and activities. Increase in temperature, rise in sea level and extreme weather events will directly affect mass tourism. Drought and desertification, forest fires, water scarcity, biodiversity losses, coastal erosion, diseases due to extreme weather events and vector-borne infectious diseases are also indirectly affected by the effects of climate change on tourism. In the report of Climate Change and Tourism Policy in OECD Countries published in 2008 by the World Tourism Organization and the United Nations Environment Program, the events that can be observed due to the effects of climate change in the Mediterranean Basin include warmer summers, water stress, biodiversity losses in terrestrial and aquatic ecosystems, and epidemic diseases.

(UNWTO and UNEP, 2008). In the final declaration of the Climate Change and Tourism Conference organized by the World Tourism Organization in Tunisia in 2003, there are very remarkable predictions for the Mediterranean basin. According to this declaration, it is stated that the temperatures will increase between 0,3 °C and 0,7 °C every ten years, the heat index (Temperature-Relative Humidity Index) will increase and the number of days above 40 °C will increase (TC Ministry of Environment and Urbanization, 2016; Republic of Turkey Ministry of Environment and Urbanization, 2018; UNWTO, 2003).

Since the main source of the tourism sector is climate, tourism centers are in direct relation with the climate and directly affect tourism activities in many different ways such as water supply, quality, heating-cooling costs, irrigation needs. However, climatic conditions and weather may increase participation in an event or, in a similar way, prevent participation. It is possible to say that the satisfaction of tourists is highly dependent on weather conditions, as climate conditions affect how enjoyable the activity will be. If we examine it from another point of view, climatic conditions can create adverse environmental conditions such as extreme temperatures, severe weather events, flood disasters, which may be a deterrent for tourists, as well as adverse conditions such as infectious diseases, stress, bad air quality that may result from extreme temperatures and insufficient water supply (Istanbul Metropolitan Municipality).

The tourism industry and destinations are clearly sensitive to climate variability and change. Climate determines the length and quality of the seasons in the trillion-dollar tourism industry and plays an important role in destination selection and tourist spending. In many places, tourism is closely linked to the natural environment. Climate affects a variety of environmental resources critical to tourism such as snow conditions, wildlife productivity and biodiversity, water levels and quality. It also affects various aspects of tourism operations (e.g. profit generation, irrigation needs, heating-cooling costs). The main impacts of climate change, which are foreseen by the Intergovernmental Panel on Climate Change (IPCC) and have the greatest potential significance for tourism sector, are summarized in table 1.

Table 1: Major Effects of Climate Change in Tourism Destinations and Possible Effects on Tourism

Effect	Possible effects on tourism
Higher temperatures	Changing seasonality, heat stress for tourists, cooling costs, changes in plant-wildlife-insect populations and distribution, spread of infectious diseases.
Reduced snow cover and shrinking glaciers	Insufficient snow in winter sports destinations, increase in snow making costs, shorter winter sports season, lessening the aesthetics of the landscape.
Increase in intensity and frequency of extreme storms	Risk for tourism facilities, increase in insurance costs / loss of insurability, downtime costs.
Increased evaporation and decreased precipitation in some areas	Water scarcity, competition for water among tourism and other sectors, desertification, increased fires affecting demand and threatening infrastructure.
Increase in the frequency of heavy rainfall in some areas	Flood damage to historical architectural and cultural assets, damage to tourism infrastructure, changing seasonality.
Sea level rise	Coastal erosion, beach area loss, high costs to protect and maintain port areas.
Increase in sea surface temperatures	Increased coral bleaching, deterioration in marine resources and aesthetics and snorkeling and diving destinations.
Changes in terrestrial and marine biodiversity	Loss of species and natural attractions in destinations, higher risk of disease in tropical-subtropical countries.
More frequent and large forest fires	Loss of natural attractions, increased risk of flooding, damage to tourism infrastructure.
Changes in soil (For example: moisture levels, erosion and acidity)	Impacts on destination attractors and loss of archaeological assets and other natural resources.

Source: UNWTO and UNEP (2008)

The effects of climate characteristics on the tourism sector are classified as aesthetic, physical and thermal effects. The thermal component in this classification explains how comfortable the tourist feels. The physical component is important to assess whether a particular activity is possible in conditions of climatic influences such as wind and rain. The aesthetic component, on the other hand, is considered as visual effects such as the appearance of clouds and reflection of light, defined as a psychological perspective enjoyed by the visitors (Istanbul Metropolitan Municipality). Therefore, adaptation is of paramount importance to overcome the current vulnerability and risks in the sector and to combat climate change.

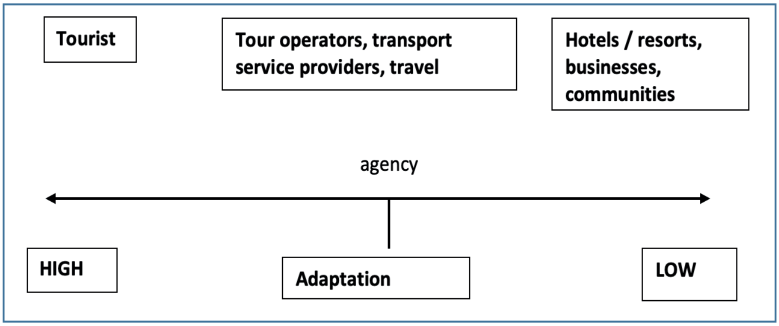
2. THE IMPORTANCE OF ADAPTATION TO CLIMATE CHANGE IN THE TOURISM SECTOR

IPCC (2007) states that the need for adaptation to climate change is inevitable for societies in the world and economic sectors such as tourism in the coming years. The inevitability of the need to adapt to future climate change and the realization that adaptation is happening today partially explain why there is a research explosion and policy interest in climate change adaptation in recent years. Research on climate change adaptation in tourism is less prominent than some other economic sectors such as agriculture, and there remains an important information gap, especially in terms of destinations.

Climate change adaptation can be defined briefly as the process of adaptation to current or expected climate conditions and impacts. In another definition, it is the process of strengthening, developing and implementing strategies in order to combat the effects of climate events (risks), to benefit and manage their effects.

Adaptation has the potential to mitigate the impact of climate change. Adaptation can be achieved by societies, institutions, individuals, governments. Economic, social or environmental drivers are motivated in many ways, such as social activities, market activities, local or global interventions. The time horizon of climate change effects should be taken into account in the implementation of adaptation measures in the tourism sector. Because the formation of the necessary information, policy changes and investments for the effective adaptation of tourism destinations will in some cases require decades, and therefore, the adaptation process should begin in a very short time for the destinations expected to be affected in the middle of the century.

Figure 1: Relative Adaptation Capacity of Major Tourism Sub-Sectors / Stakeholders



Source: UNWTO and UNEP, 2008

In the next 30 years, climate change is inevitable, as the reduction of greenhouse gas emissions will only have a small effect on greenhouse gas stocks. Harmonization is therefore a key policy response and the international community must find ways to support the adaptation process, especially in countries where the impact will be large. Policies that promote cohesion will be closely related to development in general, for example in terms of diversification of opportunities, but some specific investments will likely be made in terms of infrastructure, product range and other areas. However, adaptation to climate change is not an easy process and it has difficulties in terms of its human and economic costs. Adaptation is a challenging process, as climate change affects different parts of the world differently. Adaptation and mitigation are not alternatives to each other and are two basic complementary elements in combating climate change. Both need to be realized together (Boğaziçi University Center for Climate Change and Policy, 2020).

The dynamic nature of the tourism industry and its ability to cope with a range of new shocks, including SARS, terrorist attacks in some countries or the tsunami in Asia, indicate that the tourism industry in general has a relatively high capacity to adapt to climate change. However, it is thought that the capacity to adapt to climate change varies among sub-sectors / stakeholders of the tourism industry. Figure 1 shows the relative adaptation capacities of large sub-sectors to climate change.

Tourists have the greatest adaptation capacity with relative freedom to alter travel timing to avoid climate change affected destinations or adverse climatic conditions. Tourism service providers and tourism businesses in certain destinations have less adaptability. Large tour operators without infrastructure are in a better position to adapt to changes in the destination as they can respond to customers 'requests and provide information to influence customers' travel options. Target communities and tourism operators that invest heavily in immovable capital assets (e.g. hotel, resort complex, marina or casino) have the least adaptation capacity.

The tourism industry has adapted its operations to climate zones around the world. As seen in Table 2, various technological, managerial, policy and behavioral adaptations are used by various tourism stakeholders to deal with target level climate variability. Climate adaptation rarely depends on one method. Because it usually includes multiple adaptation methods that are very specific to the target climate and tourism products. The location-specific nature of climate adaptation will ultimately be a blend of adaptation methods and techniques applied in the tourism industry around the world.

Tabl3 2: Climate Adaptation Portfolio Used by Tourism Stakeholders

Kind of adaptation	Tourism operators / businesses	Tourism industry organizations	Governments and communities	Finance sector (investors / insurers)
Technical	Snow making • Shaping slope Rainwater collection and recycling systems Windproof building design and structure	Providing access to early warning equipment (e.g. radios) to tourism operators • Developing websites containing practical information about compliance measures	Reservoirs and desalination facilities • Charging for water consumption Weather forecast and early warning systems	Requirement of advanced building design or material (fire resistant) standards for insurance • Providing information material to consumers

Kind of adaptation	Tourism operators / businesses	Tourism industry organizations	Governments and communities	Finance sector (investors / insurers)
Administrative	• Water conservation plans Low season closures • Product and market diversification • Regional diversity in commercial activities • Guiding customers away from affected destinations	Snow condition reporting via media • Using short term seasonal forecasts for planning marketing activities • Training programs on adaptation to climate change • Promoting environmental management with companies (e.g. through certification)	• Impact management plans (e.g. 'Coral Bleaching Response Plan') Contract / event interruption insurance Operating subsidies (for example, insurance or energy costs)	• Adjusting insurance premiums or renewing insurance policies • Limiting loans to high risk businesses
Policy	Hurricane outage guarantees • Compliance with the regulation (e.g. building code)	Coordinated political lobbying to reduce greenhouse gas emissions and promote harmonization • Seeking funding to implement cohesion projects	Coastal management plans and detection requirements • Building design standards (e.g. for hurricane strength winds)	• Addressing climate change in credit risk and project finance assessments
Research	• Site location (e.g. north facing slopes, higher altitudes for ski areas)	• Assessing the awareness of businesses and tourists as well as information gap	• Monitoring programs (e.g. estimating bleaching or avalanche risk, beach water quality)	• Exposure to extreme event risk
Education	Water saving training for employees and guests	Public education campaign Water saving campaigns	Water saving campaigns Campaigns on the dangers of UV radiation	To educate/inform potential and existing customers
Behavioral	Real time webcams of snow conditions Greenhouse gas emission offset programs	Greenhouse gas emission offset programs Water saving initiatives	Extreme incident recycling marketing	• Good in-house practices

Source: UNWTO and UNEP, 2008

3. THE IMPORTANCE OF NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY IN ADAPTATION TO CLIMATE CHANGE

Undoubtedly, the adaptation methods and techniques listed one by one in Table 2 cannot be considered to be performed or successful alone. For this reason, adaptation to climate change should be considered as a part of national studies and efforts. In this respect, the national climate change adaptation strategy documents and translating the targets of this document into action are important as they contribute to the coordination of adaptation activities. In the "National Adaptation Action Programs" made in the least developed countries and "National Adaptation Strategies" in the developing countries, in addition to the determination of country-specific impacts, the engagement of different institutions and administrative levels, climate change adaptation activities are also addressed at local and regional levels with the broad participation of business and civil society actors (Ministry of Environment and Urbanization, 2012).

In fact, successful adaptation to climate change at the national level is possible by providing some basic conditions. The conditions that determine the elements of a national strategy are as follows:

- A systematic planning capacity in a collaborative institutional environment;
- Adequate institutional arrangements, including consistent policies, measures, and regulatory frameworks;
- Effective coordination of activities carried out under the leadership of NGOs, research institutions, the private sector and local and regional administrations and which are continuous at regional and local level;
- Scientific and technical capacity for understanding the problem and its impacts at national and local/regional level, modeling its long-term effects

and formulating measures and adaptation strategies according to the level of implementation;

- Program and project preparation capacity;

Citizen awareness and participation maintains its measures for adaptation to climate change and sets its priorities (Ministry of Environment and Urbanization, 2012).

The factors determining the capacity of countries to adapt to the effects of climate change are listed below:

- Availability of resources and their spread to the population
- Infrastructure of critical institutions and coordination of decision-making authorities
- Risk assessment methods and management (methods of spreading risks) stages
- Economic effects of climate change
- Investment programs based on impact analysis
- Linking the effects of climate change and adaptation to fiscal policies (For example, tax / incentive policies, linking with the insurance regime)
- Technology options / innovations suitable for adaptation
- Capacity to produce projects to use adaptation funds and to demand these funds rather than to supply (Ministry of Environment and Urbanization, 2012).

The most important challenge of developing a strategy for adaptation to the effects of climate change is the presence of obstacles in realistically detecting effects, vulnerabilities and uncertainties. In the scientific sense, the main obstacles are not knowing and measuring the effects and uncertainties sufficiently for almost every sector, and not having comprehensive models.

The vulnerability, sensitivity assessments are either absent or too general. Lack of awareness brings about insufficient adaptation measures on sector/theme basis. However, while determining the impacts, it is necessary to separate them into the economy, the growth of the dominant sectors (the effect arising from the responsibilities of reducing and controlling greenhouse gases), social life and the environment.

Aside from the absence or lack of specific policies and practices for the adaptation of sectors and resources affected by climate change to climate change, various organizations of countries with regard to climate change determine the impacts on their own and set targets in this direction. This prevents integration between sectors. The important thing here is to consider and measure the combined effects (Ministry of Environment and Urbanization, 2012).

The process of adapting to the effects of climate change includes the integration of options, costs and risks by the private sector and public decision makers in different places and over different periods. Therefore, it is important to create a climate change adaptation strategy that can direct many decision-making processes over time. This strategy should be a sustainable approach that makes societies more resilient and ensures the long-term well-being of the environment and economy. It is important to support a sustainable approach to climate change adaptation with the basic "strategic principles" summarized below:

- 1. Adaptation must be achieved through measures that provide resistance. Adaptation measures must ensure strong societies, sustainable economic growth and a healthy environment.
- 2. Adaptation must be continuous and based on new knowledge. Adaptation measures should take into account the uncertainty regarding climate forecast through systematic monitoring and review. This increases the knowledge by identifying the measures that are successful and allows the inclusion of new risk information.
- 3. Adaptation should be integrated into normal development and implementation processes. Climate resistance and risk management should be integrated with existing management processes and decisions in order to broaden the scope of good development practice.

- ► 4. Adaptation should be integrated at an appropriate scale and include relevant decision-making levels. Governments have a strategic role to play here. However, the problem is not just governments, because the effects of climate change require many organizations and individual actors in society to make decisions. Adapting to climate change requires a unified approach, sometimes aiming to work on a large scale, sometimes to deal with geographically diverse regions, basins or smaller scales.
- ► 5. Adaptation should be tackled together with actions to reduce greenhouse gas emissions. Activities related to managing the effects of changing climate should also be in line with existing conditions for reducing greenhouse gas emissions. Likewise, efforts to reduce emissions must comply with the principles of adaptation (specified here).
- ► 6. The adaptation of a sector should not restrict the adaptation of other sectors. Decisions taken by an organization, business or individual to manage climate change risks should aim to build resilience for the interests of other interested parties by promoting strong societies, sustainable economic growth and biodiversity conservation.

"Strategic priority" activities to be selected for adaptation to the impacts of climate change can directly reduce the level of vulnerability to climate risks or enable opportunities to be utilized. Alternatively, activities may include building capacity or skills to establish adaptation measures. Governments have to determine the following strategic priorities/take measures in order to encourage adaptation to climate change (Ministry of Environment and Urbanization, 2012):

Taking immediate action, if possible: Climate change is generally not seen as a priority by decision makers as it is a future issue. However, it is now witnessed that the costs start to increase due to the changes in the climate while the usual practices continue. At this point, although the lack of information constitutes an obstacle, holistic planning including climate risks should be started and these plans should be combined with the planning of existing activities. Here, the first priority is to obtain more reliable and sufficient information.

Governments lead role and coordination: Governments should lead in this direction and coordinate with interested parties by including the principles of adaptation to climate change in development plans, policies and programs.

Building adaptation capacity: It is important to ensure greater access to information and to encourage decision-makers' capacity to use this information. In addition, there should be effective communication between key decision-makers in order to establish effective adaptation measures.

Reducing and managing uncertainty: Knowledge needs to be enhanced by taking a strategic approach to research and participating in partnerships that share best practices and findings, including understanding how to plan and manage uncertainty. Here the "precautionary principle" can be used as a good guide for decision making in the face of continued uncertainty.

Educating the public and other groups about the characteristics of climate risks and how they can be managed: Households, businesses and other segments of society to adapt to the impacts of climate change, Active participation of everyone is required, including NGOs, volunteers, private and public sector. Governments should increase the level of awareness on the characteristics of climate change and on how to better manage this risk and support the adaptation capacity of these actors. The more public awareness on the effects of climate change develops, the easier it will be to eliminate risks, moreover, the benefits of adaptation may also arise.

The need for reviewing management structures for adaptation to climate change: In order to adapt to the impacts of climate change, active participation of almost every sector and administration is required. Governments should support the development of these actors' ability to adapt to climate change. At this point, corporate ownership is important. In many countries, overall responsibility for climate change lies with the Environment Ministries. In addition to environmental ministries; it is of great importance that ministries such as the Ministries of Planning, Finance, Agriculture and Trade, which play a key role in development, also participate in the formulation of climate change adaptation strategies. For example, the lack of capacity of important ministries such as Public Works, Finance or Health in the governments of countries in the Pacific region, which are more affected by natural disasters, has caused many measures taken for adaptation to be negatively affected. In summary, institutional set-up can increase or decrease society's exposure to climate risks. Well-established institutions such as disaster relief payments and insurance programs affect adaptation capacity. Coastal zoning, zoning plans and building legislation are institutional examples that can contribute to (or reduce) the capacity to resist climate change effectively.

Using environmental management and planning tools to adapt to the effects of climate change: It is important to use environmental management and planning tools in the integration of climate change adaptation efforts at the project level. Here, Environmental Impact Assessment (EIA) studies, one of the environmental management tools, can be considered as a possible entry point. As in Turkey, the EIA in investment proposals in many countries is subject to the regulations. Therefore, the EIA can form a framework to identify routine issues related to climate change at the project level. Essentially, an important deficiency in including issues related to climate change adaptation in EIA practices is that EIAs aim to determine the effects of projects on the environment rather than the effects of change in the environment on projects. The first stage of an EIA is to identify activities that are likely to have significant impacts on the environment. Therefore, “environmentally harmless” activities are unfortunately not considered, even if they may be affected by the consequences of climate change. Combining climate risk analysis and adaptation to climate change with EIA processes will require determining the sensitivity of the project screening process to climate change and determining the level or potential of the project from climate change, and expanding the project to include all of these (Ministry of Environment and Urbanization, 2012).

4. CHALLENGES OF INTER-SECTORAL INTEGRATION FOR ADAPTATION TO CLIMATE CHANGE

The effects of climate change are not limited to spatial or sectoral scales. Because climate effects occur on a large scale and although some effects are mostly related to a specific sector, they carry inter-sectoral effects that are interconnected. For this reason, there is a need for inter-sectoral integration in decision-making and policy-making processes at all levels of combating climate change. However, this integration or coordination is not always possible. There are various reasons for this.

5. CONCLUSION

It is known that climate change has far-reaching consequences for tourism businesses and destinations. At the destination level, the magnitude of the impact of climate change depends on the importance of tourism in the regional economy, the characteristics of climate change and its impact on the natural environment, the adaptation response of the tourism sector and other long-term factors affecting the effects of climate change in the tourism sector, globalization and economic fluctuations, fuel prices, aging in industrialized countries population, increased travel safety and health concerns, increased environmental and cultural awareness, advances in information and transportation technology, and environmental constraints. It should not be assumed that no destination will be affected by climate change (UNWTO and UNEP, 2008). Given that the direct and indirect impacts of climate change on the tourism target are largely negative, it is in the industry's interest to actively contribute to both adaptation and mitigation. Since the existence of the sector is based on nature, especially climate, it is exposed to the effects of climate change more than other sectors. Therefore, adaptation is vital for the tourism sector (Somuncu, 2016; 2018).

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SECTOR SPESIFIC CLIMATE CHANGE ADAPTATION STRATEGIES: ENERGY

Prof. Dr. Levent Aydın

1. ENERGY SECTOR IN ADAPTATION TO CLIMATE CHANGE: CONCEPTUAL FRAMEWORK

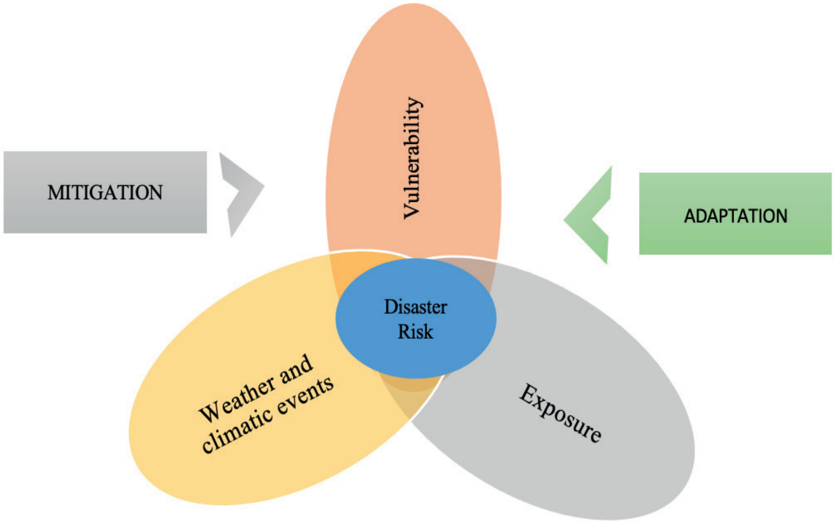
1.1. Adaptation and Mitigation

Adaptation is defined as "an adjustment in natural and human systems in response to actual or expected climate effects" (IPCC, 2012). While mitigation of climate change reduces the severity and frequency of climate change hazards, climate adaptation actions counter a changing environment to reduce:

- The vulnerability of a system, the tendency or susceptibility of a system to be adversely affected; and
- Exposure of an area of livelihoods, ecosystems, services and economic assets in areas that may be adversely affected by climate change hazards.

As shown in Figure-1, there is a risk of disaster when a socio-ecological system is simultaneously vulnerable and exposed to climate hazards. The benefits of mitigation cover climate hazards globally and many non-specific climate aspects. On the other hand, adaptation efforts are required to reduce both vulnerability and exposure to current and projected climate change. The benefits of adaptation are to reduce disaster risk to a local and specific level for a sustainable society in the long term.

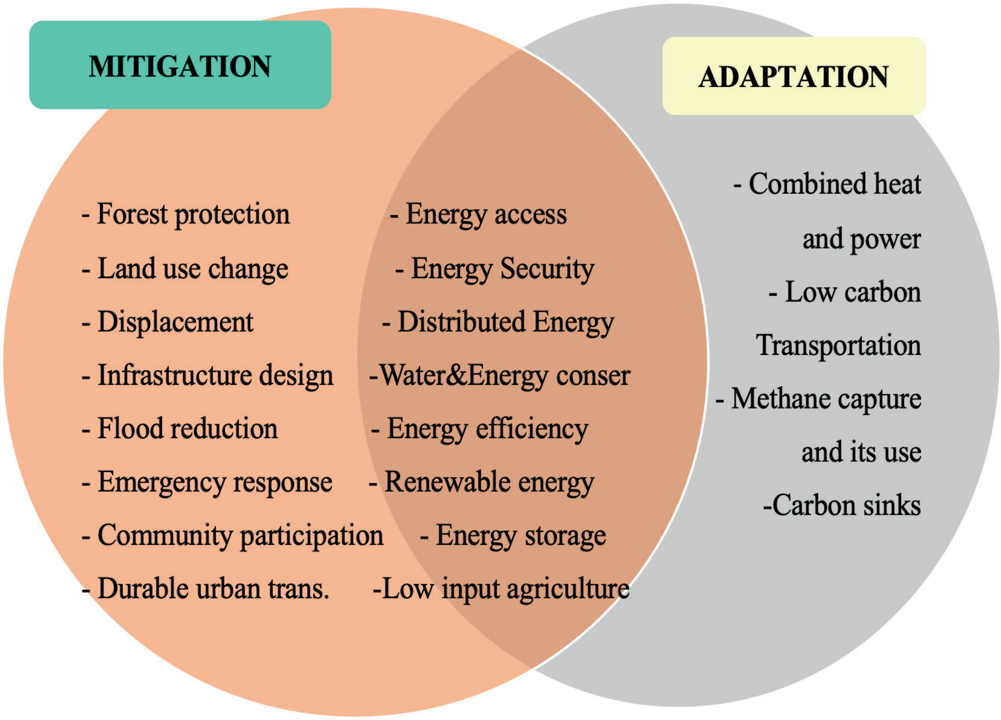
Figure 1: Disaster risk factors in the context of climate



Understanding the difference between adaptation and mitigation is essential to understanding what adaptation means for the energy sector. As the energy sector is often associated with mitigation efforts, opportunities for energy adaptation are constantly not considered.

Figure 2 details how climate and energy interventions can reduce emissions and create resilience, or both at the same time, resulting in both mitigation and adaptation benefits (Winkelman, 2016).

Figure 2: Climate change adaptation and mitigation intervention distinctions and synergies in energy



For example, energy efficiency programs are a mitigation intervention and will reduce carbon emissions. However, these programs will also reduce the vulnerability of an energy system to climate hazards that can affect energy supply security. If less energy is required for the same service, power outages cause less damage and thus promote climate resistance. Other examples include microgrids that create both low carbon and more flexible power systems. Water efficiency measures also have the dual benefit of requiring less pumping energy, reducing the carbon footprint and preparing for a possible reduction in future water resources. Indeed, mitigation financing can indirectly contribute to adaptation efforts.

Indeed, it is important to understand the distinctions and synergies between mitigation and adaptation from the outset. Recognizing the differences and overlaps will help us understand why the energy sector is not ready for serious climate change and variability in the following chapters.

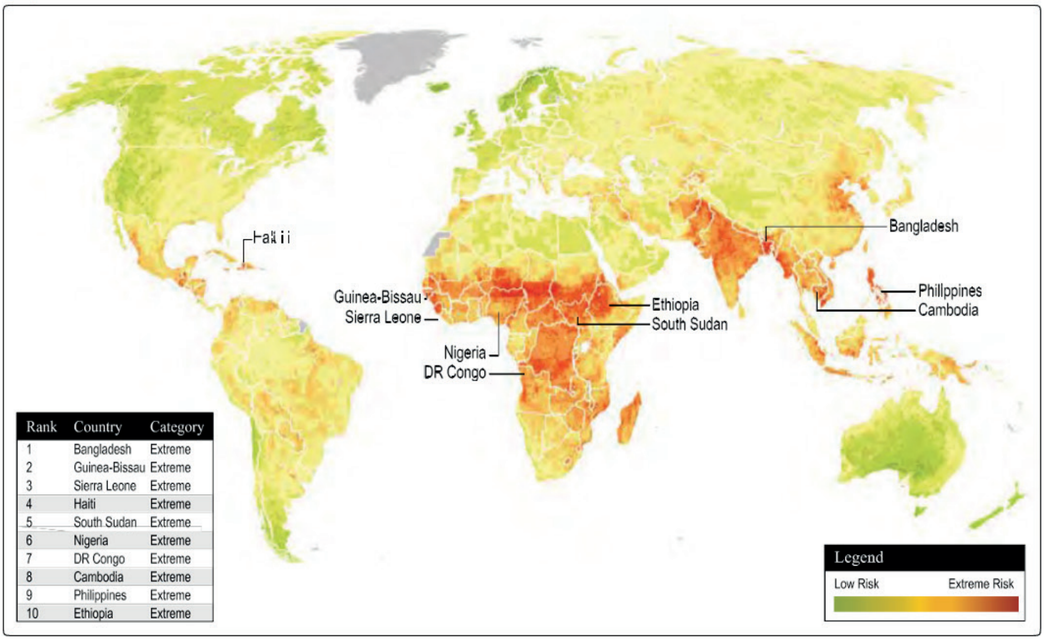
1.2. Where is adaptation to climate change required?

In 2016, global warming had already reached +0,83 degrees Celsius compared to the pre-industrial reference period, according to the World Meteorological Organization (WMO). IPCC projections indicate a warming trend of 2,6 to 4,8 degrees Celsius by 2100, a possible sea level rise between 0,26 and 0,55 meters, and an increase in the tendency and frequency of extreme weather events such as tropical cyclones (IPCC, 2014).

To geographically visualize vulnerability and exposure where they need to be addressed, Maplecroft has designed a Climate Change Vulnerability Index.

Figure-3 shows that the regions most vulnerable to climate change are developing countries. Therefore, this chapter will focus on developing countries while addressing the issue of climate change adaptation and the energy sector (Maplecroft, 2014).

Figure 3: Maplecroft Climate Change Vulnerability Index 2014



This index takes into account exposure to climate-related events such as sea level rise, a country's dependence on certain sectors such as agriculture, and the government's ability to adapt. Data for 170 countries are covered by this Climate Change Vulnerability Index

For example: In Bangladesh, damage costs from single cyclone events are expected to increase fivefold to $ 9 billion by 2050, accounting for 0,6% of GDP, which falls disproportionately to poor households in coastal areas. Coastal weirs and cyclone shelters are effective in limiting the damages and deaths caused by cyclones.

Countries at extreme risk have many similar climate vulnerability features, including:

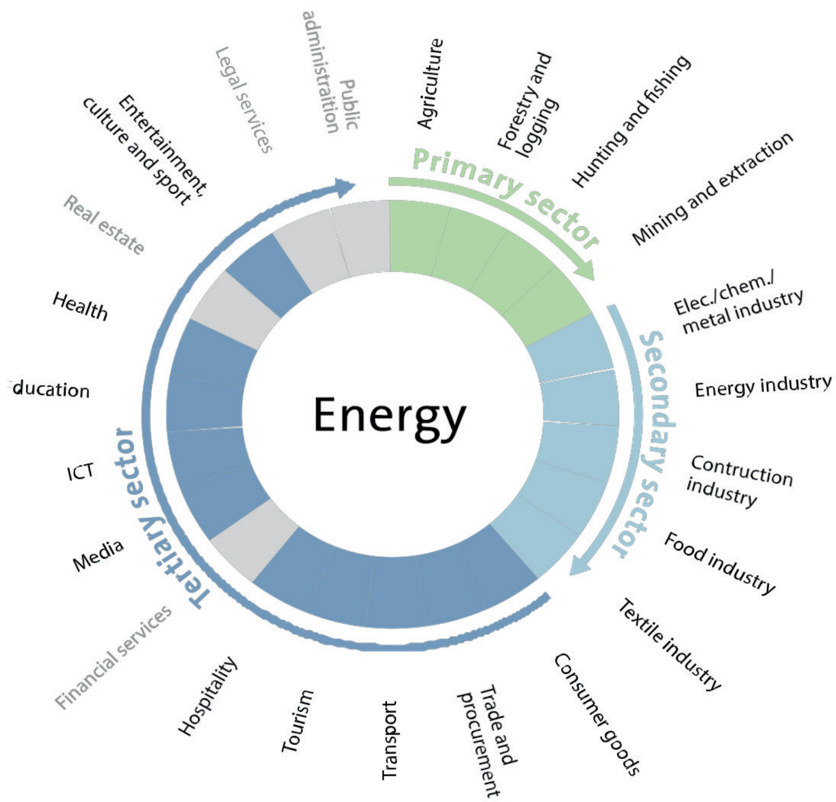
- High levels of poverty;
- Dense populations;
- High exposure to climatic events;
- High reliance on agricultural land in flood and drought risk areas; and
- Poor access to reliable energy (World Bank, 2010).

Using the ranking in this index, it is clear that countries with lower levels of economic development most need adaptation to climate change. This is because they have little financial capacity to adapt their economies to predicted climate hazards. There is a direct relationship between the vulnerability to climate change and the level of economic development.

1.3. How does the energy sector contribute to adaptation to climate change?

The role of the energy sector for adaptation in general should be acknowledged before detailing how to build a more durable energy system. In other words, this chapter explains how energy and access to energy can support adaptation in all sectors (IEA, 2015). A sustainable energy system contributes to adaptation as energy provides input to almost all goods and services of an economy. In particular, food production, water treatment and distribution industries need energy as the primary input. A strong energy sector can provide input to GDP, employment, trade opportunities and welfare advantages that strengthen the resilience of the economy. Figure 4 shows how energy is input into most tertiary sector services, as well as all third and second sectors. Gray colored words describe weak energy input connections, black colored words describe strong energy input connections (ADB, 2012).

Figure 4: Energy input requirements for all economic sectors



With increasing economic growth, the economy as a whole is more resilient to the effects of climate change. In China, India and South Korea, investments in non-traditional energy sources such as renewable energy are used to increase economic growth (World Economic Forum / HIS CERA, 2012). With an increase of 71% by mid-century in non-OECD countries as demand for energy increases, this sector has great potential to play an important role in economic growth and resilience (IEA /OECD, 2016).

In addition to diversifying the energy mix, the energy sector can provide more efficient agricultural activities through improved irrigation systems. Also, providing energy access to education allows higher quality tools to be used by more people for more hours a day. Increasing capacity building raises awareness of climate change and informs adaptation strategies.

Another example of how the energy sector contributes to adaptation concerns all the additional energy demand that will be needed during heat waves. Adaptation measures include air conditioning installations in public buildings to prepare for a warmer climate. A reliable source of energy is the backbone for such a measure to be effective.

Currently, however, Nationally Designated Contributions (NDCs) and National Adaptation Plans (NAPs) often bypass the energy sector as a contributor to adaptation and focus solely on using the energy system for mitigation. Although the energy sector is still an important tool for mitigation, it is not a structural component of adaptation planning.

2. THE EFFECTS OF CLIMATE CHANGE ON THE ENERGY SECTOR

2.1. What makes the energy sector vulnerable to climate change?

As 70% of global greenhouse gas emissions arise from energy activities, the energy sector contributes mainly to climate change. However, the energy sector itself is affected by climate change and depending on the modalities, area of influence and intensity of the impact, these effects may have negative consequences on the economy. To date, insufficient attention has been paid to energy sector vulnerability in relation to projected climate change.

Various features of the energy sector make it vulnerable to climate change and force sustainable transformation. The energy sector consists of a vast network of physical infrastructure that is vulnerable to damage caused by extreme climatic events.

The energy sector requires long-lasting infrastructure. In fact, power plant infrastructure lifetimes are between 15 and 40 years (even higher for nuclear power plants) and transmission line lifetimes between 40 and 75 years. This means it is important to plan strategically according to climate projections and to be aware of the long-term effects of climate change.

In addition to energy being input to many sectors, the energy sector also depends on other sectors to operate. The water and agriculture sectors are examples of indispensable inputs for energy production and use that are at risk of climate change impacts.

Most importantly, energy sector generation resources such as thermal power and hydroelectricity all depend on climatic conditions. This section focuses on how four climate stresses affect the energy system: temperature rise, precipitation fluctuation, extreme weather events (storms, cyclones) and rise in sea level.

2.2. How does climate change affect energy production?

The hydroelectric sector will be particularly affected by changes in water flow due to snow and glacial melt, precipitation variability, heat waves, droughts, floods and extreme storms. In Figure 5, the projected changes in hydroelectric generation in 2050 are presented based on the IPCC A1B emission scenario from the 12 General Circulation Model (GCM) and hydropower generation in 2006.

For example: For gas turbines, the power output decreases in proportion to the temperature increase. A 5.5 degree increase in ambient air temperature results in a 3 to 4% reduction in energy output. (Neumann et al., 2009). In Kenya, economic losses in hydropower potential, reduced to 2100 as a result of rainfall scarcity, could range from $ 4 to $ 19 million for a high climate change scenario. (Droogers, 2009) During the 2003 and 2007 heat waves in Europe, 17 thermal power plants had to be shut down or production stopped in Germany, France, Spain, Romania, Czech Republic and Slovakia, as there was insufficient cooling water and the waste water exceeded the temperature limits (Linnerud, 2010).

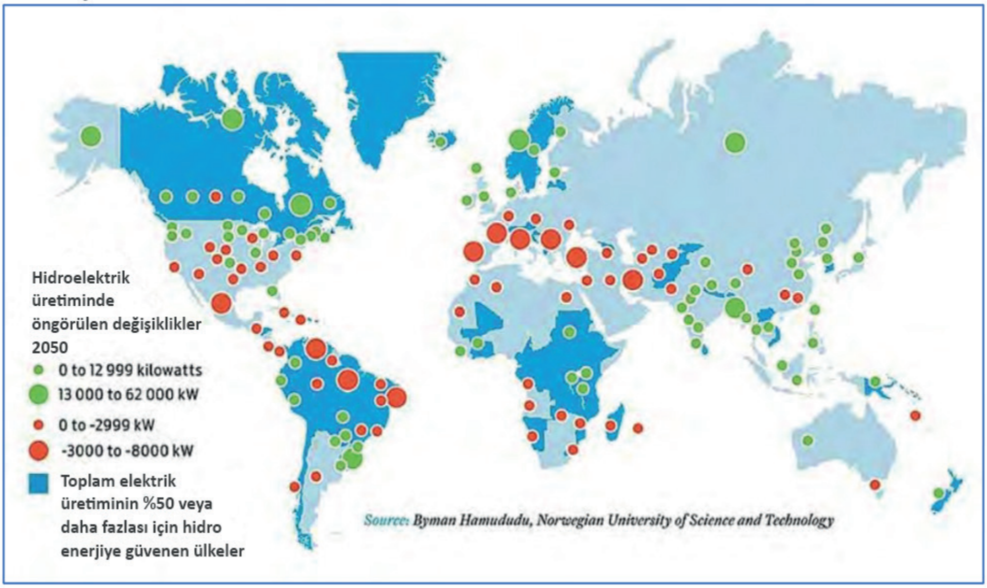
It is important to recognize that many countries that are strongly dependent on hydroelectric power, such as South America and Africa, will experience large fluctuations in leakage and have little adaptation capacity to deal with these changes.

Table 1: Main effects of climate change on energy production sources by climate stressor

Climate stress	Warming trend	Precipitation	Cyclone	level
Hydro Power Plants	High temperatures can cause the melting of glaciers, increasing the amount of water in hydro basins. Extreme temperatures can affect energy production due to increased reservoir evaporation.	Changes in precipitation can increase flow variability. Droughts can affect currents and energy output.	Equipment damage can reduce output.	It has no significant effect
Wind farms	Increasing temperatures can reduce air density, reducing energy output.	It has no significant effect	Change in wind speed can increase output variability. Damage from cyclones can reduce plant life and efficiency.	Sea level rise can damage coastal infrastructure.
Biomass	Extreme temperatures can cause fires and threaten plants. Increasing temperatures can affect crop yields and irrigation needs.	Drought can affect crop yields Precipitation fluctuations can cause variable irrigation needs.	Storms can threaten crop yields.	Erosion and salinity can threaten crop productivity.
Solar power plants	High temperatures can reduce solar PV cell efficiency. High temperatures can alter Concentrated Solar Power (CSP) efficiency.	Increased cloud cover can reduce solar PV generation output. Drought could affect Concentrat-ed Solar Power (CSP) produc-tion	Extreme events can damage structures and shorten plant life.	It has no significant effect

Climate stress	Warming trend	Precipitation	Cyclone	level
Thermal power plants	Higher temperature of the cooling water can reduce plant productivity.	Increasing water content can affect fossil fuel quality. Drought can affect availability of water for cooling	Cyclones can damage plant infrastructure.	Sea level rise can increase risk of damage to coastal infrastructure and coastal stations

Figure 5: Distinctions and synergies of climate change adaptation and mitigation intervention in the energy sector



Source: Hamududu et al., 2010

2.3. How does climate change affect energy transmission and distribution?

The effects of climate variability and change on energy production are obvious, but energy transport, transmission and distribution infrastructure will also be directly and indirectly affected.

For example: In the electricity sector, the resistance of the copper lines increases by 0,4% and the transformer capacity decreases by 1% for each degree Celsius temperature increase (Aivalioti, 2015).

Table 2: Distinctions and synergies of climate change adaptation and mitigation intervention in the energy sector

Climate stress	Warming trend	Precipitation	Cyclone	Sea level
Transmission and distribution	Higher temperatures can increase electrical resistance for transmission lines and decrease transmission efficiency. High temperatures can increase the risk of fire and damage infrastructure, including power lines.	Precipitation variations can hinder or delay road transport, which in turn can affect oil or gas transportation.	Storms and strong winds damage infrastructure and power lines, reducing system reliability.	Sea level rise can damage infrastructure due to salty water corrosion

Figure 6: Extreme ice and snow loads on pylons near Münster, Germany in autumn 2005

2.4. How does climate change affect energy consumption?

In addition to increasing energy demand due to development and population growth, energy use will also change. Global warming will provide the increasing energy need for cooling in summer and a decrease in the need for heating in winter. In general, additional energy reserves and emergency energy capacity will be required for extreme events such as heat waves.

For example: In Thailand, a global temperature rise of 1,7 to 3,4 degrees Celsius could result in an increase in peak electric power capacity demand of 6,6% to 15,3% by 2080 (ADB, 2010).

Table 3: Table 2 Main effects of climate change on energy consumption by climate stressor

Climate stress	Warming trend	Precipitation	Cyclone	Sea level
End users	Higher temperatures can increase the energy demand for cooling and reduce the energy demand for heating.	Variable precipitation can increase power outages and cause outages. Floods and droughts may require additional urgent energy capacity.	Extreme weather events can damage end-user infrastructure and cause power outages.	Sea level rise can increase the energy demand for desalination facilities (as freshwater sources are threatened) and water efficient irrigation techniques (as crops are threatened).

Energy production will be particularly vulnerable to temperature increases and precipitation fluctuations. Transmission and distribution networks will suffer from extreme storms and tropical cyclones. Energy consumption will be highly sensitive to heat waves for cooling energy demand.

The energy sector will therefore be increasingly affected by the effects of climate change. Moreover, the climate sensitivity of developing countries adds to the seriousness and urgency of these consequences. As mitigation is currently a priority for climate action in the energy sector, the following section will detail the key action areas for a more flexible energy system.

3. KEY AREAS OF ACTIVITY FOR BUILDING A RESILIENT ENERGY SECTOR

3.1. What adaptation measures are in place to adapt the energy sector to climate change?

Climate proofing means “taking into account and internalizing the potential risks and opportunities for the design, operation and maintenance of the infrastructure of climate change scenarios” (UNDP, 2011).

Climate control also includes preventing mismatch, which is "adaptation that fails to reduce vulnerability, instead increases it". For example, providing a community with only access to energy can lead to over-exploitation of natural resources. Water is often the targeted source as diesel pumps make water withdrawal much easier compared to manual labor. In general, power generation also requires tremendous amounts of water, making it difficult to balance water availability with energy demand and provides a problem of increased urgency and importance. Although energy will contribute heavily to adaptation to climate change, incompatibility awareness should be present during energy project planning and implementation.

Projects should be implemented with a holistic approach, taking into account all natural, human, social and financial resources specific to the socioecological system on which the project is based.

Climate adaptation will remain an ongoing process, as there will always be uncertainties about the nature and intensity of future climate change and the Vulnerability of systems.

There are many types of adaptation for the energy sector. First, adaptation measures can be proactive and reduce exposure to future risks, such as planning the location of future power systems in less exposed areas. Second, adaptation measures can be reactive and reduce impacts on pre-installed systems, such as retrofitting a dam in an installed hydroelectric power plant.

Below are some general adaptation solutions that protect the markets of the energy sector:

- A critical adaptation measure to address climate change uncertainty is to ensure adequate adaptation capacity (Adger et al., 2006). Adaptive capacity refers to "the ability or potential of a system to respond successfully to climate change". This can be facilitated through control and access to social, human, natural and financial resources. For example, women in developing countries are more vulnerable to climate change because they cannot access information; where there is little access to finance for infrastructure, buildings and transport systems are vulnerable to climate events.
- Access to energy reduces climate vulnerability, especially in rural areas in developing countries. Populations without access to energy are more vulnerable to extreme weather events, as precipitation variations without water pumps can have serious consequences on the availability of water for a society. Access to energy can also increase livelihood diversity. As rural families diversify their portfolio of activities and social skills, they can improve their living standards. However, since it is often costly to extend an electricity grid to rural areas, an effective way to increase energy access in rural areas is through renewable energy systems from the grid. With this renewable and decentralized approach, the population is less vulnerable to climate change.
- Energy diversification eliminates dependence on a single-generation resource to increase supply security. By diversifying the energy sector, preventing the energy supply from being less vulnerable to climate variability and change, particularly fluctuations in water availability.
- For example: East Africa is particularly vulnerable to climate change, as 80% of electricity generation comes from hydroelectric sources, but precipitation fluctuations in this area will pose a risk (Karekezi et al., 2005). Energy diversity

can reduce much of East Africa's energy sector vulnerability.

- Energy efficiency, water efficiency and demand-side management can also ease supply constraints. Developing countries suffer not only from vulnerable infrastructure and well-maintained power generation sources, but also from inefficient electricity use. Also, higher temperatures reduce production efficiency and increase energy demand during warmer seasons. These effects can be compensated for by designing a more efficient energy infrastructure. There is a great potential for efficient use of resources, especially in the construction sector. This potential is especially important for urban areas as cities are important consumers of energy.
- Reducing and shifting energy demand from peak hours and thus softening energy demand throughout the day and year will lower the total energy capacity required. By softening the highest energy demand, by reducing the risk of power outages and load shedding, energy supply security is increased and a more flexible energy system is achieved. Energy storage (ex. batteries), smart grids for the power grid, other flexibility and demand-side management measures can change this energy load.
- Unlike central energy systems, distributed energy system can increase flexibility. In general, centralized energy systems interconnected with many different energy producers and consumers are more vulnerable to climate change because an outage at some point in the system can affect the entire network. Decentralized systems with shorter transmission and distribution lines are not interdependent and can therefore reduce climate-related risks occurring in a given area.

Table 4 below lists the energy source and other important adaptation measures related to the climate stressor that will be needed to create flexible energy systems.

Table 4: Main effects of climate change on energy transmission and distribution by climate stressor

Climate Stress	Warming trend	Precipitation	Cyclone	Sea level
Hydro plant	Glacial melt can increase the water capacity requirements of a hydroelectric power station, thus inducing the need for enlarged and strengthened dams and hydropower reinforcement.	Increases in precipitation can increase mountain erosion and the amount of silt and sand in the water carried to the hydroelectric power plant. This effect will require improved silica removal gates and improved hydrological prediction. Floods may require extended hydro flood gates and higher dam height. Depending on the flow regime (for example, if precipitation decreases), the displacement of upstream river branches or dams can be considered.	Increasing storm and cyclone density and or frequency may require flexible hydroelectric infrastructure.	No major adaptation measure
Wind farm	No major adaptation measure	Flood risks may require the plant to be relocated.	Increased wind speeds will be maximum at higher altitudes, and higher towers can be used to catch the strongest winds. The change in wind speed may require vertical axis turbines to be considered because the latter are less sensitive to rapid changes in wind direction.	Rising sea level may require plant relocation.
Biomass	Higher temperatures may require crop types that can tolerate these higher temperatures.	Precipitation uncertainties may require improved irrigation systems. Increased rainfall may require crop choices for biomass that can tolerate higher water stresses.	Storms may require early warning systems for immediate harvest.	Sea level and salinization risk may require the construction of drainage systems.

Climate Stress	Warming trend	Precipitation	Cyclone	Sea level
Solar power plants	Increased temperatures may require increased air flow below the mounting structure to cool.	Reduced precipitation risks for CSP plants may require air cooling systems rather than water cooling systems. Water reuse can also be considered.	Increasing storms and cyclones may require panels designed to withstand strong winds .	Rising sea level may require plant relocation.
Thermal power plant	Increasing temperatures may require more efficient cooling systems (wastewater use, water reuse, water recovery from heat exchangers, reduction of evaporation losses) and decentralized production.	Drought and floods may need remediation soundness of plant stations. Flood risks may require the relocation of storage reservoirs. Reduced precipitation may require air cooling systems rather than water cooling systems. Water reuse can also be considered.	Storm risks may require improvements in the robustness of facility stations. Extreme events may require additional storage capacity. Extreme events may require emergency planning procedures. Increasing storms may require windproof standards.	Sea level rise may require plant displacement, flood control systems (embankments, ditches, ponds, barriers).
Transmission and distribution	Increasing temperatures may require additional power line protection. Underground transport and transfer structures can be used. Cooling may be considered for substations and trans-formers resistant to high temperatures and ICT components.	No major adaptation measure	Extreme events may require improved power line robustness. Extreme events may require emergency planning procedures and regular infrastructure reviews and monitoring. Extreme events may require concrete-sided	Sea level rise may require displacement and strengthening to prevent saltwater corrosion.

Climate Stress	Warming trend	Precipitation	Cyclone	Sea level
End-user	Rising temperatures may require energy-efficient appliances/fuel substitutes for heating/cooling and transport.	Variable precipitation may require water-saving devices.	Extreme storms can increase power outages and require investment in decentralized power at the home level for energy supply stability.	Sea level rise may require repositioning.

Adaptation measures presented in Table 4 can only be used after site-specific climate risk assessment. Large infrastructure projects already require environmental impact assessments to reduce the actual impact on the ecosystem; this includes, for example, analysis of dam construction in a particular environment. However, climate risk assessments are not conducted systematically.

A climate risk assessment will assess climate variability risks on infrastructure as opposed to an environmental impact assessment that assesses the risk to the ecosystem. It is very important that all infrastructure projects, especially long-lived ones, carry out both environmental impact assessment and climate risk assessment, or combine the two estimates to identify where extra adaptation needs exist today and in the future.

A region should also take into account its current energy system and identify the sector in which its energy supply trusts most. For example, in a region highly dependent on hydropower, local governments and the private sector should focus initially on diversifying the energy mix, secondly on strengthening dams, creating trenches, and diverting tributaries to prepare for water current surges. Adaptation measures cannot be generalized, as specific geographical and socio-economic conditions require a differentiated local approach.

For example, technological adaptation mechanisms to protect the Dong Nai Basin hydroelectric power plants in Ho Chi Minh City include:

- Diversion of upstream river tributaries,
- Placement of new storage reservoirs,
- Replacing old turbines with adapted new turbine designs,
- Non-technological adaptation will also be required i.e. improved hydrological forecasting of the facilities operations,
- Strengthening high-risk infrastructure against extreme weather events. For example, the transmission and distribution lines are arranged to be repositioned to avoid strong wind, flooding and corrosion.

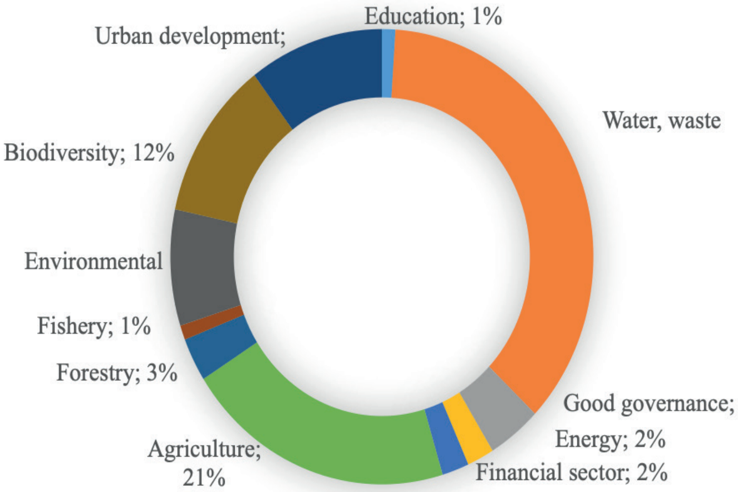
Finally, decentralized energy solutions increase energy security and stability. Renewable energy is key to creating this decentralization, with the benefit of both mitigation and adaptation.

3.2. What is the financial implication of implementing adaptation strategies?

Adaptation to a global average temperature increase of 2.0 degrees Celsius is estimated to cost between $ 70 billion and $ 100 billion a year (World Bank, 2010) This price tag is almost equivalent to 70% of the total Official Development Assistance (ODA) payment in 2015. (World Bank 2017). Infrastructure upgrade and new infrastructure are set to cover most adaptation costs. Geographically, adaptation costs are unevenly distributed. Sub-Saharan Africa will suffer the biggest expenses of up to $ 20 to 30 billion a year by the middle of the century. Resilience building in coastal areas will be the most expensive component of adaptation as they are subject not only to extreme weather events but also to slow-starting changes such as erosion, saltwater intervention and sea level rise. Studies for the energy sector alone show that even the European Union's adaptation costs could be between 636 and 654 million € per year by 2025 (Karekezi et al., 2005).

Unfortunately, there is currently not enough investment to address this challenge. Adaptation investments are between 8 and 15 billion dollars per year; not even 10% of the required amount. The main contributors to these funds were the World Bank's Climate Investment Funds (CIF) and the Global Environment Facility's Least Developed Countries Fund (LDCF). Besides little investment in adaptation, there is an investment imbalance between mitigation and adaptation. The Climate Funds show that only a quarter of the climate finance approved since 2003 supports adaptation, with the rest going to mitigation. Currently, energy system adaptation funding is mostly from climate adaptation funds, not energy sector funds focusing on energy mitigation. Analysis of climate change adaptation funds during 2016 at the German Federal Ministry of Economic Cooperation and Development (BMZ) shows how little attention has been paid to the energy sector for adaptation measures. In Figure 6, only 2% of all BMZ climate change adaptation funds in 2016 were connected to the energy sector.

Figure 6: Bilateral BMZ climate funds (in%) for adaptation to climate change by sector (GIZ, 2017a)



Although adaptation is costly, many low-cost solutions are available; such as early warning systems and power supply diversification with many benefits. In summary, climate adaptation funds are insufficient and unbalanced in the energy sector, although the effects of climate change are already present and will have costly consequences in the future.

4. STAKEHOLDERS' RESPONSIBILITIES FOR ADAPTATION TO THE ENERGY SECTOR

How can the stakeholders contribute on adaptation to climate change in the energy sector?

The effective implementation of adaptation measures requires the mobilization of all stakeholders. The donor community can implement local or regional projects in addition to providing financial support to existing funds. The public sector can contribute to adaptation by creating an effective policy framework and supporting research and development in academic institutions.

Energy regulators also play an important role in ensuring long-term investment security. Energy services and industries should ask themselves the following questions:

- How vulnerable are we to climate change?
- What climate resistance building options are available?
- How can we predict future vulnerabilities to better target investment?

Table 5 explains how some stakeholders can contribute to climate change adaptation in the energy sector.

Energy services and industries have a very important role in adaptation, as shown in the industry column in Table 5. In the long run, utilities and companies have their own interests in protecting their assets from the effects of climate change.

Table 5: Categories of stakeholders' climate change adaptation responses in the energy sector

Stakeholder	Academia	Regulatory Government		Industry	Donors *
1. Climate change affects awareness raising	x	x			X
2. Climate change risk assessments	x	x	x	x	x
3. Diversify and increase energy supply / storage capacity / access	x		x	x	x
4. Area space planning		x		x	
5. Early warning and disaster recovery management systems		x	x	x	x
6. Strengthen the infrastructure		x		x	x
7. Energy/water efficiency	x		x	x	x
8. Energy security standards		x	x	x	x
9. Monitoring and Evaluation	x	x	x		x

** Donors include both technical assistance and financial assistance for energy adaptation projects.*

For example: In South Africa, Eskom Holding is an energy sector corporation with an 85% coal-fired power plant generation portfolio. The utility company adopted a Climate Change Policy in 2004. In 2007, the company determined one of the priorities of the Six Point Plan regarding adaptation to climate change. Part of the adaptation strategy includes evaluating climate variables and their impacts on company assets and defining plans to adapt to these effects. Concretely, as drought was identified as a serious risk for Eskom's thermal power plants, it invested heavily in dry cooling technologies instead of water cooling technologies (Braun et al., 2016).

4.1. How can the donor community contribute to the adaptation of the energy sector?

The technical donor community is ready to address most of the adaptation actions outlined above. Gesellschaft für Internationale Zusammenarbeit (GIZ) has started to address this issue directly by integrating its adaptation approach into a renewable energy development project.

For example, a good example of how the energy sector contributes directly to climate change resilience is the “Development of Climate Risk Insurance for Renewable Energy in Barbados” project funded by the Advancing Climate Risk Insurance Plus (ACRI +) program hosted by GIZ.

This special project aims to develop a roadmap that adopts an Integrated Climate Risk Management (ICRM) approach to ensure that current and future power generation, transmission and distribution infrastructure is climate and disaster resilient. Examples of specific measures to be taken to achieve this:

- Understanding of climate projections;
- Integration of risk transfer mechanisms through infrastructure damage insurance;
- Access to finance for post-disaster management;
- Improved location planning based on risk mapping;
- Flexible building design standards; and
- Early warning systems for energy suppliers.

However, in most cases, energy adaptation benefits are merely unwanted common benefits of energy mitigation programs or general climate resilience projects. The positive adaptation effects in the energy sector can be increased, especially by considering adaptation to project or program design.

Table 6 highlights examples of GIZ, EUEI PDF, UNFCCC and World Bank climate and energy projects that include adaptation benefits.

Table 6: Climate and energy development fund projects with climate change adaptation benefits

Examples of CLIMATE projects with energy sector adaptation	Examples of ENERGY projects with energy sector adaptation
Energy/water efficiency GIZ supports the Caribbean Community and the Common Market (CARICOM) and eight small island and coastal states in the Caribbean in their efforts to adapt to climate change to protect natural resources such as water and forest (GIZ, 2017b). Disaster recovery management systems: GIZ supports the Western Balkans in their climate change adaptation, with a particular focus on flood and drought risk management in the Drin River Basin. The basin provides resources for electricity generation, irrigation, fishing and recreational activities (GIZ, 2017b). Disaster recovery management systems: In Nepal, compliance projects have received $ 6.37 million from the UNFCCC Least Developed Country Fund (LDCF) to conduct vulnerability assessments and provide early warning systems. Thanks to this project, 35 Community Disaster Management Committees and eight Village Disaster Risk Management Committees were established in Terai (ODI, 2014b)	Energy efficiency: EUEI PDF provided support to Cameroon and Cambodia Ministries of Energy in the development of National Energy Efficiency Policies, strategies and Action Plans (EUEI PDF, 2017a). Developing countries suffer from inefficient use of electricity; this consumption problem can be compensated by designing a more efficient energy infrastructure. Diversifying and increasing energy supply/ access: In West Africa, EUEI PDF provided policy and regulatory framework support for clean energy mini-grids (EUEI PDF, 2017b). By increasing energy access, fragile rural communities are made more resilient to climate hazards. For example, urban aid and disaster management systems can be quickly deployed and implemented. Diversifying and increasing energy supply/ access: The World Bank's Program for Scaling Renewable Energy in Low-Income Countries (SREP) has committed $ 11.78 million to gain access to electricity for 30,500 households in Nepal with adaptation benefits. Energy security standards EUEI PDF, Pacific Commission Secretariat assisted the Member States in the development of energy security indicators48. Energy infrastructure must be designed to withstand fluctuating temperatures as well as extreme climatic events such as floods and storms.

Currently, most of the above-mentioned adaptation categories lack technical and financial support, especially for projects in developing countries. In this section, two specific categories of adaptation will be explained in detail, which are crucial to properly addressing energy sector adaptation: “Climate change risk assessments” and “Monitoring and evaluation”.

4.2. Climate change risk assessments

Indeed, the lack of climate risk assessments is an obstacle to building resilience. Climate risk assessments are not conducted systematically, especially as improving energy access and infrastructure can be urgent in developing countries. However, this assessment practice can help energy projects remain sustainable in the long term. Climate risk assessments and vulnerability assessments belong to preventive actions to reduce the risk of climate change. The assessment should preferably be done before the start of the energy project and should carefully consider long-term climate risks.

The Climate Change Vulnerability and Risk Assessment of the European Union can be given as an example of methodologies for climate risk assessments by developed countries. The Vulnerability Sourcebook developed by GIZ can also be used as a tool to assess a project's climate change risk.

4.3. Climate change adaptation monitoring and evaluation

An additional obstacle to adaptation development is the monitoring and evaluation of adaptation projects after their implementation. Second, fundraising agencies are required to attract funds for impact assessments. Also, if there is no way to record the success rate of adaptation projects, best practices continue to be defined. There is a lack of standard monitoring and evaluation tools. According to ODI, “Unlike monitoring and reporting against mitigation targets, it has been more difficult to separate adaptation and resilience development activities from activities that contribute to "good" development. This can make it difficult to measure and report the impact of adaptation financing. This can make it difficult to measure and report the impact of adaptation financing.

GIZ has compiled a set of sample indicators from various international examples of tailoring to the industry. In Table 7, these sample indicators are presented in dark gray boxes. In light of the information on common benefits, additional indicators can be added to this list that take into account the increasing resilience of renewable energy generation; For example. These potential additional indicators are added to the table in light gray.

Table 7: The donation fund community's proposals to increase the effectiveness of adaptation to climate change in the energy sector

	Indicator Type	Indicators
Pre-adaptation project implementation	Climate parameters	Annual temperature change Monthly average temperature Number of hot days Change in annual precipitation
	Climate Change readiness	Number of climate change hazard communication distribution outlets Number of climate change vulnerability assessments at national and local levels Percentage of government investment in adaptation targeted programs Percentage of policies using results from climate change vulnerability assessments Number of natural disaster early warning systems
	Climate impacts	Weather-dependent electricity supply interruption Percent GDP loss per year due to heavy rainfall

	Indicator Type	Indicators
Uyum eylemi ve uzun vadeli etkiler	Adaptation action	Percentage of new hydropower projects considering future climate risks Number of water efficiency measures used in energy generation/extraction Percentage increase in energy storage capacity Number of new major infrastructure projects in areas at risk
	Adaptation action	Percentage increase in additional energy capacity and access to energy Percentage increase in renewed energy capacity according to the level of vulnerability to climate change Percentage increase in renewable energy production capacity Diversification level of energy supply Examples of technology: Thermal energy: Site map accounting for projected flood and drought-prone areas Hydroelectric: Number of dams equipped with desilting gates; mapping of hydroelectric power plants that require capacity expansion due to changes in river flow regime Biomass: Irrigation planning accounting for projected flood and drought; budget for heat resistance crops, internal regulations for storm-protected biomass power plants Wind Map taking into account predicted wind speed changes and sea level rise
	The long term adaptation effect	Percentage reduction in material damage to energy facilities due to the effects of climate change Decrease in the percentage of energy users losing access to energy due to climate change-related

4.3. Policy recommendations and conclusion

The donor fund community can contribute to overcoming barriers to adaptation and thus enhancing their existing portfolios. The donor community needs to participate in projects that fully explain the effects of climate change to manage climate risks.

The donation fund community's proposals to increase the effectiveness of adaptation to climate change in the energy sector

- The donor fund community should improve communication and provide a reliable source of information about the benefits of adaptation in the energy sector and the benefits of a flexible energy system for climate adaptation. Information about adaptation in the energy sector in combating climate change should be understood and disseminated correctly. Academia and national government actors are also stakeholders to facilitate information communication.
- Through dialogue services, the Donor fund community can contribute to coordination between stakeholders related to climate change adaptation. Especially at the policy level, coordination between ministries and sectors is essential. Energy planning departments, agriculture, water and other natural resource sectors need to cooperate. This will also increase project implementation efficiency.
- It should be recognized that projects in the energy sector often have an intersecting win-win focus to both reduce climate change and adapt to its effects. By realizing the mitigation-adaptation synergies for the energy sector, funds will be allocated more appropriately and more sustainable and efficient measures will be taken.
- The donor community should take climate protection measures in sustainable energy projects to prevent, respond to and prepare for climate risks. Developing projects with a climate risk-based approach, such as the one in Barbados, the donor fund community can ensure that energy is accessed, produced and used sustainably. This climate risk management approach can play an important role in ensuring the climate-resistant development of energy systems.
- Including climate vulnerability assessments and standards prior to the implementation of infrastructure projects can also successfully reduce climate change costs. Annex 1 provides an example of climate change risk assessment methodology.
- Developing indicators to monitor adaptation benefits before and after project implementation will allow for accurate monitoring and evaluation of adaptation. Using a baseline, adaptation indicators will contribute to the identification of best practices. Referring to the previous section, examples of indicators are presented that the donor community can follow for their projects.

As a result, all components of the energy system are increasingly affected by climate change. As the energy sector is the backbone of the economy, adaptation to climate change is a must. For countries threatened by climate change, only a flexible energy sector will be able to provide sustainable growth patterns. Precipitation fluctuations affect hydropower generation, extreme events disrupt electricity transmission and warming temperatures increase the energy demand of the end-user. All market segments of the energy sector are vulnerable.

To combat these impacts, adaptation solutions are both structural and policy oriented for each energy stakeholder and market segment. Strengthening existing infrastructure provides flexibility. Diversification of the energy sector increases energy security. Finally, energy efficiency can provide energy sector flexibility.

However, the cost of adaptation should not be overlooked, as it will take between $ 70 and $ 100 billion a year by the middle of the century to build social resilience. Currently only 10% are available. Energy sector stakeholders should focus lightly on mitigation and adaptation efforts to tackle climate change sustainably. Overlapping projects with both mitigation and adaptation advantages will provide the most efficient and effective measures.

In order to effectively tackle the effects of climate change, the donor fund community can overcome structural barriers to increase resilience. In the energy sector, energy adaptation projects lack consistent strategies and best practices. In addition to being ready for climate change, including climate risk assessments, post-implementation monitoring and adaptation projects should be evaluated to ensure flexibility.

The energy sector and adaptation to climate change are clearly linked. With increased funds and targeted action for an adapted energy sector, we can fill the resistance gap and promote sustainable development.

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ECONOMIC COST ANALYSIS AND FINANCING OF ADAPTATION TO CLIMATE CHANGE

Prof. Dr. Levent Aydın

This text, which deals with the economic analysis and financing of adaptation to climate change, consists of two parts. In the first part, the economic dimensions of adaptation, economic and cost analysis, in the second part, its financing and resources will be examined.

1. ECONOMIC ANALYSIS OF CLIMATE ADAPTATION

1.1. How to Support Decision Making in Economic Climate Change Adaptation?

Why do we use economics?

As the inevitable climate change will affect every part of our society, adaptation is increasingly recognized as an important part of every policy. The gradual adoption of adaptation strategies and plans has been accompanied by greater consideration of the costs and benefits of alternative action paths. However, economic analysis for adaptation is not just a problem with the costs or financial returns of climate protection projects.

There is broad acknowledgment that economic analysis, currently used in adaptation, can provide valuable information for decision makers and stakeholders, such as:

- To clarify the trade-offs associated with different development pathways in the medium and long term and provide an indication of the net value of different options under different possible futures;
- To emphasize more transparently the value of future benefits, including the importance given to the future by current generations. This can ultimately increase the consideration of sustainability principles in decision making;
- To strengthen the society's strategic thinking and planning capacity in the

face of high uncertainty, and to increase society's resilience to future risks by supporting the identification of robust solutions capable of high performance;

- Provide a structured approach to design, implement and evaluate projects, measures and policy programs, and to compare the trade-offs between don't wait-and-wait strategies and emergency action. This can ultimately support the application of the precautionary principle and increase the capacity of society to adapt to nonlinear dynamics in the climate and natural system.

What does it include?

Economic evaluation of adaptation measures differs from a normal economic evaluation in that the focus of the analysis is on managing uncertainties and risks. Different time scales, complex systemic relationships and dynamics, multiple sources of uncertainty, etc. should take into account.

In addition, mainstream adaptation includes intervention decisions, the nature of the intervention, spatial and temporal scales, and a large number of sectors and decision makers that vary depending on the institutional context.

Why should you worry about uncertainties?

Uncertainty is the condition of having limited knowledge where it is impossible to fully describe current situation or future consequences. There are several sources of uncertainty in adaptation: lack of information, too much information or conflicting information, measurement errors, transnational uncertainty, subjectivity of opinions.

Generally, three types of uncertainty are considered:

- Epistemik belirsizlik: olguyu karakterize etmek için bilgi veya bilgi eksikliği;
- Normatif belirsizlik: sorunların çerçevelenmesi ve bunların bilimsel olarak araştırılmasının yolları konusunda önceden mutabık kalınmaması;

- Transnasyonel belirsizlik: eksik veya çelişen bilimsel bulgular.

It is important to note that too much information or conflicting information can also create uncertainty; therefore, collecting more data and information to reduce epistemic uncertainties may not always be successful in reducing uncertainty.

Several principles structure the economic analysis of adaptation:

- Investments are seen as dynamic processes that must respond to the new climate and socio-economic conditions. Hence, there is a strong focus on risk management and learning.
- The focus is on prioritizing strategic scoping, staging and adaptation, taking into account adapted responses to current and future climate change over long periods of time.
- Much more attention is paid to early steps to adequately characterize current policy objectives, the wider non-climatic drivers, interventions and context of decisions.
- Practical adaptations are seen as a portfolio of measures taken to address uncertainties about climate change, enabling the future society to deal firmly and flexibly with unforeseen events. Investments can include a wider range of response types than an optimization approach would allow.

A policy-oriented framework for the adaptation economy, the ECONADAPT project, has supported the development of a "policy-oriented framework" characterized by:

- Integrating (disseminating) adaptation into existing policy and development, with more emphasis on a policy-oriented approach within the framework of adaptation.
- With greater recognition of uncertainty and the use of iterative risk management approaches, there has been a tendency to look at the phased and timing of adaptation.

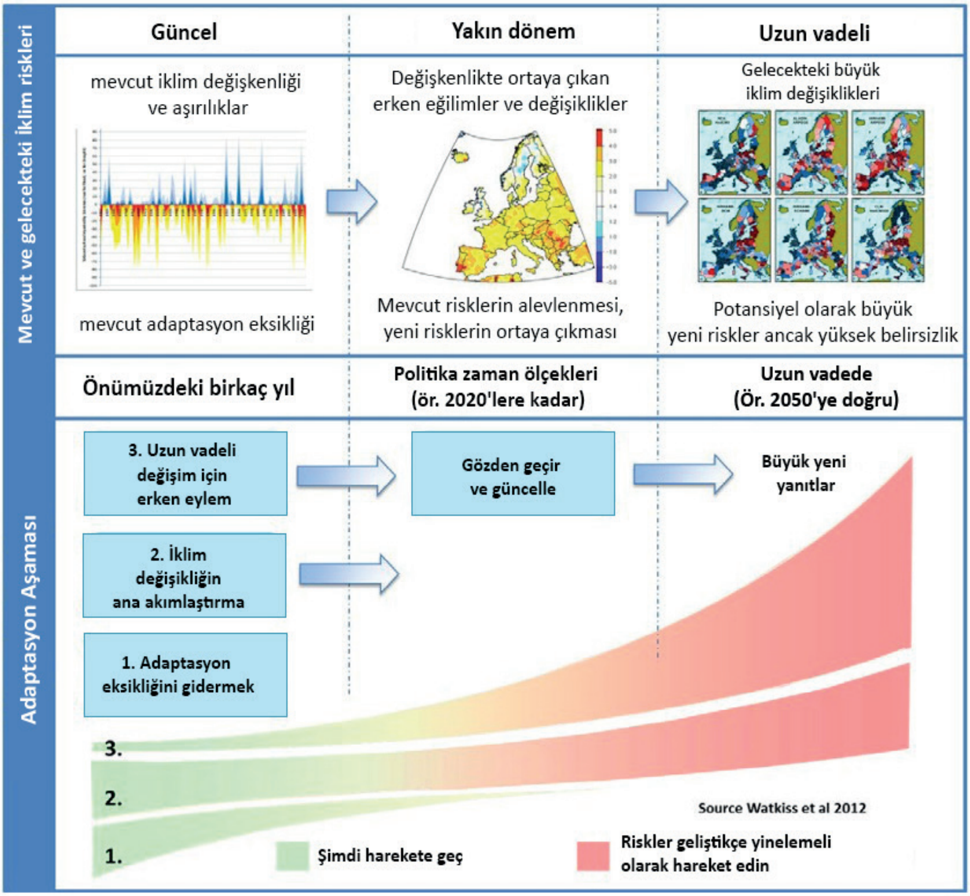
ECONADAPT starts with current climate variability and evaluates future climate change by taking into account uncertainty. It then explores how adaptation decisions perform against these risks and proposes classifying actions into three types of early policy decisions and associated interventions, actions that can be taken in the next decade to address the effects of short, medium and long-term climate change under conditions of uncertainty.

These are:

- Urgent actions that address the current risks of weather and climate extremes (adaptation gap) and also build resilience to future climate change. This includes early capacity building and the implementation of low and unrepentant actions that provide immediate economic and future benefits under a changing climate.
- Integration of adaptation into urgent decisions or activities with long lifetimes, such as infrastructure or planning (climate-capable development). This includes different options as compared to immediate actions that address current risks (described above) due to future climate change uncertainty. It includes a greater focus on climate risk screening and identifying flexible or robust options that perform well under uncertainty.
- Early monitoring, research and learning to start planning the future effects of climate change. This focuses on adaptive management, the value of knowledge, and future option values and learning so that appropriate decisions can be brought forward or delayed as evidence and information emerges. The three categories can be considered together in an integrated adaptation strategy, often referred to as a portfolio or adaptation pathway.

A picture of the framework is shown in the figure below. The framework begins with climate change (top), each broken down into a set of associated risks associated with different policy issues and time scales. Starting from the current climate variability and extremes (top left) i.e. adaptation gap. Over time, climate change will affect these existing impacts and often lead to major new risks (top right) despite high uncertainty. In response, an adaptive management framework for adaptation has been proposed (below).

Figure 1: Climate change risk and its stages



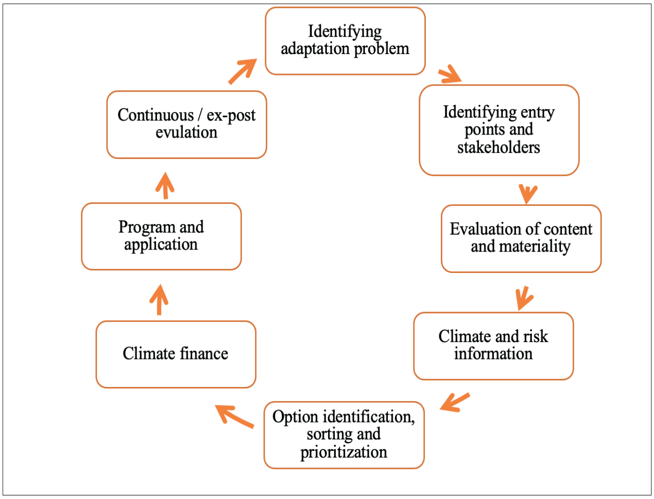
1.2. What Are the Key Steps in Economic Analysis of Climate Change Adaptation?

In the ECONADAPT project, a framework for economic analysis of climate adaptation in different adaptation decision-making contexts has been developed. The framework can be implemented to assist in defining, timing and sequencing adaptation and shortlisting options. This can help identify focus areas for an industry plan or strategy or a list of options for individual projects.

1.2.1. Identifying adaptation problem

The policy-led approach suggests initiating evaluation by setting overall goals and objectives for adaptation. This guides analysis to inform policymakers to inform early decisions. Critically, this often focuses on 'what am I supposed to do in the next five years?' It points out that this may include urgent action and early interventions to start adapting to future climate change. This framing is particularly important in adapting to the adaptation planning process and prioritization of early actions for early climate finance.

Figure 2: Economic analysis of climate adaptation key steps



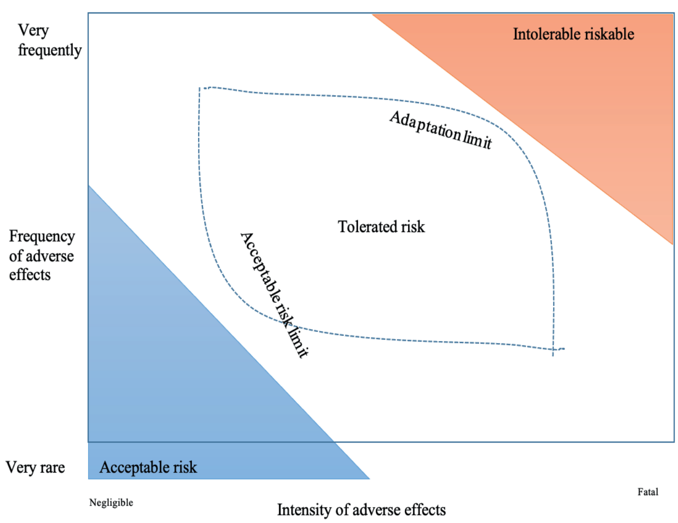
Considering the uncertainties in decision making is important in defining the problem. Adequate consideration of uncertainties and their interactions is required when designing an adaptation project. However, managing all the uncertainties is a difficult task. While it is possible to reduce epistemic uncertainty by acquiring knowledge through participatory processes or by reducing normative uncertainty, transnational uncertainty cannot be reduced.

A risk framework can represent a good strategy for dealing with uncertainties. Risk can also be identified as potential for adverse consequences on life, livelihoods, health, ecosystems, economic, social and cultural assets, services and infrastructure when the outcome is uncertain.

Three broad categories of risk can be used to guide decision making: acceptable risks, tolerable risks and intolerable risks (exceeding the socially negotiated norm). Figure-3 maps these risk categories in a two-dimensional space. You can see that the type of risk depends on the degree of potential impact as well as its likelihood (frequency). Low probability catastrophic events can have the same high degree of risk as very likely events of moderate impact. The boundaries have a fuzzy nature due to the qualitative definition of acceptable, tolerable and intolerable risks. Coloring around the boundaries indicates that these actors' view of what is acceptable, tolerable or intolerable may change. Adaptation can be viewed as the action aimed at maintaining the position of a particular target (such as the technical norm for flood protection) within a tolerable area. Evaluating and managing risks consists of several steps: defining and modeling the systems to be managed; identification of hazards associated with the operation of the system; selecting events that can initiate accidents; quantitatively analyzing accidents (including exposure and vulnerabilities); Risk assessment and execution of decision making process.

Various economic methods are available to analyze the economic risk of alternative investment options quantitatively or qualitatively.

Figure 3: Risk categories



It is important to emphasize that the use of a clear way of communication and a well-established vocabulary to reduce uncertainty from different subjective views can help avoid linguistic ambiguity. Transparency often helps; however, particular attention should be paid to communicating information on scientific methods, statistics and the like. Communication about uncertainty should be different for different audiences.

1.2.2. Identifying entry points and stakeholders

More emphasis is placed on integrating adaptation (dissemination) into existing policy and development rather than implementing the measures as an independent activity. This requires the integration of adaptation to existing policies and processes, not only for climate change risks, but also for broader policy objectives and wider costs and benefits. More importantly, this is to include the adaptation process to development, which is a key issue in the developing country context. One component of this dissemination process is to find relevant entry points, that is to identify opportunities in the national, sector or local planning process where adaptation can best be integrated. It is necessary to participate in bilateral and multilateral meetings with stakeholders at different stages of the project and to ensure good communication and information exchange.

It is important to choose time horizons in the economic evaluation of adaptation. Two concepts are particularly important when deciding to focus on the short or long term future in the assessment.

- Short term: On the one hand, focusing on the short term seems more attractive to meet the interest horizons of most stakeholders (e.g. investors, local and national governments). On the other hand, for many effects, such as sea level rise, short-term horizons require small differences between climate change scenarios, which prevents comparison of impacts and hence adaptation between high and low emission scenarios.
- Long-term: In terms of the end of the century (or beyond) reasoning does not seem very meaningful to many stakeholders, in the long run the drastic differences in the effects between scenarios become apparent and can be characterized. In addition, this result underpins studies of prime importance in the climate change discourse, such as comparing the investments required to reduce emissions with adaptation costs.

1.2.3. Evaluation of content and materiality

Gathering the prior knowledge level in a content analysis is necessary to accurately target the following steps of the assessment. These are:

- Characterizing the physical content, synthesizing information about environmental features, climate and danger;
- To define the socio-economic context to define the boundaries of the adaptation goal, to identify which persons and activities are relevant;
- Policy, institutional and stakeholder content, such as; establishing a

comprehensive list of interested persons, companies and institutions and their normative and administrative responsibilities

1.2.4. Climate and risk information

The next step is to develop climate knowledge and risk knowledge. In keeping with the iterative approach, this should start with current climate variability and then look at future climate change projections with great emphasis on capturing uncertainty.

This risk analysis should also be done in the context of the adaptation decision, ie who and what decision it aims to provide. For example, when it comes to a particular infrastructure project, the economic costs and benefits of increasing flexibility in design may be explored. In a more complex policy or program mainstreaming environment, it will focus more on the risks of various activities, paying attention to the lifetimes of different areas and decisions.

It is important to provide and use climate information for adaptation economy. Climate information should be reliable, legitimate and timely. While the physical climate sciences community tends to focus on the first two criteria, the last two are particularly important for adaptation-oriented stakeholders and policymakers. Climate experts working with the adaptation community need to be flexible, especially in response to temporary requests and bespoke applications. At the same time, the provision and use of climate information should be in partnership with climate experts, not something economic experts should undertake alone. Building trust and understanding is essential in the relationships between these different communities.

1.2.5. Option identification, sorting and prioritization

The modeling framework for impact assessment can be used to calculate the impacts of climate change hazards, with or without the adaptation measure selected. Comparison of future results under the two assumptions will allow to evaluate the effectiveness of the measures. Often, however, it may be unclear how existing assessment models can take into account, such as early warning systems or the effects of some soft adaptation measures. It is important to take into account what the modeling framework can and cannot do.

Adaptation measures are effective under certain conditions. Many measures lose some or all of their effectiveness as they cross some system thresholds. For example, a dam to protect the city from upstream from flooding of the river will cease to serve the purpose when rainfall and discharge in the basin so that the water levels in the dam will exceed some critical threshold, also called the “tipping point” of adaptation. The moment the tipping point is reached is typically dependent on a hazard, for example a heavy rain event or a hurricane leading to a flood or climate change scenario, and can be determined by modeling the system under different scenarios over multiple future time periods. Due to the great uncertainties regarding the occurrence of disasters and future climate scenarios and modeling constraints, it is often difficult to determine the timing of tipping points.

To avoid reaching a tipping point, the decision maker is faced with a number of viable adaptation options: for example, raising the dam further and/or changing the downstream direction of the river and/or changing land use practices (e.g. deforestation). If no option other than Current is acceptable, the current option is often referred to as a "deadlock " option. The decision maker needs to be very aware that decisions can lead to possible deadlock situations when future generations' choices are very limited.

Economic evaluation includes measuring the value of proposed adaptation measures. A range of methods exist, either through a cost-benefit, cost-effectiveness, or multi-criteria framework, or using methods that generate robust adaptation strategies, particularly under catastrophic uncertainties and risks.

Figure 4 and Table 1 below summarize the main groups of economic instruments and their potential uses and compare their strengths and weaknesses. However, there are no hard or fast rules about which tool to use, with some techniques suited to various elements of the policy-driven framework. There is no " one-size-fits-all" approach to economic evaluation; each method offers unique strengths and challenges. It is important to carefully select the most appropriate approach for each adaptation decision-making situation.

Figure 4: Adaptasyon ekonomisinde temel yöntem grupları ve potansiyel kullanımları

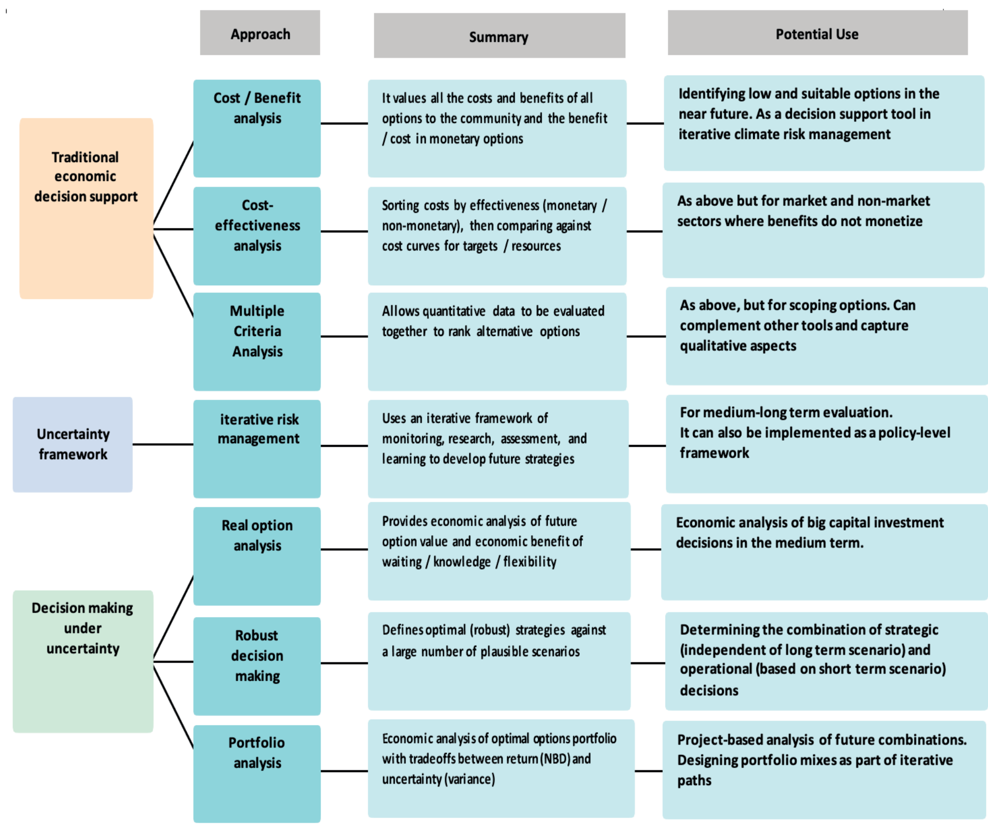


Table 1: Key strengths and limitations of economic tools to support adaptation decision making

METHOD	STRONG SIDE	CHALLENGES	Dealing With Uncertainty
Cost-benefit analysis	It is most useful when climate risk possibilities are known and sensitivity is low. In addition, places where net market values can be used	Valuation of non-market sectors/non-technical options. Uncertainty limited to probabilistic risks/sensitivity tests	Does not explicitly deal with uncertainty, but can be combined with sensitivity testing and probabilistic modeling
Cost-effectiveness analysis	As above, but for non-monetary sectors and where pre-defined targets need to be achieved	Single header metric is difficult and complex to identify, or less suitable for cross-industry risks. Low uncertainty assessment	Does not explicitly deal with uncertainty, but can be combined with sensitivity testing and probabilistic modeling
Multiple Criteria Analysis	When there is a mixture of quantitative and qualitative data	It is based on expert judgment or stakeholders and is subjective, including uncertainty analysis	Can integrate uncertainty as an evaluation criterion, but is often based on subjective expert judgment or stakeholder opinion
Iterative risk management	Especially useful when there are clear risk thresholds and long-term and uncertain challenges	Challenging when identifying multiple risks and thresholds acting together is not always easy	Openly deals with uncertainty by encouraging iterative analysis, monitoring, evaluation and learning
Real option analysis	Great irreversible decisions, if information about climate risk possibilities is available	Requires economic valuation (see fig. CBA), probabilities and clear decision points	Clearly deals with uncertainty by analyzing adaptation performance for different potential futures
Robust decision making	When uncertainty and risk are great. Can use a mixture of quantitative and qualitative data	Requires high computational analysis and lots of work	It explicitly includes uncertainties and risks, especially systemically dependent risks, to achieve strong solutions
Portfolio analysis	Number of complementary adaptation actions and good information	It requires economic data and possibilities. Mutual dependency issues	Explicitly deals with uncertainty, examining the complementarity of adaptation options for dealing with future climates

Modeling approaches according to different adaptation contents;

- For analysis focusing on current climate variability (adaptation gap), Cost-Benefit Analysis (CBA) and Cost Efficiency Analysis (including CEA) available decision support tools can be used;
- Because adaptation interventions are often difficult to evaluate and often involve a lack of quantitative information, Multi-Criteria Analysis (MCA) is often used;
- For long-term applications in conditions of low current adaptation gap, Iterative Risk Management (IRM) is more applicable.
- If investments are closer to the term (especially investments with no high return on capital), there is learning potential as new climate risk information becomes available and there is an existing adaptation gap, Real Options Analysis (ROA) is potentially a useful tool;
- Robust Decision Making (RDM) can be used when the risk of non-compliance is high for adaptation analysis in the face of uncertainty. RDM has a wide application for present and future time frames and focuses on soundness rather than optimism as a decision criterion;
- Under the high uncertainty of combinations of potentially complementary adaptation projects, Portfolio Analysis (PA) can be a useful approach for analysis.

1.2.6. Financing, programming and implementation

In many evaluations, the creation of a prioritized compliance plan marks the end of the analysis. However, in a policy-centric approach there are additional activities that should be considered as part of the evaluation. Critically this includes funding for implementation plans: Unless a source of finance is identified, it will be a 'on the shelf' plan, reducing the interest and impact that detailed analysis seeks to convey.

Indeed, it is more helpful to consider the source of potential funding from the start of a plan than to wait until the end of the evaluation to assess it. This is important because the needs of the funders are different and should therefore be considered in the design of the information and analysis framework from the very beginning of the project.

1.2.7. Continuous / ex-post evaluation

The policy-led framework encompasses a reflexive-participatory framework based on iterative risk management: It encourages the continuous incorporation of new information into decision-making about the complex dynamics of social-ecological systems and their interactions with a changing climate as they exist. There are dimensions to consider:

- Procedures for planned evaluation and revisions, including scope and periodicity
- Responsibilities of the monitoring and evaluation process, ensuring partnership and participatory approach
- Procedures for foreseen decision chains

1.3. Microeconomic / Macroeconomic Assessment Projects:

When is it useful?

Large capital investments have long lifetimes and are therefore vulnerable to future climate risks. There are also cases of deadlocks in adopting large and inflexible assets. At the same time, large new structures often take years to plan, finance and build; therefore, it may not be possible to adopt a preventive or precautionary strategy and expect better information and reduction of uncertainties.

Economic analysis methods can help to take into account adaptation dimensions in the evaluation of projects, particularly including large infrastructure investments. They can help integrate future knowledge and value of flexible design into projects. They can bring transparency in weighing current and future preferences and exchanges. They can also help assess the increased costs of additional investment expenditures against their effectiveness in reducing future (uncertain) climate change risks in the long term.

1.3.1. Application to land and coastal flood risk management: Sample project

For the city of Prague (Czech Republic), an example of the implementation of policy-oriented projects in offshore flood protection and coastal and river flood protection in Bilbao (Spain) are presented. The implementation of the policy-led framework focuses on using climate information with risk data to prioritize adaptation options and address uncertainties.

1.3.1.1. Identifying adaptation problem

The Czech study carried out an ex-post assessment of the adaptation of flood risk protection built between 1999 and 2014, including the associated investments and social benefits in the cost-benefit analysis.

The Spanish study conducted an assessment of a planned infrastructure measure consisting of the transformation of an urban peninsula into an island to reduce the risk of flooding from the combination of river and coastal flooding.

1.3.1.2. Evaluation of content and materiality

This step consisted of synthesizing information on geo-morphological and hydrographic features, climate, and the hazard trend of the case area. The boundaries of cases have been identified that determine which persons and activities are exposed to climate related risk.

The Czech case study focused on Prague, located in the Lower Vltava river basin region, one of the two river basin districts in the Vltava river basin, both of which are managed by the government agency Povodí Vltavy. Prague is the predominant economic unit in the river basin and the area where the floodplain is located covers residential areas as well as various important industrial areas, recreational areas such as urban parks, as well as agricultural areas in the south of Prague.

The Spanish case study focused on the Bilbao region, located in a flood-prone area of the Golden Horn. The region was shaped according to the needs of the manufacturing industry accompanied by a rapidly growing population in the middle of the 20th century.

1.3.1.3. Climate and risk information

In the case of Prague, different combinations of harmonious climate and socio-economic scenarios are chosen. Climate data has been included from a wide variety of climate models and so enough samples have been taken from cross-model uncertainty. For the Bilbao case, only the results of one climate model were used, after making the data set represent the group mean of multiple models.

However, in the Prague case, present and end of century conditions were modeled. Modeling multiple future time frames greatly improves the assessment of future benefits of compliance, but requires more computational power. In Bilbao, the study used climate forcing data resulting from downsizing a state-of-the-art Regional Climate Models suite. Under the scope of new IPCC emission scenarios, RCP (Representative Concentration Pathways) 4.5 and 8.5 new definitions of flood hazard probabilities were created.

In both cases, the flood maps for multiple turns that floods the period allowed to be treated as stochastic events of the flood were produced. For the Prague example, simplified relationships and data interpolation are used to obtain flood extensions from maximum precipitation. Risk area datasets are intersected with flood maps using security gap curves. Country specific security gap curves (ie, depth damage curves) have been applied.

In the Bilbao example, floods of different sizes were treated as separate probabilities, so they underestimated the expected annual damage, possibly due to their joint probabilities. The risk area data sets were obtained from land use maps obtained with very high spatial details. The following factors have been considered: population, economic activity and potentially affected environmental interests. The effects also included intangible and non-monetary metrics such as health and traffic disruption.

1.3.1.4. Option identification, sorting and prioritization

In the Prague example, adaptation measures to the increased risk of land floods include line measures (e.g. fixed flood prevention earth clamps, reinforced concrete walls, mobile barriers) and barriers in the wastewater system (e.g. Backflow preventers). In the Bilbao case study, the main measure of adaptation to coastal flooding was the opening of the Deusto canal and transforming the area under study from a peninsula to an island. An additional measure to be implemented in Zorrotzaurre is the rise of the urban area developed along the Deusto canal.

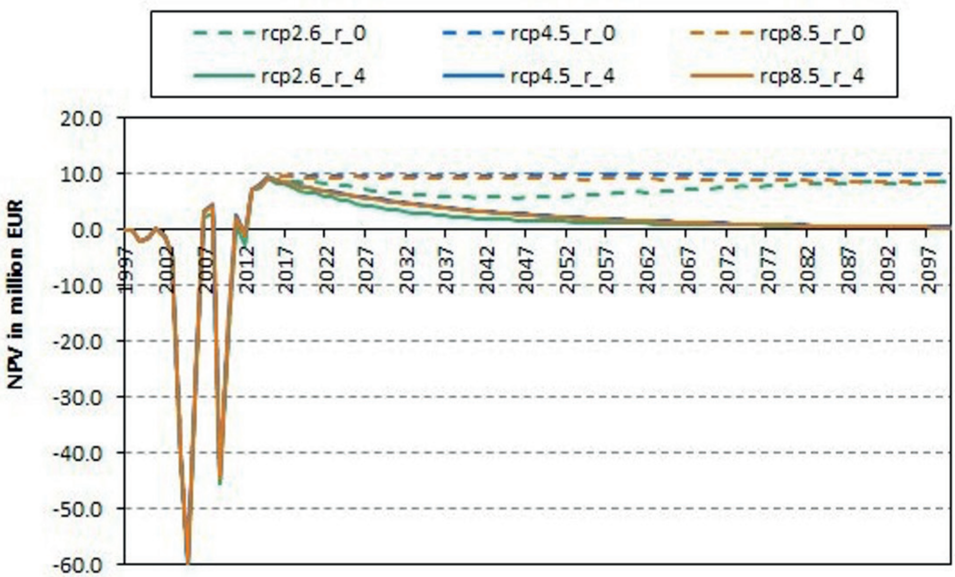
Two methodologies have been applied in economic valuation:

- For the Prague case study, a comprehensive sensitivity analysis and cost-benefit analysis were used: climate scenarios and model uncertainty, economic growth, discount rates, infrastructure cost variables and depth-damage functions;
- Three approaches were combined for the Bilbao case study: stochastic modeling, estimation of two risk measures (Value at Risk and Expected Gap) and real option analysis. Value at Risk (VaR) is a standard measure and is well recognized by international financial regulatory agencies. The VaR of the

damage from river flood in the case study expressed the losses that could occur with a 95% confidence level over a period of 85 years. Expected Deficiency, ES, represented the average damage of 5% worst cases. Therefore, ES is a better measure of risk for low probability but high damage events.

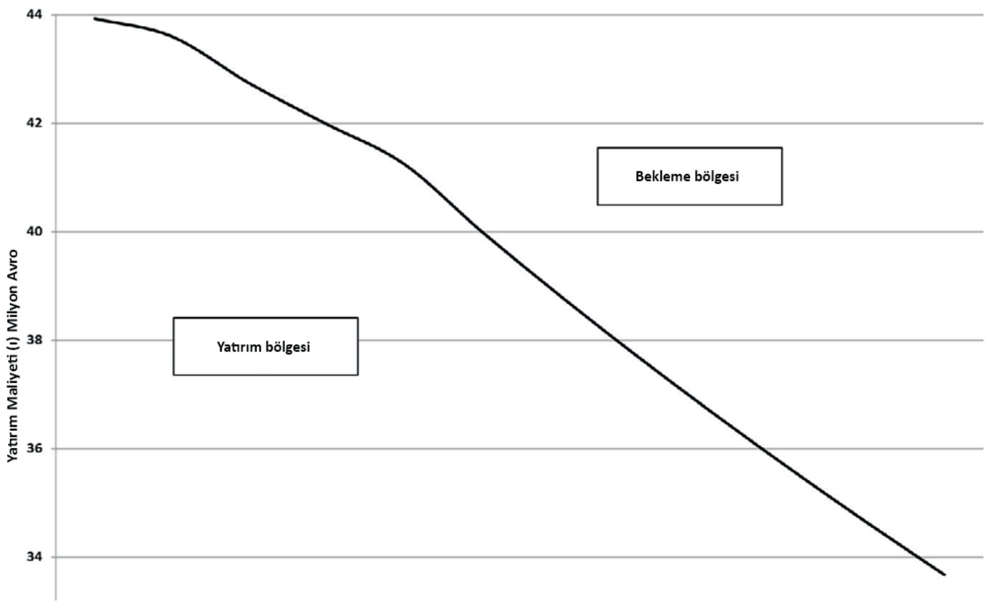
The chart below shows the annual Expected Net Present Value (ENPV) of flood protection measures in Prague for different climatic conditions (represented by RCP scenarios) and discount rates. Dashed lines represent a discount rate of 0%, while solid lines are discounted at 4%. The average value of ENPV for all RCP scenarios is € 626 million, assuming a 0% discount rate. The difference between RCPs will have a moderate impact on ENPV, the RCP2.6 scenarios will reduce the value by 30%, the RCP4.5 ENPV by 6% and the RCP8.5 by 4%. Therefore, investments are effective in future climate change scenarios. However, given the 4% discount rate, the impact of RCPs on ENPV is greater, the change being -107%, 14%, and -7% for RCP2.6, RCP4.5 and RCP8.5, respectively. Using a discount rate of over 4% meant the project was no longer more efficient.

Figure 5: Annual Expected Net Present Value (ENPV) of flood protection measures in Prague



At Bilbao, the results showed a range of 266-330 M € for VaR (95%) at baseline and 371--445 M € for Expected deficiency (ES) (95%) at baseline. Opening the canal is expected to reduce not only the expected damage, but also the level of risk, i.e. the damage that can occur in the worst 5% of cases. The expected average losses are reduced by 41 to 58 M €, while the ES decreases by 174-205 M € during the evaluation period with the opening of the channel. The final step was to evaluate the economic impact of different investment timing using real options analysis. The figure shows the results that determine the boundary value of the investment cost between the "investment zone" and the "waiting zone" for a limited time. The graph shows that the volatility is increasing and thus reducing the investment limit in uncertainty. In other words, greater volatility makes potential investors more demanding and only invest when cost is low.

Figure 6: Economic analysis results of the Bilbao scenario



The sensitivity analysis in the Prague case study showed that the critical factor in FMA evaluation is a discount rate selection. Discount rates of up to 3% still enable the adaptation option to generate positive Net Present Value. However, if the discount rate is set to 4% and higher, the project is no longer efficient. The use of various measures of economic uncertainty in infrastructure investments in Bilbao (ie stochastic modeling, value-at-risk and expected losses and expected losses through actual option analysis) provided different types of information in decision-making. The main advantage of the presented methodologies is the capacity to evaluate and integrate multiple sources of uncertainty in the assessment, not only about whether to invest, but also about the best timing for the investment.

1.3.2. Macroeconomic Evaluation

1.3.2.1. When is it useful?

One of the subjects the adaptation economy has focused on so far has been bottom-up, working at the sector level. Another focus is from top to bottom with macroeconomic evaluation.

Analysis of the macro-economy of adaptation is necessary to analyze investment in adaptation and how it might affect growth, competitiveness and employment. This is the fundamental approach that leads to the efficient use of resources at the macro level, effective effort intensity, and the design of successful policies to tackle a long-term challenge such as climate change.

One of the most important ways to study these impacts is to use Computable General Equilibrium (CGE) models that are regularly used to study the economic impacts of climate change. CGE models can capture and explain market adjustments caused by a local shock to the global context and feedback of macroeconomic dynamics in each market.

1.3.2.2. An application for the planned adaptation study

0-pThe macroeconomic assessment of an adaptation should take into account short-term and long-term effects, as well as potential synergies and changes made with mitigation policies. An important area of research for macroeconomic evaluation of climate policies is the trade-off between mitigation and adaptation. In short, mitigation aims to reduce climate change damages by slowing greenhouse gas emissions, while adaptation aims to reduce climate change damages by reducing the effects on human and natural systems.

As part of ECONADAPT, a methodological approach has been developed to extend the CGE effects associated with two specific adaptation measures: i) coastal zone protection against sea level rise and ii) use of irrigation services to mitigate the adverse effects of climate change in agriculture. After analyzing the economic impacts of coastal protection and irrigation in two separate studies, ECONADAPT conducted a global analysis of the economic impacts resulting from the merger of a mitigation policy, presented as Nationally Determined Contributions to the UNFCCC and modeled pledging countries.

1.3.2.3. Methodological approach

Generally speaking, the CGE methodology is particularly suitable for dealing with the effects of market adaptation, ie the responses of agents triggered by changes in relative prices. However, the planned adaptation measures are much more difficult to model. In addition to the lack of data and the specificity of different adaptation types, there are also methodological complexities of adequately capturing the multiplicity of channels through which adaptation expenditures operate and have an impact.

Against this background, ECONADAPT has proposed different methodological approaches to extend CGE macroeconomic adaptation assessments beyond the conventional autonomous market-oriented genre (cf. Figure 1) The first dealt with the planned adaptation to public expenditure for coastal protection. The ECONADAPT project has expanded a known CGE model with a more detailed description of the public sector, taking into account not only the ultimate effects of coastal protection on GDP but also its effects on public finances.

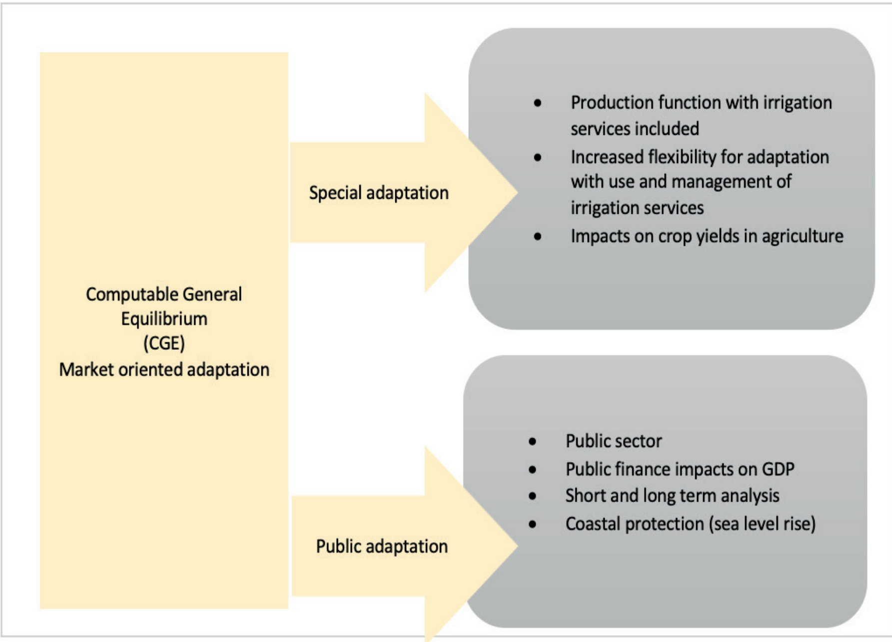
The second concerns the possibility of special agents to adapt by changing the demand for certain services that can reduce the negative effects of climate change. For this particular case, the ECONADAPT project focused on using irrigation services as a strategy to reduce yield losses. For this purpose, in the aforementioned CGE model, the production function of the agricultural sector has been expanded to take into account irrigation services.

Insight into the macroeconomics of adaptation- The ECONADAPT project evaluated the effects on GDP and public budgets in the interaction of adaptation to climate change policies, mitigation and international support from developed countries to developing countries. This has been done in consideration of adaptation to sea level rise financed by "adaptation bonds" with international mitigation efforts resulting from INDCs submitted to the 2015 COP 21 in Paris for 2030. It has pledged to provide developed countries with 30 to 100 billion dollars annually for mitigation and adaptation activities to developing regions by 2020.

Jointly implemented adaptation and reduction may require that GDP costs be slightly lower than the sum of reduction and adaptation GDP costs when applied in isolation. This positive interaction effect is explained by increased revenues from mitigation activities implemented by taxes or auction permits. These revenues are accrued in the public budget; borrowing from the private sector to reduce the public sector's need to issue bonds and thus finance coastal protection expenditures; so that public investments go beyond their current expenditure on private investment and ultimately reduce the penalty for the capital accumulation process.

There are two key messages from the resulting analysis. The first message concerns the fact that public adaptation spending overshadows private activity. The second important message is about how adaptation is financed. Indeed, if adaptation expenditures are financed by taxes rather than public debt, the distortion that distorts the effect of adaptation and the consequent punishment of growth is lower. Although taxes have a regressive effect on private consumption, public debt hinders private investment. The second effect is more dangerous for economic growth and capital accumulation. In this sense, combining mitigation efforts based on a carbon tax and adaptation may be an appropriate strategy. Developed countries can benefit from supporting developing countries in their climate change policies. The low contraction in the economic activity of developing countries can benefit developed countries directly through low international demand contraction, but also through lower / higher relative competition losses / gains following the implementation of reduction targets.

Figure 7: Macroeconomic assessment methodology



1.4. Economic Dimensions of Adaptation

When considering adaptation, economic studies provide insight into the roles of various actors in society, the character of adaptation strategies, the types of benefits and costs involved, the role of time, and a number of other factors that we discuss in this section.

1.4.1. Public and Private Actors in Adaptation Applications

Previous IPCC reports - namely the Third Assessment Report (TAR) and First Assessment Report (FAR) - can be autonomous, planned or natural adaptation actions. While autonomous actions are mostly done by private actors, they can be planned by private or public actors. Natural adaptation may occur in the ecosystem in response to climate change, but may be subject to human intervention.

There are important economic distinctions regarding the roles of private and public actors in terms of human action. Some adaptation actions create public goods that provide many benefits, and in such cases, the implementing party typically does not achieve all the benefits. For example, if one person pays to protect a shoreline or to develop an irrigation system, the earnings often go to others. Practice and observations on classical economic theory (Samuelson, 1954) and adaptation show that such actions will not be by certain levels of private investment (creating market failure). In turn, this calls for action from the wider community (eg governments, non-governmental organizations or international organizations) to the public.

The public provision of certain adaptation measures that lead to less than the socially desired level of adaptation is discussed.

1.4.2. Broad Classification of Adaptation Strategies

There are many possible adaptation measures as well as TAR and FAR. Economically, these involve a mix of public and private activities that take place in both local and international settings. A broad feature of these and those who can undertake them is as follows:

- Changing business management, facility investment, business choice or resource use (mostly private)
- Direct capital investments in public infrastructure (e.g. dams and water management - mostly public)
- Technology development through research (e.g. development of product range - private and public)
- Creation and dissemination of adaptation information (through dissemination or other means of communication - mostly public)
- Human capital increase (e.g. investment in education - private and public)
- Redesign or development of adaptation organizations (e.g. modified types of insurance - private and public)
- Changes in norms and regulations to facilitate autonomous action (e.g. changed building codes, technical standards, regulation of networks / networks / facilities, landscaping - mostly public)
- Changes in individual behaviors (with private, possible public incentives)
- Emergency response procedures and crisis management (mostly public).

Not all adaptations may involve investment. Some adaptation measures involve replacing recurring expenses as opposed to new investments (replacing depreciated equipment with more customized items). Sometimes adaptation involves changes in behavior and lifestyle (for example, due to the increased frequency of heat waves).

1.4.3. Broad Description of Benefits and Costs

The consequences of adaptation decisions cannot be expressed comprehensively through standard economic accounting of costs and revenues. Adaptation decisions can also affect other factors such as income distribution and poverty; regional distribution of economic activities including employment; non-market factors such as water quality, ecosystem function and human health; and social organization and cultural practices.

Adaptation options have wide-ranging and complex implications for:

- Macroeconomic performance (see, for example, Fankhauser and Tol, 1995)
- Allocation of funds that have an exclusionary effect on other climate and non-climate investments with the consequences of future economic growth (Hallegatte et al., 2007; Hallegatte and Dumas, 2008; Wang and McCarl, 2013)
- The welfare of current and future generations through resource availability and other non-monetary effects
- Risk distributions to all of the above due to routine variability plus the extent of climate change and uncertain estimates of adaptation benefits and costs.

Some of these elements pose difficulties in terms of measurement and monetization. Generally, this means that some analysis is in strict quantitative terms, but others are not. In light of this, it is reasonable to conclude that an impartial, comprehensive analysis will consist of a multi-metric analysis that includes cost-benefit and other monetary elements plus non-monetary measures. This analysis will support adaptation decision making.

1.4.3.1. Side Economic Effects of Adaptation Measures and Policies

In addition to creating a more resilient economy to the effects of climate change, adaptation strategies often have significant side effects. These can be positive (common benefits) or negative (common costs). Major impacts occur when actions aimed primarily at mitigation or non-climate issues change climate adaptation. Examples:

- Sea walls that protect against sea level rise and also against tsunami. However, they may have common costs that damage neighboring regions, fishing and mangroves (Frihy, 2001).
- Crop varieties adapted to climate change have greater resistance to drought and heat and therefore increase productivity in droughts and extreme temperatures associated with climate change (Birthal et al., 2011).
- Better building insulation, which reduces energy use and associated greenhouse gas emissions, also improves adaptation by protecting against heat (Egbendewe-Mondzozo et al., 2011).
- Public health measures that adapt to increases in insect-borne diseases also have health benefits not associated with these diseases.
- More efficient use of water - adaptation to a drier world - will also benefit in current water scarcity conditions. The development of improved desalination methods has the same values (Khan et al., 2009).
- Placing the infrastructure away from low coastal areas adapts to sea level rise and provides protection against tsunami.
- Reducing the need to use coal-fired power plants through energy-saving adaptation will also lead to reduction, improving air quality, and reducing health impacts (Burtraw et al., 2003).

1.4.3.2. Economic Evaluation of Side Effects

Many studies (eg. Brouwer and van Ek, 2004; Ebi and Burton, 2008; Qin et al., 2008; de Bruin et al., 2009a; Kubal et al., 2009; Viguie and Hallegatte, 2012) argue that common benefits should be effective in decision making. If a country has a fixed amount of money to allocate between two competing adaptation projects, and both strategies produce net positive auxiliary effects, the socially optimal allocation of adaptation investment will differ from the particular optimum and support the activity with greater direct positive side effects.

1.4.4. Adaptation as a Dynamic Problem

Adaptation is not a static issue. Rather, it develops over time in response to a changing climate (Hallegatte, 2009). Adaptation is perhaps best addressed by a long-term transitive, continuous, flexible process involving learning and adjustment (Berkhout et al., 2006; McGray et al., 2007; Pelling et al., 2007; Leary et al., 2008; Hallegatte, 2009; Hallegatte et al., 2011c; IPCC, 2012). In general, the literature shows that optimum adaptation and the desirability of specific strategies will change over time depending on climate challenge as well as other factors such as technology availability and maturity (de Bruin et al., 2009b). In the next few decades, where projected temperatures do not vary significantly between socioeconomic/climate scenarios, adaptation is the main economic option for dealing with the climate change that occurs.

Risk is also an important consideration; it is more uncertain in the long run than in the near term. Risk-sensitive decisions often include options to make or wait (Linquiti and Vonortas, 2012). The option issue covers option values and uncertainty about future choices (Beltratti et al., 1998).

The dynamics are also related to the persistence of the strategy, due to the timescale consequences of some adaptation strategies, such as the construction of sea walls or the discovery of drought tolerant crop genes, from a decade to a century. The upfront costs and permanent benefits and the attractiveness of investments increase when benefits last long or climate change damages accumulate slowly.

1.5. Costing the Adaptation

As the need for action became clearer, the interest in estimating adaptation costs increased. The literature focuses on two cost levels:

- estimates on a global scale, assessing the overall need for largely financing funds;
- b) regional and local scale estimates limited to a particular sensitive economic sector that can be applied to support adaptation decision making or to allocate scarce resources among the best possibilities for effective adaptation.

The methods for these two types of studies differ greatly, but are similar for both types for important methodological considerations regarding cost adaptation.

1.5.1. Methodological Evaluation

1.5.1.1. Data Quality and Amount

There is little debate about data gaps in assessing the benefits of adaptation, but poor or sparse data clearly limit the accuracy of these predictions (Callaway, 2004). It can be said that there is a great difficulty, especially in many developing countries, such as low quality and limited data, some transactions occur in informal economies and social networks, so they are not reported. It can often be said that historical weather data are typically not sufficiently detailed (Hughes et al.,. 2010) For example, incomplete and conflicting data on home renovation costs for hurricane protection (Bjarnadottie et al., 2011). In addition, non-market data are lacking, especially on items affected by climate and possible adaptation, such as the value of ecosystem services.

1.5.1.2. Costs and Benefits Are Location Specific

Calculation of localized impacts requires detailed geographic knowledge of climate change impacts, but they are an important source of uncertainty in climate models. Global estimates of adaptation cost are often not based on local-scale physical attributes that are important for adaptation; this partially explains why local and regional scale adaptation cost estimates are not consistent with global estimates (Agrawala and Fankhauser, 2008). Compared to developed countries, there is limited knowledge and understanding of the possible market sector impacts of climate change in developing countries.

1.5.1.3. Costs and Benefits Depend on Socio-Economy

Sometimes it is assumed that the climate will change but society will not (Pielke, 2007; Hallegatte et al., 2011). Future development paths affect climate change impact predictions and may change predictions from positive to negative effects or vice versa. Some studies show that higher growth rates increase hurricane vulnerability (Bjarnadottir, 2011). On the other hand, higher income allows for financing of risk mitigation policies.

1.5.1.4. Discount Rates Matter

Discount rates are a fundamental problem as adaptation costs and results occur over time (Baum, 2009; Heal 2009; Hof et al., 2010). Views on this question vary sharply. Some say that a low discount rate is necessary for distant climate change in the future to become important. A low discount rate is the main reason for the relatively high climate damage estimates in the Stern Review (Stern, 2006). For climate adaptation projects, the social or consumption discount rate is relevant. Although there are no good arguments for specific proportions, the rates used range from 0,1 to 2,5%. While Nordhaus (2008) chooses a value of 1,5%, Stern uses a much lower value such as 0,1%. While Nordhaus emphasizes consistency with rate of return on investment as a driving justification, Stern points to ethical issues. Allowing environmental services to enter consumption can significantly alter the social discount rate and create a low or even negative social discount rate (Guesnerie, 2004; Sterner and Persson, 2007; Heal, 2009). The UK Treasury now mandates the use of reduced discount rates for long-term projects, as suggested by behavioral studies and theoretical analysis (Arrow et al., 2012).

1.5.2. Review of Current Global Forecasts: Gaps and Limitations

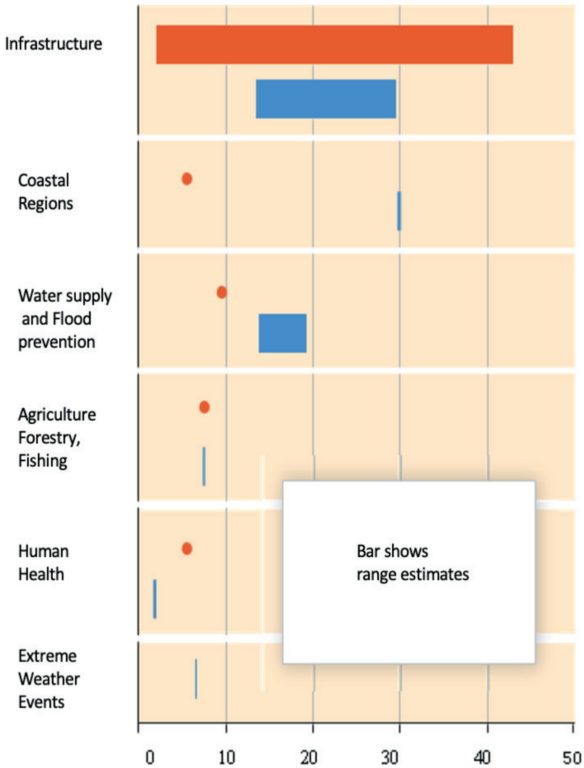
A limited number of global and regional adaptation cost assessments have been made in the last few years (Stern, 2006; World Bank, 2006, 2010; Oxfam, 2007; UNDP, 2007; UNFCCC, 2007, 2008). These estimates have a wide range and are mostly complete for developing countries. The latest and most comprehensive global adaptation costs to date range from USD 70 billion to USD 100 billion annually by 2050 (World Bank, 2010; see. Table 2. IPCC (2012) considers confidence in these numbers to be low because the estimates are derived only from three relatively independent lines of evidence. World Bank (2006), Stern Review (2006), Oxfam (2007) and UNDP (2007). UNFCCC (2007) calculated the current and planned investment and financial flows (I&FF) and then estimated the additional investment required for adaptation at a premium to existing and planned investments. World BANK (2010) followed the premium climate change forecasting UNFCCC (2007) method, which forms the basis of existing and planned investments. However, more extensive modeling (as opposed to the development of unit cost estimates) included marginal cost curves and climate response functions built for adaptation actions, and maintenance and coastal port rehabilitation costs.

Table 2: Study Estimates of global adaptation costs

Studies	Results (Billion $ / year)	Time span	Sector	Methodology and comments
World Bank (2006)	9-41	Current	Uncertain	Climate Cost of Foreign Direct Investments, Gross Domestic Investments and Regional Development
Stern(2007)	4-37		Uncertain	World Bank's Update (2006)
Oxfam(2007)	>50	Current	Uncertain	Estimating cost estimates from World BANK (2006) plus national adaptation plans and NGO projects
UNDP (2007)	86 – 109	2015	Uncertain	World BANK (2006) plus costing targets for adapting poverty reduction programs and strengthening disaster response systems
UNFCCC (2007)	28 – 67	2030	Agriculture, forestry and fishing; supplying water; human health; coastal areas; infrastructure	Planned investment and financial statements required for the international community
World Bank (2010)	70 – 100	2050	Agriculture, forestry and fishing; supplying water; human health; coastal areas; infrastructure, extreme events	Improvement in the UNFCCC (2007): more precise unit cost, including maintenance cost and port upgrade, risks from sea level rise and storm surges

Given their common approach, these predictions are correlated, explaining that the predictions emerge in later years. However, there are significant differences in terms of sectoral estimates as shown in Figure 7 by the comparison of UNFCCC (2007) and World Bank (2010) studies. Extreme events, a potential source of large adaptation costs, are not properly addressed and these studies consider a limited number of adaptation options. In addition, World Bank (2010) forecasts report higher forecast ranges that reflect additional efforts to explain uncertainty. The UNFCCC (2007) considers its estimates to underestimate (at least one significant) with at least two to three factors and neglected costs in ecosystem services, energy, production, retail and tourism. For this reason, the numbers should be looked at carefully. There are a number of gaps, challenges and shortcomings associated with global predictions that deserve further discussion.

Figure 8: Comparison of sectoral results regarding compliance costs in developing countries in UNFCCC and World Bank studies (Billion USD)



The practical difficulties of conducting global adaptation cost studies are clear in the literature. The broad scope of these studies limits the analysis to a few climate scenarios, and while the scenarios can be chosen strategically, it is difficult to represent the full future adaptation costs in all sectors. Broad coverage also limits the comprehensive consideration of adaptation options, non-market and common benefits, equity issues, and adaptation decision-making (such limitations also apply to local and regional scale studies). Global studies designed to reflect the best available methods and data to estimate the magnitude of the global economic adaptation struggle have achieved this limited goal, but should be interpreted in light of these important limitations and uncertainties.

1.5.3. Consistency Between Local and Global Analysis

Adaptation costs and benefits are often obtained at national and local levels to guide specific investment decisions or to establish a "price tag" for general financing needs for adaptation (usually globally). Given these different objectives, it is difficult to compare "local", i.e. national and sectoral, with global numbers. The quantity/quality of local studies varies by sector, with more adaptation therapy in coastal areas and agriculture (cf. Agrawala and Fankhauser, 2008 and Table 3). Less is known, and many gaps remain for sectors such as water resources, energy, ecosystems, infrastructure, tourism, health, and the public. In addition, evaluations were carried out predominantly in the context of the developed country (for examples of cost and benefit assessments, see. Table 1.

Table 3: Scope and benefits of adaptation costs

Sector	Analytical scope	Cost es-timation	Benefit esti-mate
Coastal Regions	Comprehensive	√√√	√√√
Agriculture	Comprehensive	----	√√√
Water	Isolated case studies	√	√
Energy	North America Europe	√√	√√
Infrastructure	Crosscut partially covered in other sectors	√√	---
Health	Selected effects	√	---
Tourism	Winter tourism	√	---

Source Agrawala and Fankhauser, 2008
Note: Three controls show that the subject is covered well to excellent in the literature; two controls show medium coverage; a control shows limited scope; no control indicates extremely limited or no scope

However, adaptation costs, excluding coastal protection costs alone, have shown little convergence in terms of global costs locally or sectorally. The World Bank (2010) study requires a two-way approach by making parallel national (seven cases) and global adaptation estimates. For some country studies (Bangladesh, Samoa and Vietnam), a cross-country comparison of local and global adaptation costs has been made, and the gross domestic product (GDP) costs have been reasonably agreed. The costs of strengthening infrastructure against wind storm, precipitation and flooding are approximately 10 to 20% higher than disaggregated global estimates, largely due to the ability of country-level studies to take into account at least some socially contingent effects (World Bank, 2010). There is also evidence of underinvestment in adaptation (UNDP, 2007), with global estimates of the need for adaptation funds ranging from $ 70 to $ 100 billion annually (World Bank, 2010), but with actual expenditures were estimated at $ 244 million in 2011. GDP which was estimated as 395 billion USD in 2012;

1.5.4. Selected Studies on Sectors or Regions

This chapter focuses on studies demonstrating current practices in predicting adaptation economics, with a particular focus on supporting adaptation decision making through economic analysis. Within this class of study, there are two broad categories of economic analysis of adaptation at sectoral level: econometric and simulation approaches.

Econometric studies usually examine the nature of observed adaptations or the estimation of the climate change impacts with which farmers adapt. Such studies are based on observed cross-sectional, time series or panel data. Among the examples, it is assumed that an indirect adaptation took place, linking temperature and precipitation amount between crop yields or land values (e.g., Mendelsohn et al., 1994; Schlenker et al., 2006). Such approaches can also be used to estimate the marginal effect of adaptation, provided that "without adaptation" estimates can be developed.

In contrast, the simulation approach tracks the costs and benefits of adaptation strategies through relevant mechanisms, often through a set of climate-biophysical-behavioral response-economic components. There are two main issues in simulation modeling in behavioral response-economic component of simulation. The first includes rational actors that take into account the benefit and cost consequences of their choice and sustain the results of economically effective adaptation, and the second involves the decision rule or reference-based characterization of actors' response to climate stress factors (Schlenker et al., 2006; Dinar and Mendelsohn, 2011). As stated later, current practice in many industries begins with the simpler decision rule-based approach and can proceed to consider benefits and costs and then perhaps consider other factors such as equity and non-market values.

The main advantages of an econometric approach are the ability to rely on real-world data, to use "natural experiments" in some cases, and to reflect the common costs and benefits of multiple adaptation strategies to the extent that they are used together in the real world (Mendelsohn and Neumann, 1999; Dinar and Mendelsohn, 2011). The econometric approach does not require the analyst to simulate all adaptation mechanisms, only to find that there is a strong relationship between a climate stress and the outcome of interest. The data required to implement the approach is limited, so the approach can be widely applied. The main disadvantages of the econometric approach are that specific adaptation measures cannot monitor the transmission mechanisms or isolate the marginal impact of these strategies or measures; the inability to take the estimates out of context (e.g., an African study does not apply to Asia where climate, adaptation and social context differ and affect the marginal costs and benefits of adaptation measures) and that statistical estimation can be challenging and sometimes subject to multiple interpretations (Schlenker et al., 2005).

Simulation modeling can be a significant drawback, as it requires extensive data input and careful calibration. However, where data and models are available, the simulation modeling method works well. For example, an agricultural adaptation modeling system can predict factors such as incremental change in crop yield and water supply in response to changes in climatic conditions and agricultural and water resource management techniques. Another advantage of the simulation approach is that it provides an opportunity for stakeholder engagement at various stages of the analytical process: such as designing scope, adjusting parameters, selecting inputs, calibrating results and including measures to adapt to specific local interests.

A wide variety of studies are concerned with evaluating adaptation options economically. A few desirable properties can be defined from these:

- A broad representation of climate stress factors (for example, various individual climate model projections and greenhouse gas emission scenarios), including gradual change and extreme events, spanning a multitude of future outcomes. Consideration of multiple outcomes reflects the prediction of uncertainty and can help robust a number of future outcomes of the adaptation sequence resulting from the analysis (Lempert and Kalra, 2009; Agrawala et al., 2011).
- Representing a wide range of alternative adaptation responses (e.g. considering changes in crop varieties and farmer training in the agricultural sector to ensure that varieties are grown with the best available know-how). Depending on the context, a single adaptation response with size change may be beneficial (e.g. changing the height of a slab or the capacity of a dam). (Fankhauser et al., 1999; Fankhauser, 2010; World Bank, 2010).
- Rigorous economic analysis of costs and benefits, ideally involving consideration of market, non-market and socially contingent effects; one-off and reserve capital and ongoing recurring costs and costs of losses remaining after applying an adaptation response (World Bank, 2010).
- A strong focus on adaptation decision making, including a clear demonstration of the way adaptation decision-making implied in the study, and consideration of both climate and non-climate sources of uncertainty. (Lempert et al., 2006).

Table-4 highlights studies that show some of these features. The studies include both simulations of the economic impacts of adaptation options and econometric studies that examine the choices made by manufacturers to ensure adaptation. These studies often fall under the category of positive economics, where economic tools and analysis are used to examine the effects of alternative choices without imposing the author's values. Few studies contain a normative perspective, explicitly or indirectly, reflecting the value judgments of the authors or study participants.

Table 4: Studies showing the economic evaluation of adaptation options.

I. Agriculture, forestry and livestock

Sector	Work and scope	Methodology
Effects on livestock producers in Africa	Econometric. It examines the economic choices animal owners make to sustain production in the face of the climate. Insights into adaptation options are obtained by examining how economic preferences change between plac-es and times with different cli-matic conditions.	•Consideration of multiple options (implicit) • Expected effects affected • Can be applied at multiple geographic scales • Results provide a ready way to re-estimate results for multiple climate scenarios.
Grain industry in Mali	Simulate the economic consequences of potential adaptation possibilities. Examines the consequences of crop migration, development of heat-resistant varieties, reduction of soil fertility loss, expansion of cultivated areas and changes in trade patterns.	• Extensive consideration of options (explicit, allowing for sequencing of measures) • Expected permanent effects Strict economic cost of adaptation options and outcomes, income and food security consequences
Simulation with cost/ benefit analysis of the plant and livestock sector in four eastern European and central Asian countries.	It basically ranks options by net economic benefits over the period 2010-2050. It considers non-market and socially contingent effects through stakeholder consultation.	Wide range of options (open, criteria listed) • Wide display of climate scenarios (56 General Circulation Models - Emission Scenarios Combinations Special Report) • Rigorous economic cost of adaptation options Integrated analysis of agriculture and irrigation water sectors

II. Rising sea level and coastal systems

Sector	Work and scope	Methodology
Coastal regions on a global scale	Adaptation simulation through the construction of sea walls and embankments, the migration of coastal inhabitants from vulnerable areas to preserve recreational value. The study reflects an economic decision rule for most categories and benefit/cost analysis for several categories.	A broad representation of sea level rise scenarios Optimization of alternatives, taking into account both the effect of adaptation and the resulting permanent effects • Rigorous economic cost of adaptation options
Sea level risks are increasing for parts of the United States coast	Adaptation decision-making simulation using primarily a benefit/cost framework, but with alternatives based on local land use decision-making rules, including sea walls, bulkheads, elevating structures, supporting beaches, and strategic retreat	Adaptation decision-making simulation using primarily a benefit / cost framework, but with alternatives based on local land use decision-making rules, including sea walls, bulkheads, elevating structures, supporting beaches, and strategic retreat
Somerset coastline risks in the UK	Simulation using a probabilistic representation to characterize the uncertainty of future sea level rise and other factors that could potentially affect coastal land use planning and development investment decisions.	• Consider the impact of both gradual climate change (sea level rise) and extreme events (recurrence interval every 1 year in 200 years) • Integrated analysis including probabilistic uncertainty analysis

III. Water and city floods

Sector	Work and scope	Methodology
Future needs and costs for municipal water worldwide scalable to national and local scales,	Evaluates the costs of reaching a water supply target with and without climate change in 2050 The level of collection used is the change in the level of food production units and storage capacity using the peak algorithm to determine the storage efficiency relationship and the cost of various alternative sources.	Multiple climate scenarios Scalable to multiple spatial resolutions where national and regional results are reported • Multiple alternative adaptation options are considered • Rigorous economic cost of site-specific capital and operating costs
Direct and indirect effects of flooding in Mumbai, India	Investigates the results of areas with different turnaround times with and without climate change; the impact of climate change uses simulations from a global climate model. It estimates direct losses from a 100-year event, rising from $ 600 million to $ 1890 million today in the 2080s, and total losses (including indirect losses) rising from $ 700 to $ 2435 million. Effects are based on adaptation options, some targeting direct losses (e.g. Improved building quality, improvement of drainage infrastructure) and others indirect losses (e.g. Increased rebuilding capacity, micro insurance) targets. Analyzes that improve housing quality and drainage reveal that by the 2080s it could lead to total losses below current levels, and full access to insurance would halve indirect losses for major incidents.	• Considers multiple adaptation options • Takes into account direct and indirect costs explicitly • Rigorous economic cost of adaptation options

IV. Energy and health

Sector	Work and scope	Methodology
In Brazil, especially hydroelectric power generation	Simulation of multiple adaptation options including regional power with energy source substitution and modeling of river flow under future climatic conditions and hydropower generation It uses the optimization model of overall energy production.	• Considers two greenhouse gas emission scenarios and the "no climate change" baseline Scalable to multiple spatial resolutions where national and regional results are reported • Takes into account multiple adaptation strategies • Rigorous economic cost of capital and recurring adaptation costs
Global adaptation costs in the treatment of diarrheal diseases, malnutrition and malaria	For three disease scenarios, the cost of three diseases was estimated in 2030 (1) current number of cases; (2) projected relative risks of these diseases in 2030; and (3) current treatment costs. The analysis assumed that treatment costs will remain constant. There was a limited assessment of socioeconomic development.	Multiple climate scenarios Clear explanation of framework and key assumptions The exacting economic cost of adaptation options using multiple assumptions to characterize uncertainty

1.5.6. Economic Tools Providing Incentives

There are many opportunities for policy makers to encourage autonomous adaptation through regulations, subsidies and direct intervention. However, these efforts need to be designed to provide efficient, cost-effective responses while avoiding adverse consequences. A key issue in designing effective policies is to understand that those who will earn the most affect their behavior. For these and other reasons, economists tend to prefer policies, mandates, or uniform policies based on voluntary action influenced by positive or negative incentives. Examples of these are various payments for insurance markets, water markets and environmental services (PES) plans. A second consideration in policy design is cost-effectiveness, that is, governments make the most of their resources. The net impact of a policy is difficult to measure because it is difficult to predict what will happen without the policy.

Finally, policies must be carefully designed to avoid adverse consequences that run counter to policymakers' goals. There is a classic example of policies promoting the adoption of water saving technology. For example, subsidizing irrigation water conservation can drive farmers to increase total water use by increasing acres under irrigation. There is relatively little literature on the use of economic tools for adaptation, with the exception of insurance and trade-related tools. One reason is that, other than insurance, few adaptation policies work directly through economic incentives and markets. However, the potential of economic tools in terms of adaptation is widely recognized.

The following stimulating tools on key sectors: (1) insurance plans (all sectors; extreme events); (2) price signals/markets (water, ecosystems); (3) regulatory measures and incentives (building standards, district planning); and (4) research and development incentives (agriculture, health).

1.5.6.1. Risk Sharing Including Insurance and Transfer of Risk

Formal and informal mechanisms for insurance can directly lead to adaptation and provide incentives or deterrents. Informal mechanisms involve relying on national or international assistance, and while these mechanisms are common, they tend to deteriorate for large, co-variable events. Another informal mechanism is to include climate change risk in corporate information arrangements. Formal mechanisms include insurance, microinsurance, reinsurance and risk pooling arrangements. Insurance usually includes ongoing premium payments in return for coverage and post-event claims payments. Unlike compensation-based insurance, index-based insurance insures the event (as measured by the lack of rain, for example), not loss, and has the possibility of providing a safety net with no moral hazard, but lacks the underlying risk and the damage is not correlated with the event (Collier et al.,. 2009; Hochrainer et al., 2009). Markets differ significantly depending on how responsibility and liability are distributed, and in many cases governments play a key role as regulatory agencies, insurers or reinsurers (Aakre et al., 2009; Botzen et al., 2009). Insurance penetration is considerable in developed countries, but low in many developing regions. Around 30% of losses in high-income countries were insured during 1980-2004, but only 1% in low-income countries. Developing countries are beginning to pool risks and transfer segments to international reinsurance markets. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) set a precedent by pooling risks across the basin, thereby reducing insurance premiums against hurricane and earthquake risks. Similar plans are under development planning in Europe, Africa and the Pacific (Linerooth-Bayer et al., 2011).

Insurance-related tools can directly and indirectly encourage adaptation: (1) Tools provide compensation payments after an incident thus reducing the risk and consequences of follow-up; and (2) they mitigate certain pre-event risks and allow improved decisions. As an interesting example, farmers in Malawi exposed to severe drought were able to grow higher yields but higher risk crops by using credit-related crop insurance, which would increase their income. (Linerooth-Bayer et al., 2011).

Indirect effects occur through the provision of incentives and deterrents. Risk coverage premiums can provide an incentive to reduce the premium by reducing risk. In practice, the incentive effect is generally weak. Studies have found that insurance decisions are based not only on costs and premiums, but also a desire to reduce anxiety, comply with mortgage requirements, and meet social norms. Also, purchase insurance can reduce adaptation with insured agents and reduce their efforts to minimize risk after receiving coverage. This is called moral hazard and is rational. The moral hazard can be reduced by the use of index-based insurance, but this has a business disadvantage due to a high fundamental risk. Another difficulty arises when local or state regulations weaken risk mitigation incentives (for example, by not allowing insurance rates to be fully adjusted to risk). Some analysts are proposing to remove existing regulations that distort market signals to reorganize incentives, but this will be ineffective given the incentive effect is not very strong and the premiums are not fully risk-based. It is also claimed that some existing insurance schemes can increase mismatch. Inadequate insurance can also occur when agents expect the public sector to provide disaster relief (Gibson et al., 2005).

1.5.6.2. Payments for Environmental Services

Payments for environmental services (PES) pay landowners or farmers for actions that protect public and environmental health services provided by ecosystems on their properties, including services that contribute to both climate change adaptation and mitigation. Potentially well-designed PES plans provide a framework for adaptation, and there is a view that with more experience and guidance on implementation among development agencies, PES as one of many applicable measures (e.g. taxes, fees, subsidies, loans) can contribute well to adaptation (Chishakw et al.,. (2012).

1.5.6.3. Improved Resource Pricing and Water Markets

Adaptation to the water sector generally starts with the consequences of future water scarcity and the potential for conflict. Techniques that are often cited for resolving these conflicts include the establishment of water markets or water pricing schemes, which are also often associated in themselves (e.g., Vorosmarty et al., 2000; Adler, 2008; Alavian et al., 2009). Traditionally, water markets facilitate the transition from low-value uses to higher-value uses, but pricing rules can also operate through urban fees and property taxes (as for water supply and urban rainwater regulations in many countries). Several studies reveal that water markets and pricing improve adaptation to climate change (Medellin-Azuara et al., 2008). In many cases, the projected increase in climate-induced water demand (particularly in the agricultural sector) and a projected reduction in water supply indicate that adaptation will be necessary.

Many countries have established structures for water pricing in the household and agricultural sectors. However, such prices are uneven, collection rates are low, rarely measured (at least for the agriculture sector, which is typically the largest water user), and pricing is generally on an annual basis rather than usage-based fees. Some important institutional barriers to water markets and pricing remain in many countries. These include comprehensive consideration of historical and existing rights, negotiability limits, legal and physical infrastructures and institutional shortcomings, lack of property rights. These can be added to issues such as third-party effects, market design, transaction costs, and marginal cost-to-average pricing.

1.5.6.4. Expenses, Subsidies and Taxes

In the last 30 years, the environmental economics literature has emphasized the importance of market-based instruments (MBI) relative to command and control regulations. MBIs have generally been shown to be more cost effective and provide stronger incentives for innovation and dynamic efficiency. There is a general preference in terms of overall efficiency for taxes over subsidies for the wide range of vehicles characterized as market-based. MBIs include harmful emissions and waste, subsidies for clean energy, subsidized loans, and others (Griffin, 2012).

In many cases, climate change further increases the impact of pricing resources below their social costs. This also applies for some ecosystem services as well as some form of energy (eg. hydro and fossil fuel based). If these resources were optimally priced, there would be more incentives to invest in clean technologies and the need for additional adaptation measures for the public sector would be reduced (ESMAP, 2010)

In addition to the previously identified tools, others that are potentially important include strengthening the property rights of schemes such as raising the price of energy through a tax, developing markets for resources, and more effective PES. These measures are desirable even in the absence of climate change; these increase even more considering the climate effects. However, it is important to note that although the situation is strong for such social cost pricing through the use of wages, this also has its limitations. Higher prices for key commodities can hurt the poor and vulnerable, and complementary measures may need to be taken to address these effects.

1.5.6.5. Intellectual Property Rights

Technology transfer is seen as an increasingly important adaptation tool due to the global benefits it provides through knowledge transfer. Approximately 165 technological needs related to reduction and adaptation are listed in the Technology Needs Assessments conducted in developing countries. Examples include applications to agriculture in Cambodia and Bangladesh and coastal areas in Thailand. In most of these cases, patents and other intellectual property protection restrict technology transfer. Patent acquisitions, patent pools, compulsory licenses and other open source approaches have been used to alleviate this restriction (Dutz and Sharma, 2012). Patent purchases involve third parties (for example, international financial institutions or foundations) who acquire marketing rights for a patented product in a developing country. Patent pools represent a group of patent holders who agree to license their individual patents to each other (open pool) or to any party (closed pool). Mandatory licenses are issued by governments and allow patent rights to be overridden in critical situations. Therefore, for all the above reasons, it is suggested that limits on technology transfer limit adaptation to climate change. However, strong intellectual property (IP) protection in receiving countries facilitates technology transfer from advanced countries, and evidence shows the systematic impact of IP protection on technology transfer, especially through export, FDI and technology licensing. For middle-income countries, the risk of counterfeiting is expected to be relatively high in the absence of such protection.

1.5.6.6. Innovation and Research-Development Supports

Subsidies that promote innovation through research and development (R&D) can be used as a measure to encourage adaptation investments and behavioral change (Bräuninger at al., 2011). Subsidies include direct payments; tax cuts or price supports that increase the rewards from the implementation of an activity. There has been some criticism of the effectiveness of subsidies (Gupta et al., 2007). There has been some criticism of the effectiveness of subsidies in terms of adverse effects on rent seeking and competitiveness. They are often poorly targeted and caught in the middle and upper income groups. What's more, subsidies mean increased budget burdens. However, it is popular with decision makers and the wider public. Today, subsidies are mostly used for reasons other than climate adaptation, and evidence is lacking for their use for adaptation purposes and for the promotion of adaptation R&D in particular. This shows that subsidies have little impact on their own, but they are working to amplify the effects of other tools such as energy taxes and improvements in energy efficiency and regulations that mandate the use of lower carbon options.

1.5.6.7. The Role of Behavior

It is well known that human behavior is generally characterized by limited rationality associated with choices under risk and uncertainty, particularly affecting the effectiveness of incentive-based approaches. Individuals exaggerate or underestimate risks and may not be able to constantly weigh long-term consequences. A well-documented explanation is that individuals do not fully use available information about risks in making their choices. Policies that make good use of these risk perceptions and behavioral biases increase their effectiveness.

For example, people react differently to soft information about distant events as opposed to concrete, current, emotionally charged information. In practice, this can limit the impact of communicating only "dry" emotionless information such as flashbacks, and underline the importance of participatory, reflexive, and iterative approaches to decision support (Fischhoff et al., 1978; Slovic, 1997)

2. FINANCING OF ADAPTATION AND FINANCING SOURCES

The global importance of adaptation was underlined with the Paris Agreement. For the first time in the negotiations of the United Nations Framework Convention on Climate Change (UNFCCC), a global objective is set that provides a collective vision for the direction of global adaptation action and underlines the links between adaptation, mitigation and sustainable development (UNEP 2016).

The agreement also includes provisions on adaptation financing, meaning that scaled financial resources should aim to strike a balance between adaptation and mitigation in Clause 9.4 (United Nations, 2015; CICERO, 2017).

Nationally determined contributions (INDC), which demonstrate the efforts of individual countries to achieve the objectives of the Agreement, clearly reiterate the importance of adaptation. The Adaptation Assessment Tool (TAAN) in INDCs provides concrete numbers in this regard: In 2018, 131 INDCs referring to adaptation (75% of all countries offering INDC). Besides INDCs, national adaptation plans (NAPs) constitute another key mechanism under the UNFCCC, which enables countries to identify their medium and long-term adaptation needs and develop and implement strategies or programs for this purpose. Moreover, national adaptation programs (NAPAs) provide a tool for least developed countries (LDC) to identify priority activities that respond to urgent needs for adaptation to climate change (IISD and GIZ, 2017).

Successful implementation of adaptation activities, for example in the context of NDCs, NAPs and NAPAs, requires funding from a variety of sources, including the private sector. Developing countries, in particular, need substantial funding to help them adapt to changing climate and pursue low-carbon and climate-resilient development pathways. According to the UN Environmental Adaptation Finance

Gap Report (UNEP, 2016), developing countries alone may require between 140 billion and 300 billion dollars annually for adaptation by 2030. These financing needs could reach $ 280 billion and $ 500 billion by 2050. (UNEP, 2016).

However, adaptation finance is only a part of overall global climate finance according to current estimates. The 2018 Biennial Review of the UNFCCC Standing Committee on Finance states that in 2015-2016, climate finance flows increased by 17 percent since 2013-2014, reaching a total of USD 680 billion in 2015 and USD 681 billion in 2016. However, adaptation finance lags far behind financing, for example, when looking at public funding provided by developed countries to developing countries through bilateral, regional and other channels. It was devoted to mitigating about $ 24 billion in 2016, with adaptation funding from these sources only about $ 5.15 billion.

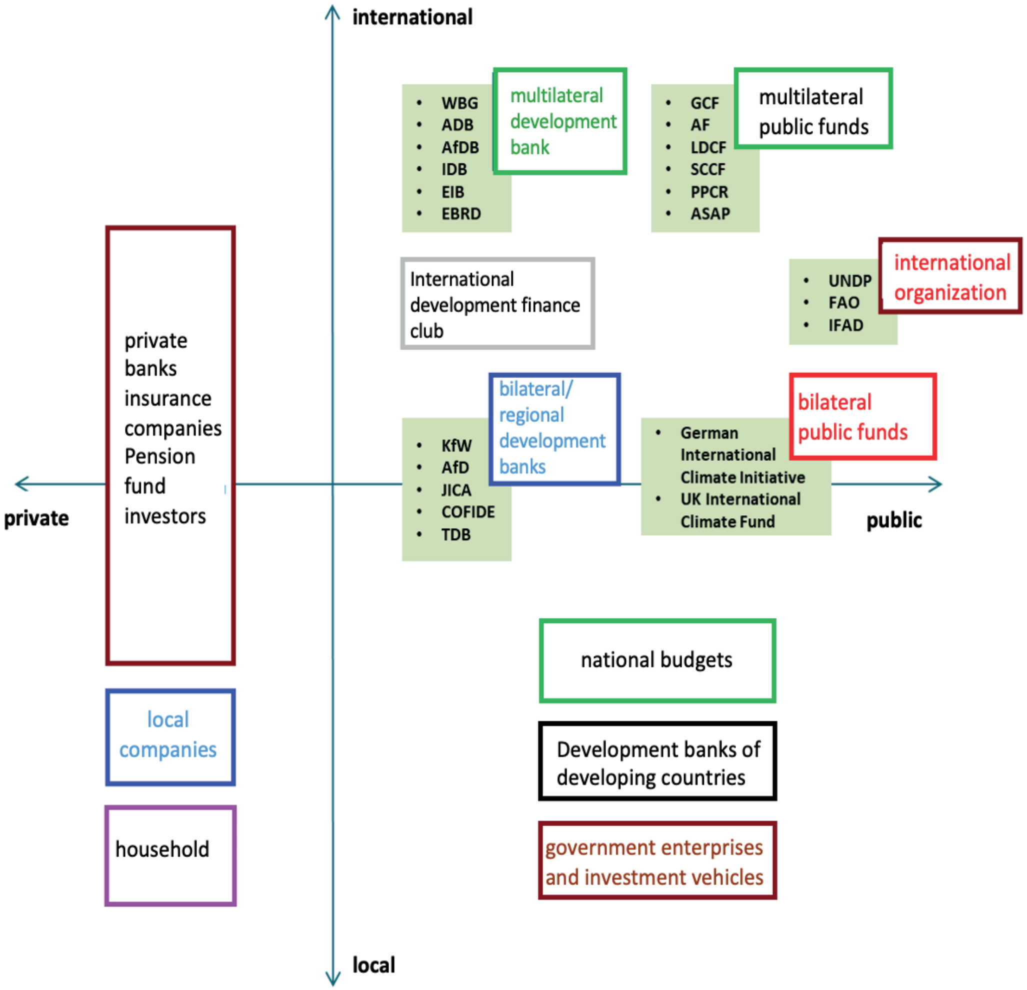
While the figures mentioned are at first glance about funding needs and actual flows for adaptation, they can only be indicative. Conceptual and practical challenges still prevent accurate tracking of financial flows, especially when action to reduce vulnerability to climate change is widespread for regular spending and development investments. The general concept of adaptation as "development in a hostile climate" makes it very difficult to distinguish between adaptation and "business as usual" development. At the same time, this preoccupation, which differentiates adaptation from development, can prevent adaptation from truly integrating into standard development practice. To address inconsistencies in measurement, multilateral development banks (MDBs) and the International Development Finance Club (IDFC) have developed monitoring methods agreed in the form of the Common Principles for Climate Change Adaptation Financing Monitoring (MDB-IDFC). In general, a growing number of key actors are interested in measuring and monitoring climate finance, including how to define and measure adaptation and how to monitor adaptation (and mitigating) financial flows differently.

2.1. Understanding the adaptation finance environment

International climate finance, and therefore adaptation finance, is extremely complex for potential buyers of climate finance seeking funding for individual projects. It can be particularly difficult to navigate, as different sources of funding and options have different characteristics and requirements.

Numerous actors play a role in raising funding for adaptation, from national and international to public and private institutions. Public climate finance providers include donor governments and institutions, multilateral climate funds and development finance institutions (DFIs). The latter essentially includes MDBs, other national and regional development banks and other financial institutions. National governments can provide funding for adaptation at both national and local levels, through legislative action or by allocating budgets to specific instruments such as national climate funds. It includes the private sector, project developers, institutional actors, households, commercial financial institutions and more. Figure 1 provides an overview of this complex landscape.

Figure 9: An overview of the most suitable adaptation finance sources



Funding for adaptation can take many different forms. The challenge in this regard is to find out which of the many potential sources of funding is suitable for a particular adaptation project or activity (for an example of the most relevant for adaptation projects see Figure) To this end, it is important to find the most suitable funding sources and to integrate financing approaches into the various stages of project or activity development. Often times, various tools are used to fund adaptation-related activities and projects. The main financing tools for adaptation are summarized in Table 1.

Table 5: Financing instruments overview (GIZ, 2018)

Financing instruments	Definition	Interesting aspects
Grant	Usually by financial transfer by the public sector or by charities. The money does not need to be refunded and is generally tax free. Grant providers closely monitor the impact of the funding provided.	Grants are often given for project preparation and technical assistance.
Credit	Debts with a fixed repayment period and fixed or var-iable interest rate to be paid at regular intervals. Usual-ly, repayment begins immediately after the loan is re-ceived by a buyer.	Many donors have different degrees of privilege depending on the recipient.
Equity	Financing provided by an investor in exchange for par-tial or full ownership of a company by purchasing its shares (usually for profit).	It is usually provided by the private sector rather than pub-lic financiers.

In the context of climate finance, the three classic financing tools described in Table 5 - grants, loans, equity - are often combined with blended finance mechanisms to mitigate risks, such as guarantees or insurance. These transfer certain identified risks from financial providers to other parties (e.g. guarantors or insurers) who have a better capacity to accept those risks. Such mechanisms increase the chances of projects to obtain commercial finance.

Different financiers typically use different financial instruments:

- International public funding typically comes in the form of loans (long-term, concessional rates) or grants - the latter mostly technical assistance, consulting services, project preparation; Collateral can be given to reduce risk for commercial investors / banks.
- Local public funding can range from dedicated grants for climate action to general public budgets.
- Private finance instruments can typically be provided as debt, equity or hybrid, and loans, bonds, venture capital, etc.

2.2. Benefiting from domestic adaptation financing

Local funding sources for adaptation include national and local governments, state-owned enterprises or national development banks. Special resources for adaptation can be increased in various ways, e.g. through carbon pricing tools such as certain taxes or emissions trading programs. At the same time, it is necessary to integrate effective adaptation and flexibility building through expenditure to provide an approach for the whole of government and public investment in different areas of government, ranging from energy and housing to transport.

2.3. Stimulating private sector adaptation finance

The private sector must play a vital role in financing adaptation. First, it must invest in its own adaptation. Climate change poses a risk to businesses, both physically and through climatic changes in regulation, technology and market dynamics. It can also open up new opportunities for companies, e.g. by stimulating demand for adaptation products and services. Moreover, societies and economies depend on the private sector for employment, infrastructure, and products or services. Companies must thus invest in their resilience to ensure their survival and growth and protect their stakeholders. Second, private financial institutions and investors - such as banks, pension funds, insurance companies, or investors - can invest or provide funds for the adaptation of others; through (micro) loans, bonds or venture capital.

Finally, private organizations can support the adaptation of others and adaptation funding, for example by offering specific products and services. For various reasons, the private sector has so far not provided enough funds to implement emergency adaptation measures. Lack of awareness on climate change risks, lack of short-term profit from adaptation and consequently limited motivation for this, and limited knowledge on how to assess the risks and costs of adaptation actions constitute some obstacles to action. In general, adaptation and barriers to private investment develop mainly in five broad areas: Data and information, corporate regulations, policies, economic incentives and communications, technology and information.

The lack of transparency as to how much the private sector invests in adaptation activities poses another major challenge, as it prevents action to increase private adaptation investment. The difficulties in monitoring private finance arise from the fact that the private sector does not always frame its involvement in the adaptation context. The sector's common willingness to disclose climate-related financial risks and the resulting lack of monitoring prevent concrete measurements and identification of financial gaps. Understanding and mistrust between private and other organizations (for example, as a result of different interests and working cultures) can seriously hinder cooperation in this regard.

Efforts are being made to develop concrete solutions for specific target groups in the private sector. For example, the Task Force on Climate Related Financial Disclosures (TCFD) has developed a framework that helps companies disclose information about the financial impacts of climate change. Financial actors such as banks are advised to evaluate borrowers' loan and loan portfolios by assessing the physical impacts and risks of extreme weather and climate events and assessing lending risks and opportunities. With the Center of Excellence for Global Climate Adaptation, the EBRD has developed guidelines for firms on how to integrate climate change issues into investment decisions. SEED Initiative Implementing Laboratories Climate Finance brings organizations, businesses and stakeholders together to jointly address the key financing challenges faced by small and medium-sized businesses - a particularly vulnerable segment of the private sector - in many emerging and developing economies.

2.4. Things to know about the current debate on adaptation finance

Current debates on finance for adaptation develop around three broad areas: Access to international public climate finance for adaptation, leverage from internal adaptation finance and mobilize private sector adaptation finance.

In accessing international public climate finance for adaptation, many countries face significant barriers to planning, accessing and providing climate finance, including dealing with multilateral climate funds. They require a certain level of capacity to prepare national mechanisms to take these steps and integrate these institutional mechanisms with national plans, policies and sustainable development priorities. In short, they must be "ready" for financing. GIZ's Climate Finance Preparation Program (CF Ready) has been working for this purpose since 2012. International climate finance helps partner countries to create conditions for the effective, transformative and efficient use of funds, especially GCF. Alongside DFIs, a wide variety of and multilateral public funds are available and ready to fund national adaptation action. In particular, all these institutions and funds differ in nature and purpose (e.g, elements such as target group, country orientation or available funding). Special tools and guidance have been developed to navigate this complex climate finance architecture. For example, we ADAPT is a Quick Guide to Climate Change Adaptation Funds.

Table 6: Overview of multilateral funds supporting adaptation (2003-2017, million USD) (ODI, 2016)

Funds	Committed	Money Deposited	Approved:	Number of approved projects
Least Developed Countries Fund (LDCF)	1251,05	1199,52	1001,5	242
Pilot Program for Climate Resilience (PPCR)	1152,81	1126,02	1000,1	75
Green Climate Fund(GCF)	100009,72	6412,6	828,8	26
Adaptation Fund (AF)	649,27	649,27	460,9	95
Adaptation Program for small-scale agriculture (ASAP)	307,52	290,13	322,0	45
Special Climate Change Fund (SCCF)	367,79	362,79	292,8	70

2.5. Overview of key financiers (multi- and bilateral funds, MDBs)

A number of different organizations are ready to fund adaptation actions.

2.5.1. Multilateral public climate funds

Multilateral climate funds play a vital role in the use of international public finances to encourage investment shifts of other public and private financial institutions necessary to achieve a wider economic and social transformation. In the last two decades, the number of international funds providing climate finance has steadily increased, and each new fund responds to emerging needs at different times. Below is an overview of some of the largest multilateral funds.

- Green Climate Fund(GCF) Total amount of approved projects including GCF financing and co-financing: 16.4 billion USD (GCF, 2019)
- Adaptation Fund (AF): To date, the Fund has approved more than 80 projects and programs with a total fund volume of US $ 532 million. Applications have been made for 45 projects with a financing volume of approximately US $ 335 million.
- Least Developed Countries Fund (LDCF) A voluntary contribution of approximately $ 1.2 billion.
- Special Climate Change Fund (SCCF) Financing adaptation and technology transfer activities in all developing countries to the UNFCCC. As of 2017, SCCF has a voluntary contribution portfolio of approximately US $ 350 million and supports 77 projects in 79 countries.
- Pilot Program for Climate Resilience (PPCR) Grant and loan financing of technical assistance and investments to support developing countries, especially small island developing countries (SIDS). 1,2 billion USD. Support for SIDS: 250 million USD.
- Adaptation to Small Scale Agriculture Program (ASAP): Grants to local small-scale farmers in countries affected by climate fragility (NDC Partnership, 2018). Received ASAP. Contribution of US $ 300 million (IFAD).

2.5.2. Multilateral public climate funds

Developed countries can provide resources to fund adaptation actions in developing countries, inter alia, through bilateral climate funds. Two of the biggest and most important are explained in more depth below.

- German International Climate Initiative (IKI): IKI finances climate and biodiversity projects in developing and emerging countries and countries in transition. It supports programs run by international and multinational institutions and organizations, such as federal implementing agencies, NGOs, businesses, universities and research institutes, development banks and United Nations bodies and programs in partner countries. The total project volume since 2008 is 2.3 billion euros.
- UK International Climate Finance (UK ICF): International Climate Finance is the UK government's commitment to support developing countries in responding to the challenges and opportunities of climate change. (UK ICF). ICF budget of £ 5.8 billion between 2016-2021. (UK ICF).

2.5.3. Multilateral development banks (MDBs)

MDBs offer a variety of tools, including debt, equity, quasi-equity, Islamic finance, local currency loans, guarantees, and political risk insurance. Most MDBs limit their participation in projects, companies and investment instruments to encourage the participation of local and international co-investors and funders. On average, MDBs tend to focus on relatively large deal sizes. Large companies, infrastructure projects, mutual funds, financial institutions, and projects in the energy, financial services or manufacturing sectors are attractive targets due to their ability to receive large amounts of funding and the potential to have a positive impact on growth and development. Small-scale private sector activities are generally not eligible for MDB support.

- World Bank Group (WBG): Since 2018, a new set of climate targets for 2021-2025 investment of over $ 200 billion in climate action; Direct adaptation provided around $ 50 billion in funding compared to the 21-25 fiscal year (WBG, 2018 and WBG, 2019).
- Asian Development Bank (ADB): From 2011 to 2017, ADB exceeded $ 25 billion in climate finance. ADB's own resources contributed US $ 21.7 billion and external sources approximately US $ 3.5 billion.
- African Development Bank (AfDB): Under the 2016-2020 Climate Change Action Plan, the Bank has committed to allocate 40% of annual approvals as climate finance by 2020. In addition, the Bank will mobilize climate finance from external sources. In order to reach parity with mitigation financing, the Bank will increase its adaptation financing by 29% in 2015 and will prioritize the mobilization of adaptation financing from climate finance.
- European Investment Bank (EIB): EIB attributes at least 25% of its investments to climate change mitigation and adaptation. EIB provided 16.2 billion Euros in 2018 due to climate change.
- European Bank for Reconstruction and Development (EBRD): EBRD's work on climate change reaches many sectors of the economy, including solar and wind energy. EBRD's green finance reached 36% of total business volume in 2018 (EBRD, 2019).
- Inter-American Development Bank (IDB): Between 2012 and 2014, IDB allocated an average of 14 percent of its financing annually to climate-related projects. IDB aims to double the volume of climate-related financing by 2020.

2.6. Developing a strategy for accessing funding for adaptation

Designing a financing strategy can be an important tool for project developers to measure the financing needs of the project's activities, determine which financing tools and potential financiers are best suited for the project, and tailor sales pitches to the financial institution in question. Ideally, financing considerations have already been integrated into the project development process. For all the different sources of funding mentioned above (international public, domestic, private), the following practical steps can be considered in such a strategy:

- Step 1: Analyzing financing and investment needs

Quantifying a project's financing needs is extremely important in designing a financing strategy. Planning for the required budget should start as early as possible during project development. Matters to be considered are: Which project activities require funding? What is the required amount of funding (eg for human resources, material costs, logistics)? When and how long is the fund required (time frame)?

- Step 2: Choose funding tools

Once the financing needs have been identified, the next step involves selecting suitable financing instruments (grants, loans, equity) for the project. Key considerations include: Can the financing be repaid after a certain period of time? Is there a possibility for annual payments (eg repayments, interest, dividends)? What is the time frame needed for funding? How important is it to be independent and flexible in the use of finances? Can the investor participate in managing and directing the project? Are there assets such as buildings, machines or vehicles that can be used as collateral? Adaptation projects often need to combine different funding sources and tools. Given the nature of the projects, eg. the steady lack of an underlying business model for generating revenue streams, adaptation projects are often funded by grants.

- Step 3: Map funding sources and select players

Mapping the (potentially) available sources of climate finance for the project will help identify possible financing actors. Adaptation funding can be provided by both public and private organizations and can be from international or national sources. It can also be of a privileged or commercial nature. Figure 1 above can provide an entry point into the actor view. Online resources such as the NDC Partnership Climate

Finance Explorer can help identify some of the funding options available. It may be useful to investigate whether there are unused national or sub-national sources of funding or whether new funding mechanisms can be introduced at country level.

- Step 4: Prepare a special sales pitch to approach selected financing actors

A project can be co-financed by more than one actor from national and international organizations, with both public and private funding. The specific resources and the suitability of a project depends on several factors such as location, project volume and project design. By reviewing the potential financing actors for the relevant financing instruments needed for a project, it should be possible to allocate the financing and time frame planned to take action from each actor. It is important to identify and consider the specific needs, formats and procedures of each actor in order to obtain funding. Adapted concept notes or proposals should take these into account and also summarize the project objectives and impacts, discuss the suitability of the project for each actor, highlight key strengths of the project, and support funding needs with difficult facts.

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SECTOR-SPECIFIC ADAPTATION STRATEGIES: INDUSTRY

Prof. Dr. Erdem Görgün

1. INDUSTRIALIZATION

Industrialization has saved millions of people around the world from poverty and create employment; has increased social welfare by using advanced technology.

Historically, the industrial and energy revolutions have gone hand in hand, producing numerous inventions that have significantly changed the global industrial environment.

The first industrial revolution was powered by steam and coal: It made it easier to produce textiles, reduce printing costs, spread of the written word, and created railways connecting nations and continents.

The second oil-powered industrial revolution: mass production made individual mobility and division of labor possible.

With Industrialization, in the last 250 years,

- Rapid economic growth was ensured,
- Energy production and consumption increased,
- It has led to the industrial development of agriculture and technology.

The industry has become one of the largest greenhouse gas emitters (GHG), representing approximately 30% of global emissions (Fischedick et al., 2014).

The use of fossil fuels as the main energy source has formed the basis of this rapid industrial growth that produces greenhouse gas emissions and causes climate change .

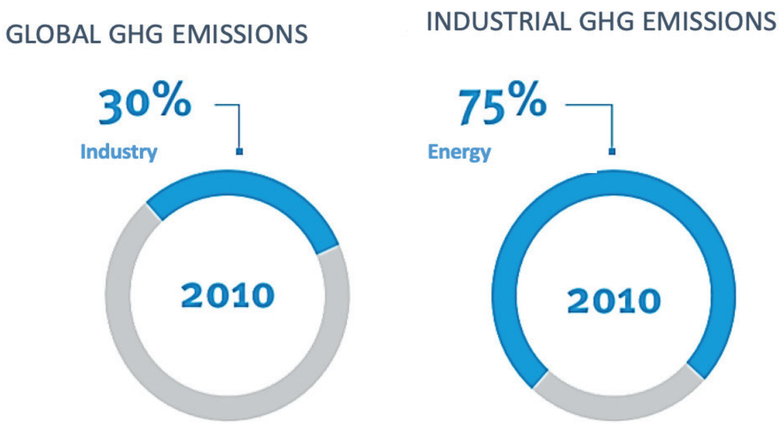
2. INDUSTRIALIZATION AND CLIMATE CHANGE

The effects of industrialization on the environment exceed the carrying capacity of the Earth and force the limits of our planet.

Traditional industrial development models need to be transformed to be more climate-resistant for future generations.

For a climate-resistant world, it is necessary to optimize the ways of industrialization. Greenhouse gas emissions (GHG) from industry represent approximately 30% of global greenhouse gas emissions, of which approximately 75% come from energy use (Figure 1) (UEA, 2015). The industry is the largest sector in terms of energy consumption.

Figure 1: Share of industry in global emissions (UNIDO)



According to the International Energy Agency, total energy consumption by industry was equivalent to 2,702.44 million tons of oil in 2012, corresponding to 28.3% of the total consumption of all sectors (UEA, 2015). Therefore, industrial energy efficiency is one of the strategic mitigation actions.

On the other hand, IPCC advocates that the energy intensity of the sector can be reduced by approximately 25% by taking energy efficiency measures (wide-scale improvement, changing and using the best available technologies).

Climate resistant industry; it is based on sustainable resources and cleaner and more efficient production technologies and practices. It should ensure that climate change and actions to combat it do not endanger the development of countries or the well-being of their citizens.

3. CLIMATE RESISTANT INDUSTRY

Studies, researches and international meetings have shown that there is an urgent need for climate resistant industrial structuring.

Identifying and implementing climate change mitigation and adaptation measures is an important component for the climate resistant industry.

Limiting a source of greenhouse gas emissions can divert the burden or risk elsewhere. It negatively impacts vulnerable spots with less capacity, putting additional pressure on ecosystems or economies already under stress.

In recent years, some industrialized countries have been able to limit increases in resource consumption and the resulting environmental impacts.

It has been achieved not only by technological advances but also by "exporting" more resource and pollution-intensive processes abroad.

Consumption and pollution patterns have often been shifted to developing economies.

4. ADAPTATION TO CLIMATE CHANGE

Climate change adaptations are actions and measures taken to help communities and ecosystems cope with changing climate conditions. (IPCC, 4 Assessment Report)

In other words, adaptation to climate change is the process of strengthening, developing and implementing strategies for struggling against the effects of climate events (risks), providing benefit and managing the effects (UNDP, 2005)

There is no clear distinction between the actions (investment, improvement, support, incentives, etc.) of the countries in their current development efforts and the climate change adaptation efforts.

Most adaptation measures have an explicit or implicit development component.

Therefore, climate change adaptation efforts should be included in development efforts (GIZ, 2014).

It should be ensured that adaptation measures are taken not against the adverse effects of climate change that we may encounter in the future, but that will provide the solution to the problems we currently face even if there is no climate change (GIZ, 2014).

Adaptation needs differ by region, people and industries.

In order to make effective and strategic adaptation planning, the systems (location, community, sector) that will be most affected by the negative effects of climate change should be targeted.

5. ADAPTATION IN THE INDUSTRY SECTOR

Adaptation in the industrial sector means taking measures against the factors that are expected to arise due to climate change and that will directly affect production and competitiveness negatively.

In particular, the expected reduction in the amount of water that can be used as a production input (and therefore an increase in costs) poses a significant threat to the industrial sector (Alkaya et al., 2010).

It is predicted that adaptation to climate change in the industrial sector can be achieved through the use of clean production technologies and eco-efficiency practices. It is also seen that the use of these methods can create an important competitive advantage for businesses.

6. ADAPTATION STRATEGIES IN THE INDUSTRY SECTOR

Factors such as the gradual decrease of resources and competitiveness and national /international sanctions standards have led the industry sector to seek alternative production methods. Concepts such as resource reduction, recycling and recovery in the industry and new concepts such as eco-efficiency (cleaner production), environmentally friendly technologies and industrial ecology have recently emerged and the need to use the existing potential in the best way has become mandatory for both environmental quality and production sustainability. (Koyuncu et al., 2015; Davarcıoğlu, 2017).

Pollutant emissions in industrial facilities are regulated and framed by certain standards through the Industrial Emissions Directive (EED) No 2010/75 / EU.

According to EED, the implementation of a sustainable management system in industrial formations is based on 5 basic principles (European Union, 2010).

- Adopting an integrated approach
- Using best available techniques
- Flexibility
- Establishing a comprehensive control mechanism
- Ensuring public participation in the processes

In Turkey the same function is fulfilled by the Integrated Pollution Prevention and Control Regulation Draft though it is yet a draft.

Best Available Techniques (BAT) defined in the Industrial Emissions Directive and Article 3 of the Regulation on Integrated Environmental Permits , when considered in terms of costs and benefits, are the most effective techniques for high environmental protection.

6.1. Best Available Techniques (BAT)

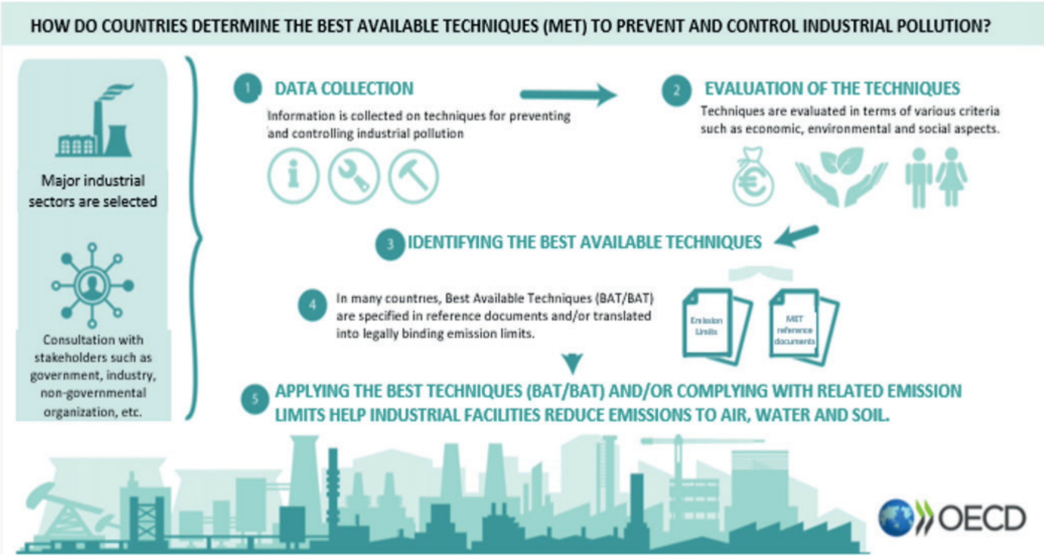
It refers not only to the technology used within an enterprise, but also to the way the enterprise is designed, established, operated and maintained.

In some cases, it does not require an investment, only the best techniques can be applied with business regulations.

The best available techniques are most effective in achieving a high level of protection of the environment as a whole. It offers cost-effective advantages, developed on a scale to be implemented in the relevant industrial sector, under economically and technically viable conditions. The technology and investment used has the potential to repay itself thanks to the savings it provides.

For the implementation of the best available techniques, the OECD aims to collect information, examine the best alternative techniques, determine the best techniques suitable for that industry, check with reference documents called BREFs and minimize solid, liquid and gas emissions and energy efficiency and suggests the steps of applying these best techniques (Figure 2).

Figure 2: Steps followed in determining Best Available Techniques (BAT) (OECD)

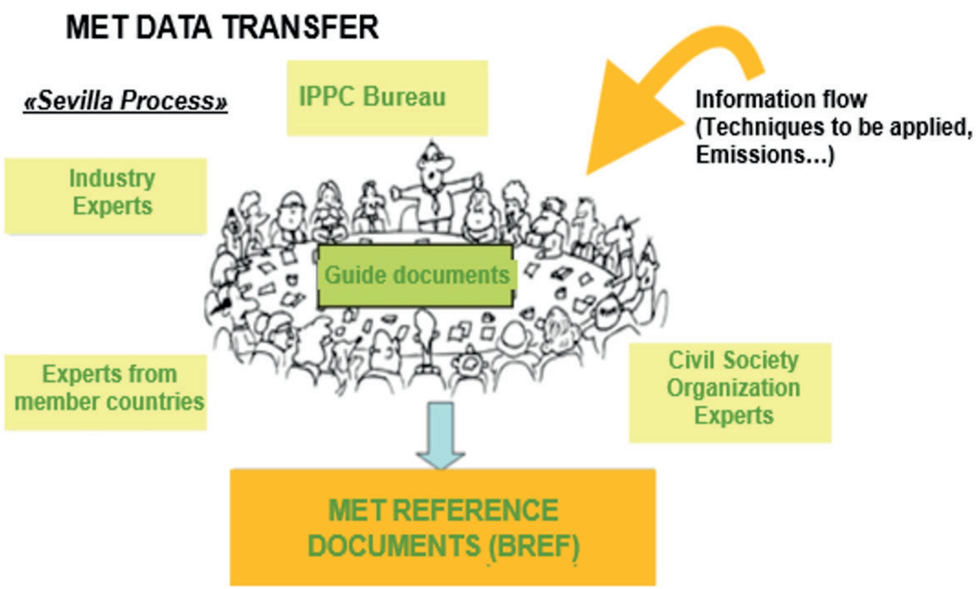


BAT Reference Documents (BREF)

- It describes the information that is considered BAT at the EU level for each activity covered by the EED.
- It provides predictability to the process of determining BAT results and gives confidence in the quality of the final result.
- It provides information on what can be done technically and economically to improve the environmental performance of an industry and therefore the environment in general.

The Sevilla Process is a process designed to agree on what constitutes Best Available Techniques (BAT) for pollution prevention and control. Requiring the polluting industry to use BAT to reduce pollution is a key feature of the Industrial Emissions Directive (EED). Once accepted, the techniques are specified in the BAT Reference Documents (BREF) (EEB). Figure 3 shows the process of creating BAT reference documents, the influential parties and factors in this process.

Figure 3: BAT Information Transfer and the "Sevilla Process"



Eco-efficiency and Cleaner production is a production strategy applied in order to reduce the environmental effects and risks to human health that occur in all stages of the product life cycle, starting from the acquisition of the raw materials used in the production of a product, production, distribution, use and disposal of wastes after use (Republic of Turkey Ministry of Industry and Technology, 2014; TTGV).

Cleaner Production Methods

It is shaped under 6 basic principles (EPA, 1998; TTGV, 2014):

- Technological optimization/change,
- Material substitution,
- Stock control,
- Optimization of the product,
- Good management of the business,

- Enterprise internal recycling and reuse.

Within the framework of these principles, parameters such as energy consumption, pollutant gas emission, wastewater production, material consumption are reduced in industries.

For example, as a result of the WASATEX project implemented in a textile factory in Croatia with cleaner production strategies, 62% of the water used was reused and the amount of water drawn from the source decreased at the same rate. Using less water has brought about a significant energy saving by heating less water. In addition, as a result of the reduction of inputs such as water and energy, an average of € 400,000 was saved annually (European Commission, 2014).

UNEP offers support programs to governments to promote cleaner production in developing countries such as Brazil, China, Mexico and India. There are similar policies for businesses by the governments of countries such as Australia and Canada.

If cleaner production techniques are applied in such projects, businesses are offered economic opportunities such as tax exemption, priority/superiority in tenders, and discounts in raw material procurement.

As a result of such technological applications, all components of urban life are handled holistically and contribute to sustainable life.

TUBITAK Marmara Research Center is another institution in which important studies are carried out on cleaner production in our country. In 2013, TÜBİTAK MAM Environment Institute was restructured as the "Environment and Cleaner Production Institute" and assumed the function of the National Cleaner Production Center in order to ensure the implementation of cleaner production studies in the industry. The Institute has been operating as the National Cleaner Production Center since 2013. The Cleaner Production Technologies Center of Excellence, working within the Institute , has accomplished many successful cleaner production projects (Figure 4).

Figure 4: TÜBİTAK MAM Environment and Cleaner Production Institute Cleaner Production Technologies Center of Excellence

Another institution, which conducts studies on successful clean production, is WWF Turkey. In Figure 5, under the scope of WWF Turkey's "Great Menderes Basin Water patron" strategy, the methodology of cleaner production projects developed for textile companies operating in Denizli and Aydin province are summarized.

Figure 5: Steps of cleaner production processes carried out by WWF

7. CROSS-SECTOR ADAPTATION STRATEGIES

The impacts of climate change cannot be limited to countries or sectors.

The impacts of climate change occur on a wide scale, and although some impacts are mostly related to a particular sector, there is inter-sectoral interaction.

Calls are made for inter-sectoral integration in decision-making and policy-making processes on international platforms.

Integrated effects cannot be adequately addressed among climate-dependent sectors. While preparing climate change adaptation strategies, it seems that an approach that integrates the strategies and policies of the sectors is needed.

In order to disseminate climate change adaptation strategies more effectively, governments need to encourage integrated adaptation planning and adopt intersectoral planning.

7.1. Eco Industrial Parks (Industrial Symbiosis)

An important way to achieve the transition to more sustainable industrial production systems can be resource exchanges between system actors, as well as changing existing production routines based on linear processes. This argument links the industrial production system perspective to 'industrial ecosystems.

Industrial ecosystems function, both analytically and practically, based on synergies created through the symbiotic exchange of physical and non-physical resources between actors.

Physical resources can consist of materials, water, energy, infrastructure and natural habitat, and on the other hand non-physical resources, knowledge, experience, expertise and management.

The industrial ecosystem approach is similar to adapting the principles of natural ecosystems to industrial processes, with a desire to contribute to more sustainable forms of industrial production. (Susur, 2019)

Industrial ecosystems contribute positively to the UN 17 Sustainable Development Goals through industrial ecology practices.

However, goals they can contribute significantly are:

- 7-Economic and Clean Energy,
- 9-Industry, Innovation and Infrastructure,
- 12-Responsible Consumption and Production and
- 13-Climate Action

Industrial ecology practices that appear for these 4 Goals are energy efficiency, innovation, shutting down the production cycle and mitigation.

In traditional production processes, natural resources are converted into products by industrial production methods. The by-product of this process is wastes that require disposal.

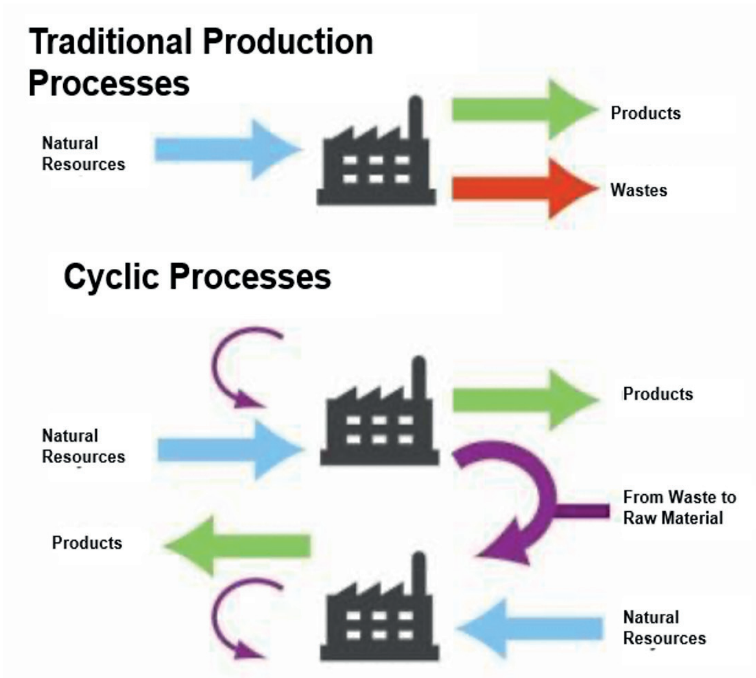
Industrial symbiosis refers to the transition from the linear production system (economic understanding) to the cyclical production system (economic understanding).

While transforming natural resources into products with cyclical processes evaluated within the framework of industrial symbiosis, it accepts the waste as raw materials and puts it back into production. In this way, both resource savings, energy efficiency, reduction of vulnerability to climate change and protection of nature are achieved.

However, clean production and industrial symbiosis integrity and hierarchy should not be ignored. First, waste should be minimized within the enterprise, then symbiotic opportunities should be evaluated (TTGV, 2013).

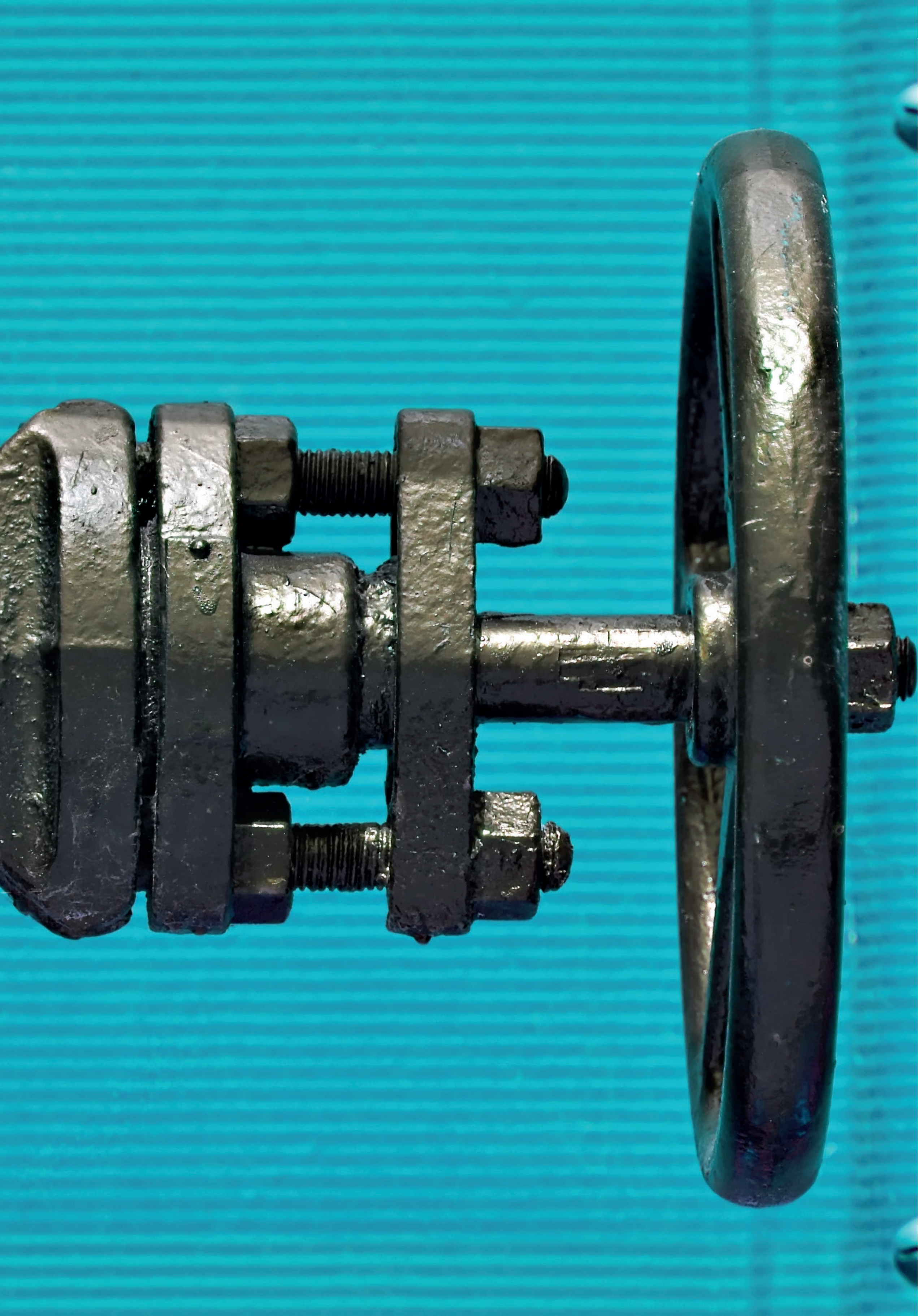
Figure 6 compares schematically traditional and cyclical manufacturing processes.

Figure 6: Traditional and Cyclic production processes



Industrial symbiosis is the adaptation of this concept in nature to industrial enterprises. Express the symbiotic relationships between living things and industrial systems.

The most basic application of industrial symbiosis is the exchange and reuse of matter (waste, by-product, water) and energy between businesses close to each other.



Until the 2000s, the definition of Industrial Symbiosis in the literature is mainly based on this framework: Businesses come together to provide competitive advantage and make substance exchanges; evaluation of synergy possibilities arising from cooperation and geographic proximity.

While Figure 7 and Figure 8 are examples of some industrial symbiosis practices in our country, Figure 9 shows schematically the operation of an exemplary eco-industrial park being implemented in Klundborg, Denmark. (TTGV, 2013).

Figure 7: An exemplary industrial symbiosis application - Olive oil production

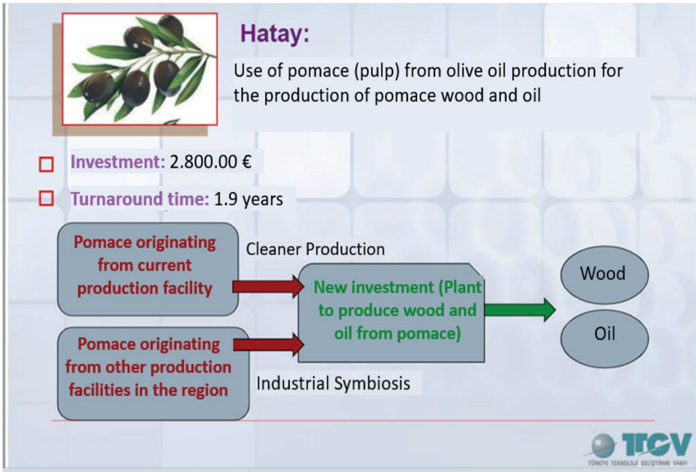


Figure 8: An exemplary industrial symbiosis application - Beer production

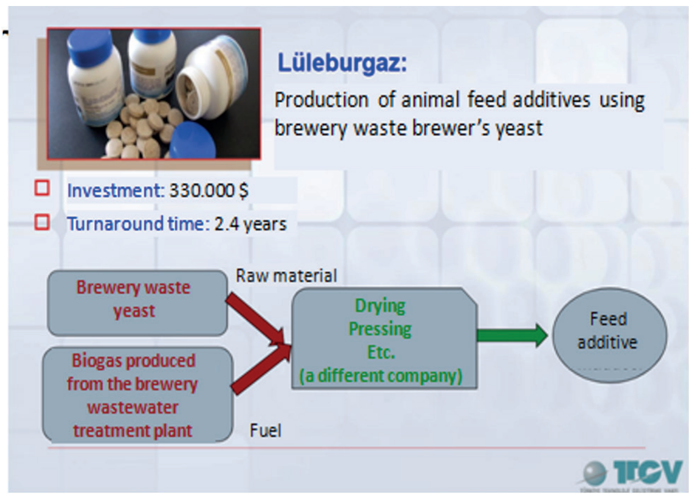
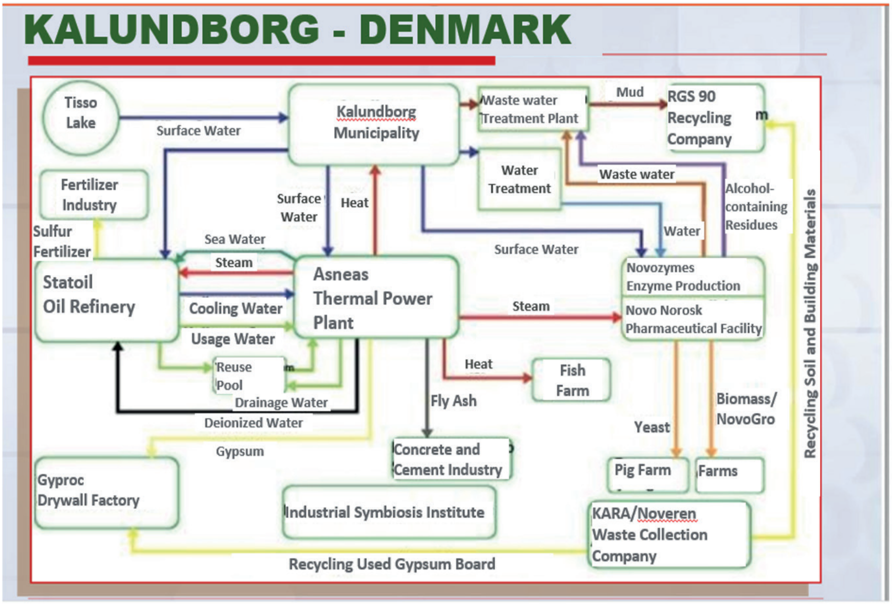


Figure 9: An exemplary Eco-Industrial Park - Kalundborg - Denmark



Thanks to the application in Kalundborg Eco Industrial park;

- 265,000 tons/year emission reduction,
- 3 million m3/year water saving (1-year water need of a city of 40,000 people)
- 15 million GJ energy worth process steam (annual electricity consumption of 75,000 homes)
- Gypsum gain equivalent to 15 million m_2/year gypsum wall
- Providing 60% of the total fertilizer need by converting 150,000 tons/year of biomass into fertilizer.
- Total earnings of more than 250 million USD

have been obtained (TTGV, 2013).

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TOOLS AND METHODS FOR ADAPTATION DECISION-MAKING MECHANISMS PROCESSES

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

1. TOOLS AND METHODS FOR ADAPTATION DECISION-MAKING MECHANISMS/ PROCESSES

Adaptation to climate change is a risk management strategy which is affected by various factors. Due to the fact that it is not possible to implement the adaptation actions for all of the climate effects; the adaptation actions must be prioritized based on the importance and necessity. For this reason, tools and methods for determining the climate vulnerabilities and climate resilience against the possible climate effects are often used during the process of decision-making for the climate change adaptation measures.

For the reason that there is no standard for the metrics that are used in the climate adaptation decision-making process; a wide range of metrics are being used which are expressed as numeric (quantitative) or non-numeric (qualitative) values. In addition to determining the adaptation necessities during the adaptation process; the metrics are also utilized for the purposes of evaluating the efficiency of the adaptation actions and to test whether or not the adaptation goals are achieved (IPCC, 2014a). Adaptation metrics vary depending on the subject that is intended to be measured, indicators and the properties of the data that can be used. It is possible both to use the known metrics in the decision-making process and to develop new metrics. Numeric metrics are generally preferred because they enable an evaluation based on comparison and periodization during the decision-making process (Prabhakar, 2014; Leiter and Pringle, 2018).

There is a consensus that there is a need for developing internationally accepted metrics which must define the data expressing a value in unit area and provide comparable results. Due to this reason, it is encouraged that the activity of the used metrics is shared in order to contribute to the development of the national and international adaptation policies and practices (Leiter and Pringle, 2018).

In this booklet, the methods which are used during the adaptation decision-making process have been explained with vulnerability analyses.

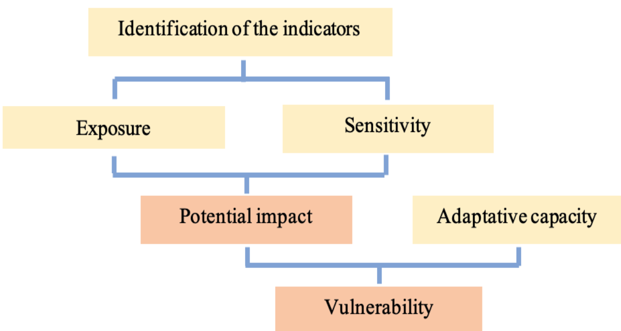
1.1. Vulnerability Analyses

Vulnerability is defined as the situation when a system is sensitive to the negative effects of the climate change, including the climate variability and extreme weather events, and its inability to cope with these. Vulnerability is a function of the character of the system, size of the system, the rate and the variability of the climate change, the sensitivity of the system in the face of the situation it is being exposed to and the adaptation capacity (IPCC, 2014b).

Vulnerability analysis is a method to define and prioritize the possible effects of the climate change. By this way, successful solutions against the climate effects can be developed.

Vulnerability analysis is comprised of four steps as defining the indicators, exposure, sensitivity and determining the adaptation capacity (Let`s respond toolkit, 2012) (Figure 1).

Figure 1: Climate Change Vulnerability Analysis Method



Source: US Climate Resilience (2019)

Identification of the indicators

The indicators are a list of the potential effects of the climate change and constitute the starting point of the vulnerability analysis.

Answer to the following question is sought at the stage defining the indicators:

- What are the fundamental impacts from climate change in this area?

The answers are given by a team with broad participation for the key sectors in this area (water, energy, natural resources, biodiversity, agriculture, health, coastal zones, city, transportation / infrastructure, disaster risk-management etc.). Draft lists of indicators can be obtained from the climate action plans or long-term adaptation strategies.

Some indicators determined for the city sector are shown in Table 1.

Table 1: Indicator examples for the urban sector

Sector	Indicator
City	Increased risk of natural fires Increased risk of spreading towards the urban fringes Increased risk of flood after rain Increased risk of heat island effect of the city

Defining the indicators enables the determination of the possible effects caused by the climate change which can occur in the respective area.

The indicators provide guidance to the analyses of the climate change and the processes of climate mitigation and adaptation. In case that the indicators are considered inappropriate for the study area or the sector; they can be altered. New indicators can be defined when needed.

Exposure Analysis

Exposure defines a situation of being exposed to an effect which is caused by the climate change. It is determined in the exposure analysis whether or not the effect will occur and an answer to the following question is sought:

- `Will this impact take place in this area? (Yes / No)

The most commonly used method for the exposure analysis is to create manual or web-based matrices. In the analysis process, answers are sought to the questions in the sensitivity column of the matrix on the basis of sectors (Table 2).

Table 2: An example of exposure analysis matrix

Sector	Indicator	Definition of the indicator	Exposure ques-tion	Answer to the Exposure Question (Y/N)
Urban	Area loss in the coastal landscapes	Rising sea-water lev-els and storm surge enhances the loss of lands in the coasts	Is area loss experienced in the coastal landscapes of this city?	

Source: An example of exposure analysis matrix

In order to ensure the correctness of the answer that is given to the exposure question, maps of the area and reports (the reports of long-term adaptation strategies and scenarios etc.) are examined and the information provided by the stakeholders are utilized.

The process relating to the example shown in Table 2 is provided below:

Answer to the following question is sought “Is area loss experienced in the coastal landscapes of this city? (Yes / No).

Answer 'Yes' is obtained after the evaluation of the stakeholders.

According to this answer, the coastal landscapes of this city are affected by the rising sea-water levels. This result is entered into the matrix. It is useful to take short notes such as 'on the North coastline of the city' into the next 'why' column in the matrix. The same is done for all the sectors and the effects listed in the matrix upon the common evaluations for the exposure analysis.

Sensitivity analysis is performed in the cases when the question of the exposure in the matrix is answered YES. When the answer is NO; it is decided that the said effect caused by climate change does not affect this area and it is ignored.

Sensitivity Analysis

Sensitivity means the degree of a system being affected positively or negatively from the situation it is exposed to, which is caused by climate change. The exposure can be direct (for example, the change in the agricultural product yielding based on temperature); as well as indirect (for example, the damages caused by the increased frequency of the overflows at the coasts due to the rising sea-water levels) (IPCC, 2014).

Sensitivity is a concept relating to the determination of the severity of the effect. In the sensitivity analysis; the sensitivity level of a field, a sector or an area is determined against the indicators of climate change.

An answer to the following question is sought in the sensitivity analysis:

- `What will be the severity of the impact if it occurs?` (Low / Medium / High)

There is not an existing standard method for sensitivity analysis. The method used most commonly is to create manual or web-based matrices. In the analysis process, answers are sought to the questions in the sensitivity column of the matrix on the basis of sectors (Table 3).

Table 3: An example of sensitivity analysis matrix

Sector	Indicator	Definition of the Indicator	Sensitivity question	Answer key for the sensitivity question	Answer to the sensitivity question (L/M/H)	Why?
City	Area loss in the coastal landscapes	Rising sea-water levels and storm surge enhances the loss of lands in the coasts	How severe would be the impact caused by the rising sea-water levels on the coastal landscapes?	Are there sections of the coastal landscapes that are lower than 5 m elevation? There are not or a small portion of the coastal landscapes-Low (< %10) some parts of the coastal landscapes -Medium (%10-15) a large portion of the coastal landscapes-High (>%15)		

Source: Let`s respond toolkit 2012

In order for the answers that are given to the sensitivity question to be quantitatively; measurable numeric values are determined for the classification of low, medium or high levels by taking the reports and scientific data related to the subject into the account.

process relating to the example shown in Table 3 is provided below:

The question to be answered is: “How severe would be the impact caused by the rising sea-water levels on the coastal landscapes?”

In order for the answer to be measurable; the impact of the sea level rise in the area is determined by numerical values. (< %10 -Low, %10-15 Medium, >%15 – High)

Upon the evaluation of the stakeholders:

It is determined that the loss of area due to the rising of the sea-water levels in the coastlines of the city is 12 %.

According to this answer; the sensitivity effect which will be caused by the sea level rise in the coastal areas in the city is determined to be medium-level by the stakeholders. This result is entered into the matrix. It will be useful to take notes such as “ratio 12 %” into the next 'why' level of the matrix.

The same is done for all the sectors and the effects listed in the matrix upon the common evaluations for the sensitivity analysis.

Potential Impact

Exposure and sensitivity together define the potential climate impacts. For example, when the heavy rain (exposure) comes together with the sloping lands with no vegetation cover on the surface (sensitivity) causes erosion (potential impact). The effects of climate change can form a chain of effects from the direct effects which range from the biophysical area to the social area (for example, erosion) to the indirect effects (for example, loss in the yielding, and decrease in income). All living creatures are directly dependent on the natural resources. There is a very strong connection between the biophysical effects of climate change, human activities and wellbeing (Konukcu et al., 2019).

Monitoring and Evaluation to Assess Adaptive Capacity

Adaptive capacity is the ability of a system to develop an adaptation against the potential effects which can occur due to climate change or other reasons (Brooks and Adger, 2004). The structural properties of the system can decrease the severity of these effects or changes in the system may occur which can adapt to these effects.

Adaptive capacity is related to the concepts of resilience and vulnerability. In the cases where the adaptative capacity is high; generally, the resilience of the system is also high and either the system is not harmed by the effects or the level of the occurring damage is low. When the adaptive capacity is low, the effects harm the system due to the fact that the resilience is low. The adaptive capacity can be property specific to the system or it can be built as a result of an intervention to the system.

For example; slopes with no vegetation cover are susceptible to erosion. For this reason, their resilience against the effects caused by the climate or the environment and their adaptive capacity are low. Soil loss due to the erosion occurs in these slopes during the precipitation, strong winds or construction activities. Vegetation of these slopes enables the plants to hold the soil by their roots and their parts above the soil. This small implementation increases the resilience and the adaptive capacity of the slopes, which decreases the risk of soil loss by erosion.

The adaptive capacity is affected by many factors including the ecologic resources, technological resources, financial resources, human resources (education) and social resources (cooperation and communication networks). For instance; having strong communication and information resources provides an information flow between the society and the authorities regarding the climate risks and the measures that can be taken. Flexibility is highly important for the adaption capacity. The level of flexibility of the system determines the extent to which the system will be affected by the climate risks (in which way and how severe) and how fast the system will recover. Flexibility is also related to the accessibility of the resources (money, manpower etc.) which can reduce the effects in case that the climate risks occur. Apart from these; the risks which occur due to the reasons which are not related to the climate, such as incorrect usage of fields or natural resources, can affect the climate adaptation capacity of the system in a negative manner (AG, 2006).

The adaptive capacity determines the implementations that the system needs in order to be able to cope with the climate risks and their costs. For this reason, it is expected that the systems with strong adaptation capacities will have solutions requiring less budget against the climate risks (AG, 2006).

Climate adaptation works aim to increase climate resilience by strengthening the adaptive capacity. The adaptive capacity is considered as a factor in the climate vulnerabilities analyses.

Analyses aiming to determine and evaluate the adaptive capacity can be performed in a wide range of scopes and extents, as the analyses of vulnerability. Natural resources, human factor, physical structure, economical structure and social components are among the variables in the indices which are used to determine the adaptive capacity against the climate effects (Nelson et al., 2010).

When the number of the variables and factors being used in the evaluation increases; the results are expected to be more accurate.

The following question is asked during the evaluation of the adaptive capacity:

- `Is there a system which can respond to the impact? If yes, what is its level? (Low / Medium / High)

There is no existing standard method to evaluate the adaptive capacity. The method used most commonly is to create manual or web-based matrices. Answers on the basis of sectors are sought to the questions in the columns related to the adaptive capacity of the matrix (Table 4).

Table 4: An example of adaptive capacity evaluation matrix

Sector	Indicator	Definition of the Indicator	Adaptive Capacity Question	Answer to the Adap-tive Ca-pacity Question (L/M/H)	Why?	Data source
City	Area loss in the coastal landscapes	Rising sea-water levels and storm surge in-creases the loss of lands in the coasts.	Is there a low, medium or high adaptive capacity which can respond to the loss of lands due to the rising of the sea-water?			

Source: Let`s respond toolkit 2012

The criteria which must be considered in order to be able to evaluate the adaptive capacity can be listed as (Let`s respond toolkit 2012):

- Scientific research. Have any scientific investigations been conducted which can be helpful for developing solutions to the potential effect of climate change?
- Policy. Is there any legal legislation, which can support the adaptation actions, in the area for which the solutions to the possible effects of climate change are desired to be developed?
- Institutional support. Are there any institutions or personnel which can participate and contribute to developing solutions for the potential effects of the climate change?
- Finance. Is there a budget which can be used for the preparation and implementation of the projects which are needed for developing solutions for the possible effects of the climate change?

Total value of the adaptive capacity is determined by a consensus among the stakeholders. Different components of the adaptive capacity are reviewed and the value of the adaptive capacity against the effect caused by the climate change is defined as low, medium or high.

A high value means that there are systems existing in the evaluated sector or the thematic area which can respond to the said effect caused by climate change. Medium value means that there are some systems which can respond to the said effect caused by climate change. For instance, there may be qualified personnel but not a budget. When the value is low, it means that there is a limited system which can respond to the said effect caused by climate change or there is no system at all.

The adaptive capacity evaluation process relating to the example shown in Table 4 is provided below:

The question to be answered is: “Is there a low, medium or high adaptive capacity which can respond to the loss of lands due to the rising of the sea-water?” The questions which are asked for this can be listed as:

- Are there any scientific publications investigating the effect of the rising levels of sea water on the coastal landscapes in this city?
- Is there any legal legislation that is directly or indirectly related to the coastal landscapes and the change in the sea-water levels?
- Is there any institutional support about the protection of the coast landscapes?
- Is there a budget that can be used for the activities of monitoring, control, and inspection, etc. regarding the coastal landscapes and the change in the sea-water levels?

The results obtained upon the evaluation of the stakeholders can be as:

- Coastal wetlands have been destroyed for the last 15 years in the coastal landscapes, in which loss of land is experienced due to the rising water levels. In the areas where the wetlands are not damaged; the rising water levels do not cause land loss.
- There is an investigation that studies the relationship between the change in the coastal landscapes and climate change.
- There is a limited budget for the implementation.

According to these answers, the stakeholders can determine the adaptive capacity as `medium`. This result is entered into the matrix. Taking short notes such as 'intact/unharmed wetland systems' into the next 'why' column of the matrix can be useful for the purposes of explaining the reason of the evaluation and to inform the stakeholders reviewing the reports.

The same is done for all the sectors and the effects listed in the matrix during the process of the monitoring and evaluation of the adaptive capacity.

Adaptive capacity evaluation is performed in cases where the question related to exposure is answered as 'yes' in the matrix belonging to the risk and vulnerability analysis, whereas; the question related to the sensitivity is answered as 'medium' and 'high' (Let`s respond toolkit 2012).

If the question related to exposure is answered as 'no' and the question related to the sensitivity is answered as 'low'; it is decided that the effect caused by the climate change is not significant in the said sector or the thematic area and this effect are ignored.

The success of the monitoring and evaluation process of the adaptation capacity can vary depending on the correct identification of local properties, the consistency of the selected evaluation methodology and the efficient representation of each of the respective stakeholders in the process.

2. MONITORING AND EVALUATION OF THE ADAPTATION ACTIONS

In order to decide whether the adaptation actions have succeeded or not, they need to be monitored and evaluated at certain intervals. Adaptation is a dynamic learning process that is affected by many factors. Monitoring and evaluation contributes to the improvement of the adaptation process via feedbacks and enables that the adaptation endeavors at national and international scale are supported by the information sharing and it also promotes evidence-based learning.

In the fourth evaluation report by IPCC; it is emphasized that the monitoring and evaluation of the solutions which are developed for the purpose of adaptation is a must for the creation of the adaption capacity (Adger et al., 2009).

Monitoring and evaluation are independent processes that are used together in order to determine the efficiency of an adaptation action (whether it succeeded or not). Monitoring aims to determine to what extent the adaptation actions have achieved the predetermined goal while evaluation aims to determine the efficiency of the implemented adaptation actions on the climate adaptation and achieving climate resilience (Quinn Patton, 2011).

Although the period for monitoring and evaluation can vary depending on the adaptation types and scope; it can be planned as periods of 3 - 6 months or 1-2 years. The questions asked in the monitoring and evaluation can be listed as (GIZ, 2011):

- Have the goals (short, medium and long term) of adaptation been achieved? Have the ecologic, social and financial vulnerabilities been reduced?
- Is the process being managed successfully?
- Are the adaptation process and the investments transparent?
- Were there any unanticipated problems faced in the process?
- Should the process be continued?

Monitoring is generally performed by teams responsible for the planning and the implementation of the adaptation action. On the other hand, evaluation can be performed by a team that includes the planners, implementers and beneficiaries (direct or indirect) such as international representatives of the societies, multinational organizations, EU supervision agencies, government institutions, scientific institutions, national/ regional/ local commissions, non-governmental organizations and the individuals in the society (GIZ, 2011).

The characteristics of the climate change (for example, determining the effects by estimations (that there are ambiguities), the climate change having a non-linear pattern and effects being spread to a long period), aggravates the monitoring and the evaluation of the climate adaptation actions (Quinn Patton, 2011).

Qualitative and quantitative methods and approaches that will be used in the monitoring process are determined based on the action to be evaluated. Each method has its own strengths and weaknesses compared to the other. Some of the adaptation actions have a complex structure. In this case; using integrated methods that can account for many factors at once might be better to use instead of the basic monitoring and evaluation methods (Dinshaw et al., 2014). Some monitoring and evaluation methods are shown in Table 5 whereas examples of methods that are used for the basic, medium level and complex adaptation actions in Table 6.

Table 5: Examples of relevant monitoring and evaluation methods and approaches

Monitoring and evaluation approaches	Examples
Overall monitoring and evaluation approaches	Improvement evaluation, life-cycle evaluation, effect evaluation and institutional learning
Formal social science methods	Questionnaires, focus groups and interviews
Econometrics/Statistics	Modeling, statistical analyses, deterministic baseline, normalization
Experiment-related methods	Case studies, experimental design, propensity score matching, regression analysis, purposeful sampling
Participatory methods	Most significant change analysis, beneficiary monitoring, limiting analysis, outcome map-ping, recall techniques
Iterative methods	Sequential targeting, result-based monitoring, contribution analysis, scenario building, gradual references, re-structures references, rolling baselines

Source: Dinshaw et al., 2014

Table 6: Examples of monitoring and evaluation methods and approaches which can be used for different adaptation actions

		Especially Implemented			Especially helps				
	Methods	Simple	Complicated	Complex	Attribution	Baseline values	Long time horizons	Accountability and Learning	Examples
Overall monitoring and evaluation approach	Developmental Evaluation			X			X		
	Impact Evalua-tion	X	X		X				
	Longitudinal Evaluation		X	X	X		X		Report titled OECD DAC on donor gender mainstreaming; Sida evaluation of its support Vietnam, Laos and Sri Lanka
	Institutionalized Learning			X					`USAID Uganda's Col-laboration, Learning and Adapting (CLA) Plan: National Health System (NHS) in the United Kingdom`
Formal social science methods	Surveys		X	X		X			Through extensive sur-veying a crisis narrative for the 2008 food and finance crisis was created
	Focus group interviews		X	X	X			X	Evaluation of the land use change by different methods
	Individual interviews		X	X	X	X		X	Evaluation of the land use change by different methods

		Especially Implemented			Especially helps				
Econometrics and Statistics	Modelling	X	X				X		Idaho (USA) Lower Red River Meadow Restora-tion Project
	Statistical Analysis	X			X	X	X		Idaho (USA) Lower Red River Meadow Restora-tion Project
	Stochastic baseline					X			Food and Agricultural Policy Research Institute (FAPRI)
	Deterministic baseline					X			Food and Agricultural Policy Research Institute (FAPRI)
	Normalisation		X			X			Evaluation of the Com-petitiveness of EU Na-tions and the Structural Changes

Source: Dinshaw et al., 2014

Adaptation monitoring and evaluation reports contribute significantly to the improvement of the process due to the fact that they include both the successful and deficient aspects of the implemented method and the applied process. In addition; these data have a guiding value for the similar works and they have significance in terms of the success of the adaptation endeavors in the future.

The first monitoring and evaluation is performed with the aim to determine the current situation before taking actions for the adaptation or implementation. This way; the baseline values are determined. Values which are obtained by the other monitoring activities during the process are compared with these baseline values and the success of the adaptation actions is determined.

The success of the adaptation actions can be classified by using various rating systems (for instance, plausible/reasonable, appropriate, efficient, effective) (McDowell, 2016). In cases where the results show that the goals are not met; the adaptation actions are revised by going back to the earlier stages of the adaptation process. If the identified goals are not met in the adaptation actions; an inconsistency (maladaptation) might occur.

Managing the process in a transparent manner, the monitoring and evaluation data being accessible, the said data being regularly shared in the national and international platforms strengthen communication network of the adaptation process in addition to supporting the adaptation policies and programs (Bours et al., 2013).

The data and the experiences obtained during the monitoring and evaluation process provide guidance with regards to measures which can be taken about the prevention of the inconsistency and the achievement of the adaptation goals, when used for the purposes of research and learning. In addition, they also provide scientific evidence against the opinions claiming that the issue of climate adaptation has started to become a superficial subject and it has turned into some sort of window-dressing action in order to provide funds to the (Bours et al., 2013).

Problems that are often encountered during the monitoring and evaluation process are as follows;

- there is no standard evaluation method,
- difficulties encountered when determining the baseline values,
- the time period which is required for the benefits from the adaptation actions being too long,
- the difficulty to determine the internationally accepted metrics,
- the difficulty to define the benefits among the sectors,
- the fact that the fundamental concepts are defined in different manners (Christiansen et al., 2016; Dinshaw et al., 2014; Bours et al., 2013).

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SECTOR SPECIFIC ADAPTATION STRATEGIES: HEALTH

Prof. Dr. E. Didem Evci Kiraz

The word "adaptation" in the sentence "to adapt to climate change" has synonyms in Turkish such as agreement, agreement, order, consistency, livelihood, adaptation (TDK,2019). Is it easy to make an agreement with climate? It looks difficult to be friends with climate with the burdens listed below that are human made environments.

- Population and migration movements
- Urbanization
- Industrial revolution
- Greenhouse gases
- Agricultural activities
- Irrıgation practices
- Interventions on surface waters
- Energy consumption
- Economic approach
- Transportation
- International trade

When the subject is human health, it is necessary to consider the disease burden to be brought about by climate change. Disease burden is one of the health indicators. To measure the disease burden, the following criteria are used: Disability Free Life Expectancy; DFLY, Healthy Life Expectancy; HALE, Disability-Adjusted Life Years; DALY, Healthy Life Year, HeALY, Disability Adjusted Life Expectancy; DALE and Quality Adjusted Life Years; QALY. It is estimated that the direct damage costs of climate change to health will be 2-4 billion dollars by year 2030 (WHO, 2018a).

In public health, decisions cannot be made without measuring and the health system cannot be managed without measuring. Following can be used to measure the health effects of climate change:

- To mitigate the expected health effects, to be ready for the unexpected
- Flexible, short and long term targets, strategies and action plans

- Planning with focus on determinants of health
- Tele-epidemiology
- Research point of view that can change at the same speed as the climate
- Blending of scientific and institutional approaches will facilitate the adaptation.

In public health, decisions cannot be made without measuring and health system cannot be managed without measuring. Following can be used to measure the health effects of climate change:

1. Measurement values of effects of climate change
2. Among the measured values, data on health consequences caused by values above the limit value, where adverse effects on human health occur
3. Data obtained from “early warning” systems
4. Multiple analysis results were obtained from past data and data for the future.

It is required to establish the early warning systems mentioned at the third article at regional and especially local levels (city, neighborhood, housing complex, residence levels); not over the world. Only the system is not enough; the complementary elements of the system as listed below must also be developed:

- To generate science
- Efforts to increase the awareness and knowledge level of the individuals and the society
- Trainer training courses supported with social communication networks, using methods such as peer training
- Sharing the emerging evidences and education materials
- Combination of theoretical information and the evidences

In Turkey, there is a “Health Threats Early Warning and Response Department” under the Ministry of Health, Public Health General Directorate. The Ministry of Health has the necessary infrastructure to determine the early warning components related with health effects of the climate change and to take action. According to WHO report, it is required to reach the capacity to manage the data collection, analysis, evaluation, monitoring, early warning and stakeholder mobilization processes.

In USA, in addition to changes in individual behaviors, it is recommended to make early warning systems, extreme temperature emergency action plans and management plans for temperature-related diseases in the general public. The study conducted in Aydın, Turkey is exemplary in this regard (Diliüz Doğan & Evci Kiraz, 2016). In a study conducted in 33 EU-member countries it was investigated whether they have early warning systems against hot airwaves. It was seen that there were early warning systems against hot airwaves in 12 countries (HHWS, 2016).

There are scientific evidences on subjects such as causes of diseases, diagnostic methods, treatments, etc. and evidence pools in which they are collected. They are available in platforms such as Pub-Med and Google academic and evidence pools such as Cochrane library.

In addition to scientific study data, there are also social evidences:

- decisions made by decision-makers
- legislation changes
- guides
- local and national practices
- responses to international practices
- decision taken at the housing complex, neighborhood, city level
- response and participation of the public
- response of the community, methods of individual's reactions to events, etc.

However, as there is no "social evidence pool", reflections of actual events such as effects of climate change, their individual and social consequences, health effects and social assessments for the future are only found in news headings and memories. Events that cause emergency situations in health such as climate change give the permanent change signals on individuals, families, work life and society. These dynamics in the society, the experiences and narratives that accumulate every day must be collected as social outputs. Like "early warning systems", social evidence pools" are key issues for the future. The social evidence pool approach has not been structured yet. When the literature is examined on this subject, it is seen that there are not many studies except for collection of social system evidences for evidence-based social study-policy approaches and sustainable development goals (NASW, 2020). The book "Silent Spring" written by Rachel Carson can be considered as a mini social evidence pool example that tells about the events related with DDT (Carson, 2004).

Climate change and health relation began to come to the agenda of the Intergovernmental Panel on Climate Change (IPCC) and WHO assessments in the 1990's. It was defined as an area that has a possibility of developing that must be focused on. When 1990-92 assessments of IPCC are examined, it is seen that the first sentence under the heading of "Human Health" is "the adaptation capacity of humans to climate conditions is very high" (IPCC, 1992). This is one of the places where "adaptation" is emphasized for the first time in the relation of climate change and health. In IPCC 2001 report, adaptation options are summarized according to health effects in a simple and understandable manner (Table 1) (IPCC, 2001). When the options are examined, it is seen that methods that are considered classic are still valid. It is clear that adaptation is possible without advanced technologies.

Table 1: Adaptation Options to Mitigate Health Effects of Climate Change

Health Effects	Legislations	Technical Information	Training Consultancy	Culture, Attitude and Behavior
Thermal Stress	Development	Residence, Government Buildings, City Planning to Reduce Heat Islands, Acclimatization	Early Warning System	Clothing, Noon Sleep/ Break
Extreme Weather Events	Planning Development Immigration Economic Incentives	City Planning Storm Shelters	Early Warning System	Using Storm Shelters
Air Quality	Emission Traffic	Public Transport, Catalytic Converter, Factory Chimneys	Pollution Alert	Car Sharing
Vector-Borne Diseases		Vector Control Immunization, Protective Covers Sustainable Surveillance, Protection and Control Programs	Health Education	Water Storage Practices
Water-Borne Diseases	Basin Protection Water Quality	Genetic/ Molecular Monitoring of Pathogens Improvement of Water Treatment Improvement of Sanitation	Boiled Water Alert	Hand Washing and Other Hygiene Behaviors Use of Cesspool

World Health Assembly stated in its new climate change and health decision in 2008 that;

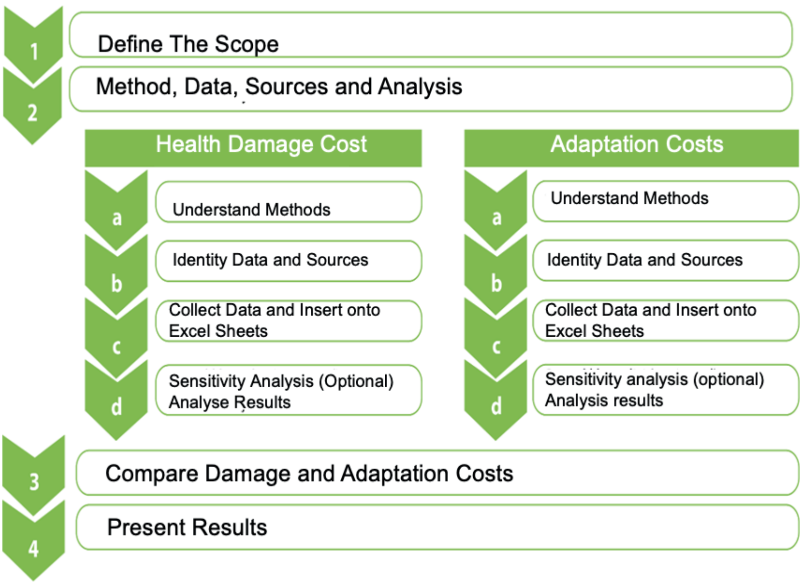
- Health sector must focus on protection of human health against climate change at the highest level

- To achieve the millennium targets and equality in health solutions must be produced covering global health risks including the climate change
- Awareness of all parties must be increased, cooperation must be developed, capacity must be enhanced
- National health sector must be mobilized, digital data must be collected, monitoring and adaptation works must be carried out
- Public health leadership must be ready to provide rapid, comprehensive responses
- Interdisciplinary and intersectoral works must be accelerated (WHO, 2008).

WHO and UN Development Program (UNDP) introduced in 2010 the first global program for public health adaptation to climate change that was implemented with ministries of health and other related bodies and organizations in Barbados, Bhutan, China, Fiji, Kenya, Jordan and Uzbekistan. Early warning systems are included among its fields of activity (WHO, 2019a).

WHO developed a method to estimate the adaptation costs in the field of climate change and health (WHO, 2013).

Figure 1: Climate Change and Health: A Tool to Understand Health and Adaptation Costs



Source: WHO, 2013

"Seven Countries Initiative" reported in 2010 and 2013 is a program executed for the purpose of protecting human health from climate change by WHO Europe Regional Office, German Federal Environment Ministry, Nature Protection and Nuclear Safety in Albania, Kazakhstan, Kirgizstan, Russian Federation, Tajikistan, Macedonia and Uzbekistan. The program covers adaptation to climate change, strengthening the health system and structuring the institutional capacity (WHO, 2020).

Among other climate change and health adaptation programs, there are the following projects which are given in detail on page http://www.who.int/globalchange/projects/en/.

- Bangladesh, Nepal and Tanzania, 2013-2018, "Adaptation of Health to Climate Change by Making Water, Sanitation and Hygiene Arrangements in the least Developed Countries", supported by UK International Development Unit
- Rehabilitation of Health Systems in the Least Developed Countries at Pacific
- Climate Practices Global Framework Adaptation Program in Africa
- Adaptation of Health Sector to Climate Change: Participation, Evidence and Action in Six Sub-Sahara African Countries
- Norway "Creating Sustainable Health System: Focusing on Rapid Recovery against Climate Effects"

Dr. Joy Shumake-Guillemot (WHO-WMO Joint Office for Climate and Health) called the title of the presentation he made in December 2014 at International Climate Services Conference in Uruguay as "Building Health Resilience to Climate Risks". In this presentation he stated that there are national health adaptation plans in approximately 115 countries.

According to a scientific article published in 2015, Canada Public Health Adaptation Classification in Climate Change can be summarized as follows (Austin et.al., 2015):

- Capacity development
- Management, Planning and Policy Making
- Implementation and Behavior
- Information
- Warning and Observation System
- Security Flaw/Vulnerability Assessment

In another article of the same author dated 2016 that deals with public health adaptation to climate change in OECD countries, the first three risks considered as the health risk related with climate change in OECD countries are listed as general health risks, contagious diseases and temperature-related diseases (Austin et.al., 2016). The adaptation mechanisms for these risks are similar to the example of Canada.

In adaptation mechanisms for health risks of climate change in OECD countries, the infrastructure works take the first place, followed by adaptation works in the second place. Adaptation works are similar to the example of Canada. Adaptation works in the countries listed from the most observed to the least observed are as follows:

- 1st place: Capacity development
- 2nd place: Information
- 3rd place: Management, Planning and Policy Making
- 4th place: Warning and Observation System
- 5th place: Implementation and Behavior

In the 24th Conference of Parties (COP24) held in 2018 WHO shared a historical document: COP24 Special Report: Health and Climate Change (WHO, 2018b). The most important section in the special report that attracts attention is the package of seven recommendations and lists the requirements for adaptation:

- Recommendation 1. Identify and promote actions to reduce both carbon emissions and air pollution, with specific commitments to reduce emissions of short-lived climate pollutants in accordance with the decision in Paris Agreement

- Recommendation 2. Including the health implications of mitigation and adaptation measures in the design of economic and fiscal policies,
- Recommendation 3. Guaranteeing the health
- Recommendation 4. Removing existing barriers to investment in health adaptation to climate change, especially for climate-resilient health systems
- Recommendation 5. Increasing advocacy of health sector in climate change activities
- Recommendation 6. Mayors and other subnational leaders putting priority on health in their climate change approaches
- Recommendation 7. Establishing system for regular tracking and reporting of health results in the process of adaptation to climate change

WHO presented a global investigation report in COP25 (WHO, 2019b). WHO Health and Climate Change Investigation Report covers the 2017/2018 results. Its main findings are summarized below:

- Scope of the strategies and plans must be strengthened
- There are problems related with basic health and climate change priorities
- Forty-eight countries (48 of 101) reported that they conducted security flaw and adaptation assessment for health. Approximately two-thirds of these countries indicated that the assessment results are used for national health policy and planning. However, results have limited effect on the allocation of financial and human resources.
- There are obstacles for access to international finance for adaptation and mitigation in health
    - Lack of information,
    - Lack of interest of actors,
    - Lack of preparation-capacity
- Although multi-sectoral cooperation is evident in health and climate change policy, the progress in this field looks irregular among the sectors

- Cooperation with the health sector on health and climate policy is at the highest level in
    - Water, sanitation and wastewater sector (45 of 101)
    - Agriculture (31 of 101)
    - Social services (26 of 101)
- There is an agreement between the health sector and transportation, electric generation or household energy sectors in one fourth of the countries or less

Country profiles are presented at the appendix of the report published by WHO. Climate change and human health profiles of 49 countries have been published since 2015.

The progress made by the world countries regarding climate change and adaptation works in health is summarized in this text. It appears that it would be useful to classify the countries as "countries resistant to climate-not resistant to climate" regarding the responses provided by the countries to climate change and also classify them as "countries with public health adaptation plans – without public health adaptation plans". Cities and sectors established in cities are under risk in countries. One of these sectors is the health sector. The health sector will find the way to increase its resilience with a public health point of view.

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SECTOR SPECIFIC CLIMATE CHANGE ADAPTATION STRATEGIES: TRANSPORTATION

Prof. Dr. Cem Soruşbay

1. INTRODUCTION

The increasing effects of climate change globally resulted in mitigation policies and practices put into force. Globally effective mitigation measures generally include strategies with long-term results and their effects extend over a long period of time. If greenhouse gas emissions are completely limited, even if the amounts discharged into the atmosphere by various sources are reduced to very low values, the effect of the existing greenhouse gases in the atmosphere will continue. For this reason, it is imperative to adapt to the negative effects of climate change, take measures and develop strategies. In addition, adaptation activities are activities its results can be seen in the short term and benefit locally.

Studies aimed at reducing the negative effects of global climate change are generally defined as adaptation studies. Climate change adaptation process is a process in which strategies are developed, implemented and the results are evaluated in order to determine the effects of climate events and to reduce the level of vulnerability to these events, to increase resistance to risks and to manage risks.

Adaptation actions and policies made specifically for climate change do not include approaches to prevent risks arising from climate change, but generally include approaches to reduce negative consequences and possible damage levels. From the perspective of the transportation sector, society and institutions should be more conscious and prepared, appropriate development of vehicle / equipment technologies, improvement of infrastructure investments, realization of planning in accordance with the climate, etc. shall come to the fore. In this process, the costs of adaptation studies should be taken into account in determining the strategies and dynamic processes should be defined.

Actions taken against climate change previously focused on mitigation strategies and measures to reduce greenhouse gas emissions have been implemented. However, in the following years, in the IPCC 4th Assessment Report, it was emphasized that the economic cost of reducing greenhouse gas emissions and taking adaptation measures would be much lower than the cost of the damages caused by climate change (IPCC, 2007).

Climate change causes an increase in land and sea temperatures, change in precipitation amount and frequency, rise in sea levels, increase in coastal erosion risk, increase in natural disasters and these changes affect agriculture, health, tourism, industry and transportation sectors. While these negative effects can be seen globally, they make their effects felt even more prominently in some regions and cause negative effects in economic and social terms.

Transport is recognized as one of the main components of life quality. Sustainability of natural resources and energy resources, prevention of environmental pollution, economic concerns and ensuring service quality are determinants in the formation of transportation policies. Ensuring the efficiency of transportation in daily life is important in terms of increasing the quality of life and ensuring the happiness of individuals.

Since the transportation sector is a resource that contributes to greenhouse gas emissions, it requires various measures to be taken in terms of reduction. However, since it is also affected by the negative effects of climate change, adaptation studies are also important in terms of mitigating these effects. In these studies, integration with the applications on reduction is also required.

Services in the transport sector are under the influence of different sectors. In addition, natural disasters caused by the effect of greenhouse gases resulting from activities in different sectors, severe climatic conditions and their adverse effects affect transportation negatively. For this reason, integration between mitigation and adaptation strategies is as important as horizontal integration on sectoral basis and vertical integration between sectors in action plans.

As a result of climate change increasing land and sea temperatures, changing the amount and pattern of rainfall, the risks of global average sea level rise and coastal erosion are also increasing, and the severity of weather-related natural disasters is increasing. Changing water levels, temperature and flow rate affect many sectors such as agriculture, food and water supply, health, industry, tourism, transportation and affect the ecosystem. In some parts of the world, the negative effects of climate change are more pronounced and more frequent.

Due to extreme climatic events, the infrastructure sector is affected especially in big cities, difficulties arise in transportation, energy, food and water supply, and this situation poses a separate threat in settlements with densely populated population (IMM et al., 2018 a).

It is also important that the transportation system infrastructure is affected when there is an increase in sea level due to the effects of climate change in large coastal settlements.

Therefore, strategic and long-term approaches are required in planning studies for land and sea areas, including transportation, infrastructure, agriculture, industry, tourism and energy sectors.

2. STRATEGY DEVELOPMENT

Efforts on adaptation to negative effects of climate change and intensive efforts on mitigation are increasingly important all over the world. Planning adaptation activities, initially vulnerable sectors are prioritized by conducting vulnerability analysis at regional, national and sectoral levels.

While preparing the national climate change adaptation strategy, the following steps should be followed respectively;

- Conducting Current Situation Analysis, determining the effects of climate change and vulnerable areas, and collecting relevant data,
- Assessment of Existing Infrastructure related to training, awareness and capacity building required for adaptation,
- Conducting the Vulnerability Analysis at the local level,
- Making Adaptation Plan with Model Study,
- Strategy Development

While analyzing the current situation, a temporal and spatial reference point should be defined and comparison should be made while evaluating the developments provided in the next stages. For this reason, measurable and clearly identifiable data should be presented on the time period, the area evaluated, the magnitudes examined etc. Based on these data and defining target values, the developments achieved should also be expressed numerically.

The type and extent of exposure of a system to the adverse effects of climate change, its sensitivity to this exposure, how it is affected and the capacity to cope with it are defined by the concept of "vulnerability" or "fragility".

There are many studies on mitigation and adaptation towards climate change in our country. However, an operational plan is required in order to plan and monitor these in a coordinated manner. Accordingly, national strategy documents and adaptation plans were prepared (TC Ministry of Environment and Urbanization, 2011a)

Main strategic documents defined national policy in this regard have been prepared due to the fact that Turkey is located in a sensitive region to climate change;

- National Climate Change Strategy (2010- 2020)
- National Climate Change Action Plan (2011 – 2023)
- National Climate Change Adaptation Strategy and Action Plan (2011 – 2023)

In addition, 11th Development Plan (2019-2023), Development Plan - Transport Specialization Commission Report (2018), National Communication Reports based on the UN Framework Convention on Climate Change, Action Plans prepared by local administrations and Action Plans prepared on a sectoral basis, also exist.

The National Adaptation Strategy and Action Plan has defined the vulnerability areas from climate change in five main groups, and adaptation strategies have been determined for each sector (TC Ministry of Environment and Urbanization, 2011b);

- Water Resources Management,
- Agriculture and Food Security,
- Ecosystem Services, Biodiversity and Forestry,
- Natural Disaster Risk Management and
- Human Health

In this context, excessive precipitation and flood events, heat waves, excessive wind and cyclones, erosion etc. effects also affect the transport sector. Within the scope of adaptation studies, it should be ensured that the impacts of climate change are determined, minimization of negative impacts, preparation against impacts, resistance mechanisms against risks and damages are established at the lowest cost, solutions are produced for the problems that occur and some impacts are turned into opportunities.

Transportation systems must be designed in accordance with local weather conditions and climate. In general, systems are designed by taking into account extreme weather conditions, based on information based on past experiences and data on this subject. However, data obtained in the past as a result of climate change may lose their validity. The increase in greenhouse gases in the atmosphere also increases the negative effects of climate change over time. For this reason, the best, worst and average case projections are required for the future by developing various scenarios.

Airports, which have an important place in passenger and freight transportation in the country's economy, are first affected by extreme climatic conditions due to their fragile structures and air transport is interrupted. Therefore, it is important to restructure air transportation systems in a way to adapt to the risks brought about by climate change. Extreme temperature changes, frost etc. design of runway and early warning systems to reduce the effects, development of drainage systems that will quickly remove the water brought by excessive rainfall from the runway, designs that can prevent electronic runway hardware malfunctions caused by extreme heat waves, etc. and similar applications can be counted among the examples on this subject.

Railway transportation is also becoming increasingly important in our country and in the world. This system is also affected by extreme heat waves and deformation occurs in the rails. In addition, weather conditions, floods and overflows affect the rail system and railway bridges and pose a risk. In this sense, adaptation studies will require different standards in the design of the system.

Road transport (92.9% of energy consumption in the Transport Sector, 2016) has an important part of the transport load in our country and in the European Union. In order to maintain uninterrupted life, intercity and urban transportation should be provided without interruption and therefore the risks caused by weather conditions should be controlled. Improvement of highway infrastructure that will prevent the effects of precipitation and extreme temperatures, providing protection with tunnels, floating or raised roads in critical regions, building preventive walls to reduce the effects of excessive rainfall, putting into practice drainage systems and removing some roads from risk areas when necessary can be listed among the application examples. Especially the existing infrastructure in the risk zones such as stream beds, coastal areas etc. should also be redesigned.

The first step in combating the effects of climate change is to determine the situation and collect data within time frames, and to define the necessary measures after analyzing these data. This is a continuous and dynamic process and action plans should be reassessed taking into account changes over time.

In order to make good use of the available resources, the economic aspect of combating climate change should also be taken into account. In this context, insurance and contingency plans are required.

3. ACTION PLAN

The action plan generally includes capabilities in mitigation and adaptation in the transport sector. Flood, storm and extreme weather conditions caused by climate change have a significant impact on the transportation sector. The action plan should be made by taking these issues into account, but a dynamic approach should be followed, taking into account both the changes in these conditions over time and the changes in the infrastructure of the transportation system and vehicle technologies. The action plan should be renewed in certain periods by reviewing the conditions.

Considering the stages defined in the strategy development process and raising awareness about the issue socially and institutionally can be considered as the first step of the action plan. In addition to the adaptation studies on some technical issues in the transport system, the users of the system also need to adapt their behavior to these changes. It is important to raise awareness among the public. Therefore, this process is an educational process that requires the society to change some habits.

Harmonization studies for the transportation sector will be carried out by identifying risks and vulnerabilities according to regional characteristics. Risk analysis should be performed by evaluating possible climate effects locally. For this, in addition to national strategies, strategies for the region should be established (IMM et al., 2018 a and b).

Keeping the development and growth in existing residential areas away from risky areas is among the adaptation efforts. This issue becomes important when evaluated in terms of Benefit-Cost.

We can list the steps here as eliminating the danger arising from natural disasters, making additional applications to protect the system and adaptation in the transportation system.

Figure 1: Transport Infrastructure Affected by Heavy Rainfall in Istanbul (2017).

Resource: İBB et al., 2018 b

External applications such as creating additional walls or developing drainage systems against flooding are carried out to protect the system. Design improvement in the infrastructure of the transportation system, different material development studies, planning of emergency routes, etc. can be defined as the adaptation in the transportation system.

In the adaptation of the infrastructure, it is necessary to plan high-risk areas and to create appropriate safety regulations for these regions. For example, in areas with high risk of being affected by floods or storms, the pavement structure, water channels, the features of the billboards on the roadside, the arrangement of the vegetation and trees should be done according to appropriate standards.

The standards valid in the design of the transportation infrastructure according to different climate change scenarios should also be arranged for the creation of systems resistant to the risks of climate change. For example, regional conditions should be taken into account in the design of the drainage system or the design of bridges and buildings.

Systematic recording of regional climate data and their effects on the transportation system and creating a large archive provide significant benefits in making the right strategic decisions. In addition, the use of early warning systems is also important in risk management.

Another approach within the scope of adaptation studies is the development of risk protection mechanisms through developments in vehicle technology, definition of new standards, application of new materials and integration of electronic systems. For example, information obtained from the communication between vehicles and early warning systems will manage risk.

In addition to the problems caused by climate change, issues such as increasing traffic density, decreasing natural resources, budget constraints, increasing fuel costs, increasing travel requirements, safety issues gaining importance, meeting some road features required by autonomous vehicle technologies require the improvement and reorganization of road infrastructure. Various projects are carried out within the European Union in this regard (FEHRL, 2019). In these projects, it is aimed at ensuring improvement in such issues as security, economy, comfort and service quality increase in transportation through adaptation studies.

Figure 2 shows an example of a project study involving road infrastructure that adapts to extreme weather conditions and where the early warning system and risk prevention systems are activated in risks such as flood, snow, icing, wind speed and temperature changes. This road system is also designed to communicate with vehicles in motion.

Figure 2: Vehicle Technology and Highway Infrastructure that Adapts to Risks Arising from Climate Change.

Resource: FEHRL, The Resilient Road, 2017

Climate change has direct impacts on transport infrastructure and during operation. These effects can generally be described in three different categories: effects of climate on system infrastructure, negative effects on coastal areas and effects of climate during operation.

Operation of transport systems is sensitive to climate. Fog, rain, snow, icing, extreme weather movements make transportation difficult and increase the risk of accidents. The frequency and intensity of natural disasters such as short periods of severe air movements, tornado, storm, flood, hail, etc. are also of great importance in terms of safety in transportation. Therefore, costs in the design and maintenance stages of the system in transportation are affected accordingly.

In transportation, operating costs are also sensitive to ambient temperatures. In extremely hot or cold environments, the energy consumption of vehicles is affected, and the additional energy consumption required in heaters and air conditioners increases to ensure comfort. In addition, additional energy consumption due to temperature increase has a negative impact on local vehicle emissions such as CO, HC and NOx, as well as greenhouse gases.

Among the first measures in the transportation infrastructure, the removal of transportation systems such as highway, railway, etc. from risk areas comes the first within the scope of adaptation to climate change. In addition, reorganization of design criteria and strengthening of the system, especially in public transportation systems, is important. Isolation of the system to ensure the normal operation of the transportation system in events of flood, heavy rainfall and flooding etc., strengthening of drainage systems to remove water from the environment, design of preventive walls, etc. are required.

Measures such as keeping backups that can be activated in emergencies in the transportation system, strengthening maintenance and repair services and gaining skills to accelerate the response, etc. are also implemented.

These approaches have different economic, social and environmental consequences. Since the activities related to climate change in the transportation sector have been limited to mitigation for many years, there is still some lack of experience globally on matters such as mitigating the risk of scenarios and projects regarding adaptation, strengthening the transportation infrastructure, determining cost-benefit analyzes, etc. The fact that the risks on transportation systems change mostly according to local conditions and the lack of a general solution to the problem also increases the difficulties in combating climate change.

Adaptation includes studies to reduce the size of possible damages. This is a continuous process and adaptation must be provided according to the changes. While evaluating the benefits of compliance studies for risk management, the predicted value of the loss to be avoided should be compared with the actual costs of the adaptation strategy.

4. CONCLUSION

Measures to be taken against climate change are carried out within the scope of interrelated mitigation and adaptation studies in general. Regarding mitigation, different approaches are carried out on sectoral basis, and significant benefits are provided by measures such as the implementation of new vehicle and fuel technologies in the transportation sector, activation of public transportation systems, etc. In general, fuel consumption should be reduced in order to achieve a mitigation. However, unlike other sectors, it is difficult to achieve the targeted values in terms of reduction due to the increase in energy consumption brought by the increasing population and transportation needs based on the increasing population and the increase in the welfare level of the society. Therefore, adaptation to climate change becomes even more important in the transportation sector.

In addition to national strategies, it is important to take into account the different conditions at the local level due to the special conditions prevailing in certain geographies and to develop adaptation plans accordingly.

In order to increase the adaptation capacities of communities in geographies that are dependent on natural resources and are open to the effects of climate change, and to reduce risks, action plans should be developed based on knowledge and data based on past experiences. In such cases Community Based Adaptation approaches should be applied in addition to national plans. This approach will gain importance for the transport sector in coastal areas and regions prone to extreme climatic conditions.

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SECTOR SPECIFIC ADAPTATION STRATEGIES: CONSTRUCTION AND INFRASTRUCTURE

Prof. Dr. Erdem Görgün

1. INTRODUCTION - WHAT IS ADAPTATION?

Over the past 100 years, the global climate has warmed by an average of 0.5 ° C, partly due to greenhouse gas emissions from human activities. The " Impact of Climate Change on Water Resources Project ", which was commissioned by the Ministry of Agriculture and Forestry General Directorate of Water Management, stated that the temperature will increase between 2 0 C and 6 0 C degrees for different scenarios from optimistic to pessimistic between 2015 and 2100; considering the precipitation in similar manner, it is pointed out that in addition to 10.6 mm precipitation increase on the basis of 10-year averages overall Turkey periodically between 2015 - 2100, there will be a decrease in precipitation that ranges between 7.7 mm and 28 mm (SYGM, 2016).

These changes will significantly destabilize the earth's hydrological cycle, cause more variability in precipitation and water flows, and increase the intensity of extreme hydrological events.

Extreme climatic events cause major economic and social impacts. The infrastructure (buildings, transportation, energy and water supply) sector is also affected by climate change in this context, which poses a separate threat to densely populated places. When there is an increase in sea level due to the effects of climate change or other extreme climatic events, the issue of infrastructural effects gains a different dimension. Therefore; a more strategic and long-term approach is required in land and sea planning studies, including transport, regional development, industry, tourism and energy (ÇŞB, 2013).

Measures to be taken against climate change follow two interrelated paths. The first is to mitigate the negative consequences, namely the reduction of greenhouse gas emissions, and the other is to adapt to the effects. Even if the world manages to limit and gradually reduce its greenhouse gas emissions, it will take a very long time for the planet to recover from the greenhouse gases currently in the atmosphere.

This situation shows that even if global emissions reduction efforts yield successful results, it is necessary to adapt to the impacts of climate change.

Adaptation: Adapting to the effects of climate change; while in the narrow sense is defined as an adaptation to the new or changing environment, in the broader sense adaptation can be defined as adjustments aimed at reducing the level of vulnerability to real or predicted climate change and variability or taking advantage of opportunities in natural systems or human systems.

Adaptation strategies offer a complementary approach to mitigate more negative consequences. While mitigating the negative consequences can be seen as reducing the possibility of adverse conditions to occur; adaptation can be seen as reducing the severity of many effects if adverse conditions persist. In short, adaptation reduces the level of damage likely to occur.

For social systems, the success of adapting to climate change depends mostly on the availability of necessary resources. These resources consist not only of financial and natural resources but also of information, technical capacity and institutional resources. The types and levels of the required resources are also largely dependent on the nature and speed of the actual or expected environmental / climate change and the measures planned to be taken.

Climate change adaptation processes in social and natural systems are highly complex and dynamic, often involving many back-flows and dependencies on existing local and material conditions.

2. CONSTRUCTION AND INFRASTRUCTURE SECTOR

Before starting to examine the appropriate strategies of the construction and infrastructure sector, it is helpful to define some concepts:

Construction: It is the process of building all kinds of production-based buildings that correspond to human needs such as construction, building, infrastructure, industrial industrial structures.

Construction Industry: It is the economic sector dealing with the alteration, repair and repair of land and construction, buildings, structures and other real estates.

Infrastructure: The basic physical and organizational structures and facilities required for a society or organization to function. Infrastructure facilities are generally referred to with the following classification.

- Transport; transport services such as highways, bridges, bike paths, railways, airports and ports.
- Energy; Energy production and distribution, including electrical networks, IT systems
- Water and wastewater systems; Potable water, wastewater, storm water networks, fire hydrants, potable water and wastewater treatment plants
- Security and Durability; earthquake warning systems, flood warning systems, etc.
- Financial; Financial markets and services that support economic processes such as capital development, investment, and risk management.
- Health and education; hospitals, schools
- Public Spaces; natural resources, parks, beaches, cultural structures (museums, theaters, concert halls, etc.)

The construction sector in Turkey, when viewed from the context of infrastructure investments and house constructions, is among the prominent sectors in recent years.

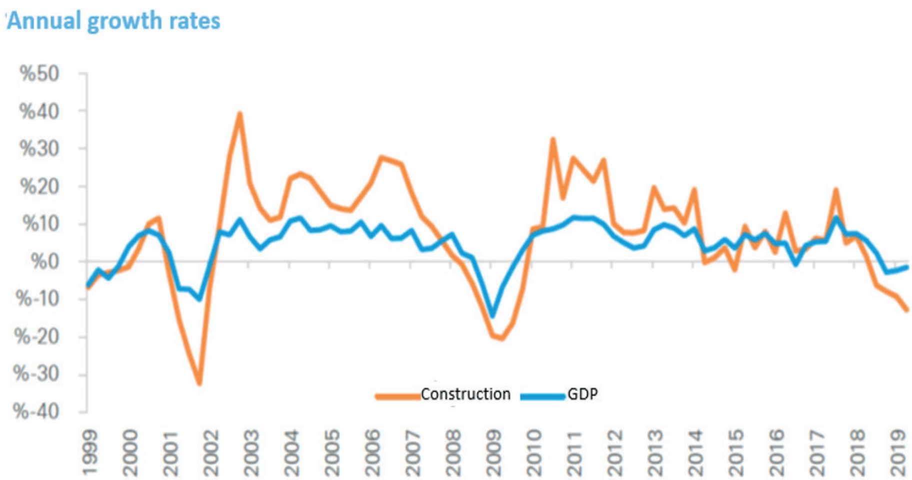
The construction industry is considered to be one of the most important sectors of the economy.

- Growth trend of Turkey's economy traditionally rests on the construction market.
- It has a locomotive role in employment with the side sectors it interacts with.
- It is also closely related to finance due to the large amounts of these amounts.

Construction Sector, growth rates

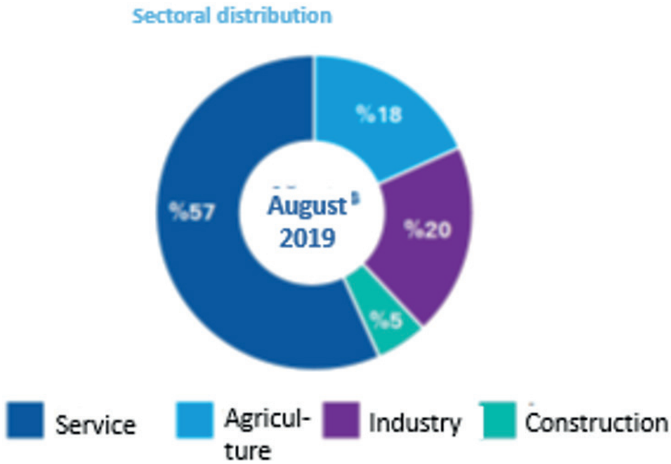
The annual growth rates of the construction industry in our country in comparison with GNP are given below. Figure 1 shows the relationship between the growth in the construction sector of our country and the GDP.

Figure 1: Construction Sector Growth Rates (KPMG, 2020)



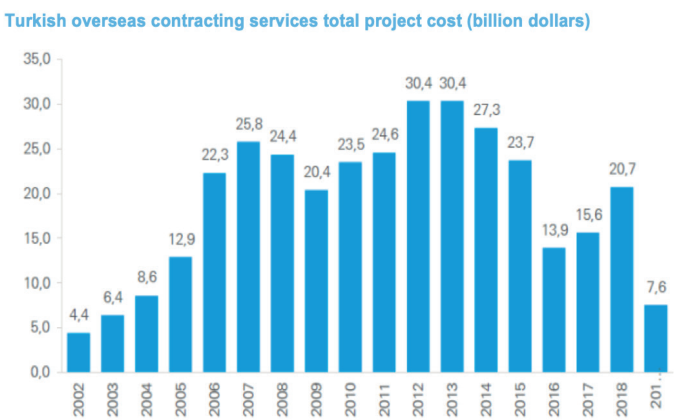
The contribution of the Construction Sector to Employment is as follows. Accordingly, as of August 2019, the contribution of the construction industry to the total employment in our country is 5%. The contribution of the construction sector to employment in our country is presented in Figure 2.

Figure 2: The Impact of the Construction Sector on Employment (KPMG, 2020)



The Turkish construction industry also carries out important projects abroad. The chart below shows the foreign business volume of our construction industry (Figure 3).

Figure 3: Construction Sector Overseas Business Volume (KPMG, 2020)



Resource: Ministry of Commerce

3. CLIMATE CHANGE AND CONSTRUCTION AND INFRASTRUCTURE SECTOR

Most of the resource use in the world is realized by the construction sector.

It is known that most of the environmental problems related to energy consumption and resource use are caused by buildings.

Buildings that replace the natural cover, asphalt surfaces, and especially the reflective feature of glass cladding buildings, which increase rapidly in large metropolises, create heat islands in cities.

Sustainable design of buildings will limit the resource use caused by buildings as well as the environment caused by buildings. infrastructure systems are the lifeblood of a city.

Not only drinking water systems, but also wastewater and sewage, transportation, telecommunications and energy units play a major role in the functioning of a city. The design of construction and infrastructure systems should be done in a long-term use.

The construction industry in 2018 constituted:

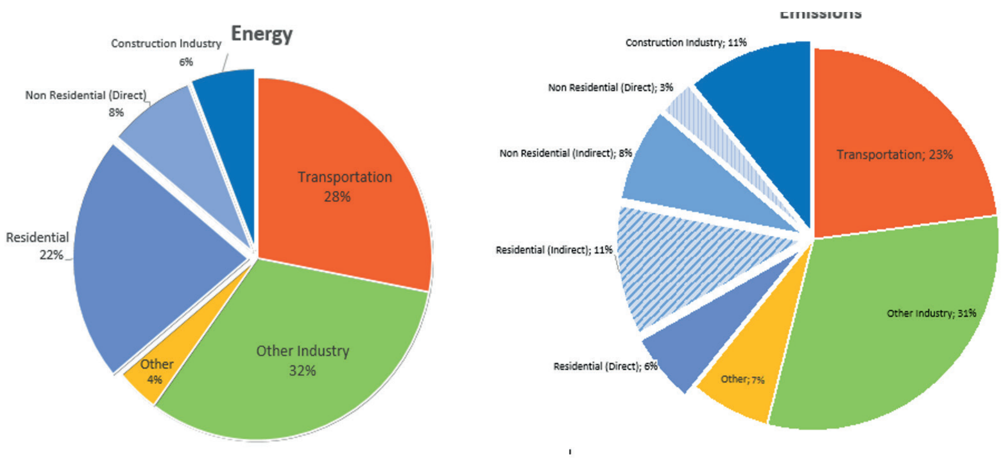
- 36% of global final energy use ,
- approximately 39% of CO_2 emissions from energy and process .
- 28% of the global carbon emissions caused by building operation (heating, cooling, lighting, etc.).
- 11% of global carbon emissions are generated during the construction process and material production (such as steel, cement and glass).

The construction industry uses 4.2 trillion kilograms (kg) of cement per year.

- One kg of cement releases more than 0.5 kg of CO_2 into the atmosphere. (2019 Global Status Report).

Figure 4 summarizes the energy consumption and emission rates of the construction sector.

Figure 4: The energy consumption and emission rates of the construction sector



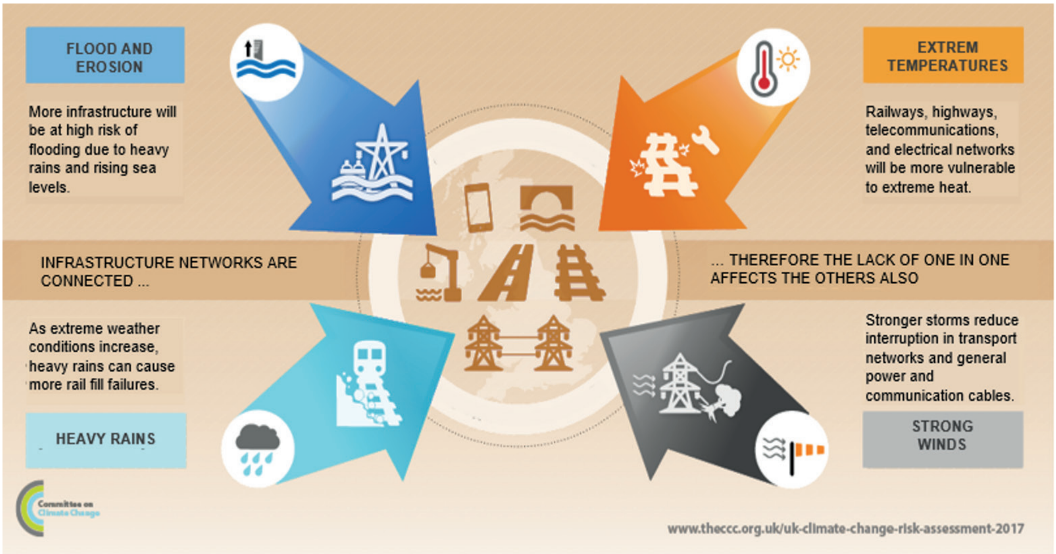
The impact of human-induced climate change will continue to increase over the next decade, even if emissions are completely reduced.

Natural and human systems must develop sufficient adaptive responses to avoid the risks posed by climate change and even take advantage of the opportunities that may arise.

Climate change and construction / infrastructure sectors appear to be mutually influencing each other. On the one hand, while creating consequences such as construction activities, use of natural resources, energy consumption and environmental pollution, they create accelerating and triggering effects on climate change. On the other hand, the negativities caused by climate change have negative effects on the construction and infrastructure sectors. In this section, only the effects of climate change on the sector will be mentioned.

Floods and erosion, extreme temperatures, strong precipitation and strong winds are important climatic events affecting construction and infrastructure. Figure 5 summarizes this cycle.

Figure 5: Significant climate change impacts on the construction and infrastructure sectors



Climate change is expected to have significant impacts on construction and infrastructure. The impact of climate change on the sector is an important economic, environmental and social issue.

Infrastructure is already sensitive to current climate variability and the future climate is likely to be much more challenging and destructive.

As construction and infrastructure assets have long operating lives, they are sensitive not only to the climate present during their construction but also to climate changes throughout their use.

Much of the infrastructure built in the next five years will continue to be used long after 2030.

This is an important part of the transition to a green economy.

Sub-sectors that can be affected in the construction and infrastructure sector:

- Water
- Energy
- Telecommunication
- Transportation
- Buildings

Changes in temperature and precipitation will put additional pressures on infrastructure, particularly the rail, road, water and energy sectors.

High temperatures create the risk of buckling in the railway network, causing sagging of electrical cables and softening and deterioration of road asphalt. Winds blowing stronger than expected have similar negative effects.

Figure 6 presents some examples of the effects of climate events on major infrastructure investments.

Figure 6: The effects of climate change on infrastructure investments

4. CLIMATE RESISTANT CONSTRUCTION AND INFRASTRUCTURE

Adaptation measures are required to increase the climate resilience of the infrastructure due to the increased exposure due to climate risk.

Existing infrastructure is designed and built for past or present climate and may not be resistant to future climate.

To ensure the lifetime of the infrastructure, it must be climate resistant.

The new infrastructure, its positioning and designing considering the current and future climate, , can be resistant to climatic conditions by providing the construction and operation.

Sustainable, ecological, water and energy efficient, environmentally friendly buildings should be planned and built.

5. ADAPTATION STRATEGIES IN CONSTRUCTION AND INFRASTRUCTURE SECTORS

Green Building applications have been started in the construction sector in order to reduce the pressure of climate change on the environment.

The World Green Building Council (WorldGBC) defines green building as "a building that reduces or eliminates negative impacts in its design, construction or operation and can have positive effects on our climate and natural environment."

Green buildings seek to slow the effects of climate change by promoting the energy efficiency of larger green and sustainable communities.

The construction industry still represents the largest share of total global energy CO_2 emissions, according to the 2018 Global Situation Report by the Global Building and Construction Alliance (GlobalABC) by the International Energy Agency (IEA).

There are a number of features that can make a building 'green'. These are:

- Efficient use of energy, water and other resources
- Use of renewable energy such as solar energy
- Pollution and waste reduction measures, reuse and recycling
- Good indoor air quality
- Use of non-toxic and sustainable materials
- Environmental assessment in design, construction and operation
- Evaluation of the users' quality of life during design, construction and operation
- Design that adapts to a changing environment

The benefits of green buildings can be grouped into three categories:

- Environmental
- Economic,
- Social

ENVIRONMENTAL:

- Green buildings not only reduce or eliminate negative impacts on the environment by using less water, energy or natural resources, but also - in most cases - serve nature by generating its energy or biodiversity (on building or city scales).
- The construction sector has the greatest potential to significantly reduce greenhouse gas emissions compared to other major emission sectors - UNEP, 2009.
- This emission saving potential is stated to be up to 84 gigatons of CO_2 ($GtCO_2$) by 2050 through direct measures in buildings such as energy efficiency, fuel switching and renewable energy use - UNEP, 2016.
- The construction sector has the potential to save 50% or more of energy by 2050 to support limiting global temperature to 2 ° C (above pre-industrial levels) - UNEP, 2016.
- It has been observed that green buildings that receive a «Green Star certificate» in Australia produce 62% less greenhouse gas emissions and consume 51% less drinking water than average buildings.
- Green buildings approved by the Indian Green Building Council (IGBC) provide 40 - 50% energy savings and 20 - 30% water savings compared to traditional buildings in India.
- It has been demonstrated that green buildings in South Africa that receive a «Green Star certificate» provide an average of 30 - 40% energy and carbon emissions each year and 20 - 30% savings in drinking water each year.
- It has been shown that green buildings that receive LEED certification in the

USA and other countries consume 25 percent less energy and 11 percent less water than non-green buildings. (WGBC, 2020)

ECONOMIC:

- Global energy efficiency measures can save an estimated 280 to 410 billion € in energy expenditure (almost twice the annual electricity consumption of the US)
- Canada's green building industry generated $ 23.45 billion in GDP and generated nearly 300,000 full-time jobs in 2014. Canadian Green Building Council / Delphi Group, 2016.
- Building owners, whether new or refurbished, report that green buildings deliver a 7% increase in asset value over traditional buildings - Dodge Data & Analytics, 2016.

SOCIAL:

- The benefits of green buildings go beyond the economy and the environment and have been shown to generate positive social effects as well. Many of these benefits are related to the health and well-being of people working in green offices or living in green homes.
- Workers in well-ventilated offices record a 101% increase in cognitive achievement - Harvard TH Chan School of Public Health / Syracuse University Center of Excellence / SUNY Upstate School of Medicine, 2015.
- Workers in windowed offices slept an average of 46 minutes more per night - American Academy of Sleep Medicine, 2013.
- Research suggests that better indoor air quality (lower CO_2 and pollutant concentrations and high ventilation rates) can lead to an improvement in performance of up to 8% - Park and Yoon, 2011.

Green building practices meet 9 of the 17 Sustainable Development goals of the United Nations. From this point of view, its importance is revealed once again. Figure 7:

Figure 7: UN Development Goals Fulfilled by the Green Building Concept

Green Infrastructure applications have been started in the infrastructure sector in order to reduce the pressure of climate change on the environment.

Green infrastructure is a cost-effective and flexible approach to managing wet weather impacts with many community benefits.

GREEN INFRASTRUCTURE:

Single-purpose gray rainwater infrastructure is designed to remove urban rainwater from the built environment with traditional piped drainage and water treatment systems, while Green infrastructure provides environmental, social and economic benefits, reducing and treating rainwater at its source (European Environment Agency, 2017).

Green Infrastructure is consciously integrated into spatial planning and regional development to protect and enhance nature and natural processes.

Green Infrastructure is an important strategy in the European Landscape Connectivity Agenda aimed at reconnecting vital natural areas to urban centers and improving their functional roles.

It is an important planning concept aimed at protecting natural capital and increasing the quality of life at the same time.

Climate-resistant adaptation measures for the sector:

- To ensure that structures are resistant to potential increases in extreme weather events such as storms, floods and heatwaves, and extremely cold weather. To ensure that investment decisions take into account changing consumer demand patterns as a result of climate change.
- To increase flexibility so that structures can be changed in the future without creating excessive costs.
- To ensure that organizations and professionals have the right skills and capacity to implement compliance measures.
- To build a more flexible and robust infrastructure network that can cope with the projected climate impacts.
- More environmentally friendly technologies should be developed,

- Green building and green infrastructure works should be supported,
- CO_2 footprint should be reduced,
- an urban green space should be created,
- Buildings and infrastructures should be planned more accurately against future climate change,
- Risk zoning should be included in city planning,
- City planning should also help combat climate risks by providing building durability,
- Urban planning policies that define long-term goals for decarbonization of buildings and the construction sector should be put into force,
- Low carbon releasing materials should be used in constructions.

6. INTERNATIONAL PRACTICES - EUROPE

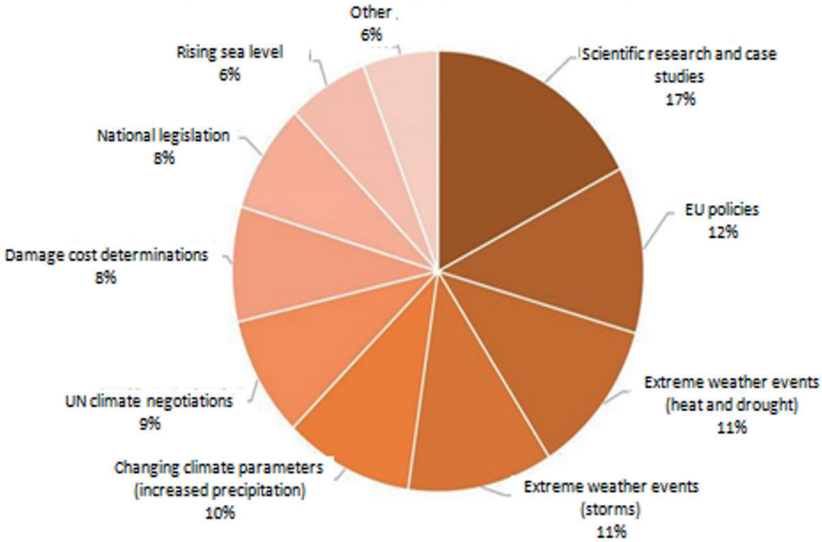
If we state that Finland is the first country to develop an adaptation strategy among the 33 European countries subject to a study and that this was done in 2005, it can be understood more clearly that the issue of adaptation entered the policy agenda relatively late even in Europe.

Today, it would not be wrong to state that 76% of European countries have developed a climate change adaptation strategy and 61% have adaptation action plans. (Pietrapertosa, Khoklov, Salvia and Cosmi, 2018).

In a scientific study focusing on 147 local climate change adaptation plans in Europe, it was found that the number of local climate change adaptation plans is in an increasing trend throughout Europe; that flood protection, water management and urban planning measures are more on the agenda than others, and different adaptation capacities and adaptation planning patterns appear across Europe depending on the geographical location. These factors are presented in Figure 8.

Among the findings of the study, the importance of scientific research and case studies is among the factors that trigger adaptation planning. This is followed by EU policies, extreme weather events, changing climate parameters, United Nations (UN) climate negotiations, damage cost determinations, national legislation, rising sea levels and other factors. The conclusion that can be drawn from this is that local governments' consideration of climate change is closely linked to the findings of science, felt events and international / national political developments. It possible to see a similar pattern of interaction in Turkey.

Figure 8: Factors Affecting Local Climate Change Adaptation Plans in Europe(www.iklimhaber.org)



The study also includes the factors highlighted as obstacles to adaptation to climate change. Lack of financial, human capacity and data, uncertain responsibilities, uncertainties regarding the effects of climate change, insufficient legislation and political ownership are emphasized. In this respect it is frequently stated that there are similar needs in Turkey.

In another current comprehensive study that covered the local climate change plans in 885 big cities with population over 50.000 in EU-28, Iceland, Norway, the population in Switzerland and Turkey, it was determined that 66% of the cities had mitigation plans, 26% had adaptation plans and only 17% had both mitigation and adaptation plans.

Within the scope of the research, it should be emphasized that 80% of cities with a population of more than 500,000 have mitigation and/or adaptation plans. The study reveals that the existence of national laws requiring a climate change strategy and plan at the local level (countries such as Denmark, France, and the United

Kingdom) increases the development of climate change adaptation plans at the local level five times compared to those in countries where these do not exist.

Covenant of Mayors for Climate and Energy

One of the most important actions of the EU regarding Adaptation to Climate Change is the Covenant of Mayors for Climate and Energy, which was opened for signature in 2008.

The vision of the agreement is, by 2050, accelerating the decarbonisation of its regions, strengthening their capacity to adapt to the inevitable effects of climate change, and allowing citizens to access safe, sustainable and affordable energy.

The signatory cities pledged to take action to support the implementation of the EU's 40% greenhouse gas reduction target by 2030 and the adoption of a common approach to climate change adaptation. (Covenant of Mayors, 2020)

As of today, 10,152 local administrations with a population of approximately 320 million from 60 countries are signatories to the Covenant of Mayors. 6,148 of these signatories shared their local climate action plans with the secretariat. 5,007 of them were accepted.

However, it should be emphasized that only 2,341 of them (23% of signatories) track their progress performance.

In other words, even though there is a climate action plan, there is a great deficiency in implementation and monitoring, at least in terms of accountability and data sharing. It is striking that only 295 results are displayed when municipalities with action plans on adaptation are searched in the database.

7. TURKEY

Combating climate change at the local level in Turkey is at an early stage. Though the issue of mitigation is relatively highlighted under the scope of this limited struggle, there is a need for a starting point for the issue of climate change adaptation, an area too late to think over in Turkey until today.

Although there is an adaptation strategy and adaptation plan at the national level, it should be noted that the number of municipalities with comprehensive and science-based adaptation strategies and plans at the local level is not much.

Taking into account the fact that the number of metropolitan municipalities in Turkey is 30, the number of provincial municipalities is 51, the number of metropolitan district municipalities is 519, the number of district municipalities is 403 and the number of town municipalities is 386, the situation becomes even more striking. According to Address Based Population Registration System (ABPRS) data, 93% of Turkey's population lives in municipalities.

83% of the population living within the municipal boundaries reside in metropolitan municipalities.

Although it constitutes only 0.2% of the total number of municipalities, it may be useful to look at the report cards of our metropolitan municipalities, where roughly 60 million citizens live, in combating climate change.

The circular published by the Ministry of Environment and Urbanization on January 23, 2019 can be considered as a new milestone for local combat with climate change. In the circular sent by the Ministry to 81 provincial governorships and all municipalities, warnings were made regarding the implementation of urgent measures to be taken against disasters caused by climate change.
In the Circular, it was stated that in recent years, the number and severity of disasters,

especially floods and floods caused by global climate change, have increased, and especially the disasters that have recently reflected on the public have caused loss of life and property.

The Ministry underlined that local governments "have the capability and responsibility to intervene in the problem in place and firstly" and stated that it is an essential issue to take immediate measures against disasters caused by climate change.

Within the scope of the circular, the studies regarding the measures to be implemented immediately are listed in items.

The table below shows the actions specified in the "Circular on Climate Change and Disaster Measures" published by the MoEU (MEU, 2019).

Table 1: Circular on Climate Change and Disaster Measures (ÇŞB, 2019)

1	Debris and soils accumulated in the stream beds will be cleaned, stream and canal rehabilitation works will be accelerated, bridge and culvert works will be carried out in a way that does not narrow the water flow section in order to ensure the flow of water at low elevations of the land and to allow the construction of infrastructure facilities.
2	Terracing works will be carried out on slopes with flood risk and the structures under risk will be determined and necessary actions will be taken in accordance with the legislation.
3	The existing structures, which are insufficient for the removal of floods and rainwater, will be rehabilitated, and necessary measures will be taken against landslides in hilly areas where waste systems, one of the areas sensitive to landslide, are used and the settlement is developed.
4	While determining new settlement areas, sensitivity maps will be prepared by determining the areas that have been exposed to landslides and other disasters and where disasters can be expected, these maps will also be taken into consideration while preparing and approving development plans.
5	For new residential areas, engineers and urban planners will be provided with sufficient information and data on avoiding high-risk areas.
6	In seaside cities, elements and structures that will slow down or block the flow of flood waters towards the sea will be modified or removed.
7	In order to eliminate flood waters, basins that can be irrigated at certain points in city centers and can be used as recreation areas will be created, necessary incentives and information will be provided to ensure that citizens in disaster-exposed areas do not return to disaster areas.
8	Mutual information exchange with citizens on disaster risks will be strengthened, early warning mechanisms against disasters will be developed.
9	In accordance with the relevant legislation, all kinds of technical, training, personnel and coordination support can be requested from other public institutions and organizations; apart from that, it will work in coordination with the aforementioned institutions and local administrations.

If we look at the database related to the Covenant of Mayors for Energy and Climate for municipalities in Turkey, we see a total of 22 municipalities (Table 2). However, 12 of them submitted the action plan. All 3 of them have a monitoring plan.

Table 2: Municipalities in Turkey Which Are Signatories to the Covenant of Mayors (Covenant of Mayors, 2020)

Signatories	Population	Commitments	Status	Adhesion date
Yenimahalle, TR	663580	2030 ADAPT		2019
Bolu , TR	311810	2030 ADAPT		2019
Çorlu , TR	262862	2030 ADAPT		2019
Sakarya Metropolitan Municipality, TR	1010700	2030 ADAPT		2018
Gaziantep, TR	1947244	2030 ADAPT		2017
Pendik Municipality, TR	691681	2030 ADAPT		2017
Bayındır Belediyesi, TR	40216	2030 ADAPT		2017
Şişli Municipality, TR	272380	2030 ADAPT		2017
Bağcılar Municipality, TR	762000	2030 ADAPT		2016
Bursa Metropolitan Municipality, TR	2842547	2030 ADAPT		2016
İzmir Metropolitan Municipality, TR	4113072	2020 2030 ADAPT		2015
Çankaya Municipality, TR	914501	2020		2015
Maltepe, TR	460955	2020		2014
Nilüfer, TR	350000	2020 ADAPT		2014
ESKİŞEHİR TEPEBAŞI, TR	359303	2020 2030 ADAPT		2013
Antalya Metropolitan Municipality, TR	2043432	2020		2013
Kadikoy, TR	452302	2020 2030 ADAPT		2012
SEFERIHISAR, TR	35000	2020		2011
Bornova, TR	412275	2020		2011
Eskişehir, TR	482793	2020		2011
Karşıyaka - İzmir, TR	348000	2020 2030 ADAPT		2011
Karşıyaka (Erdek-Balikesir), TR	2663	2020		2009

In Turkey, municipalities are in the position of leader or project partner in 23 projects in the scope of Climate Change Capacity Development Grant Program.

Some projects funded within the scope of Grant Program for Developing Capacity in the Field of Climate Change in Turkey, are aimed at developing the local capacity of adaptation to climate change:

Some of them can be listed as follows:

- Climate Change Adaptation and Mitigation Game Project for Big Cities,
- Sensitivity Against Climate Change on the Agricultural Sector Capacity Development in Turkey,
- Adaptation of Antalya's Seas and Coasts to Climate Change Project,
- Capacity Building Project for Combating and Adaptation to Climate Change in Thrace Region,
- Water Management Modeling Project of Kızılırmak Delta Project within the Scope of Climate Change Adaptation Process in Samsun.

We also have municipalities that prepare Action Plans, although they have not signed the Covenant of Mayors:

- Denizli Metropolitan Municipality,
- Kocaeli Metropolitan Municipality,
- Kahramanmaras Metropolitan Municipality,
- Mugla Metropolitan Municipality,
- Sakarya Metropolitan Municipality,
- Hatay Metropolitan Municipality,

Climate change action plans are prepared, updated, or are near to completion. (iklimhaber.org)

8. CONCLUSION AND RECOMMENDATIONS

Increasing the resilience of the Construction and Infrastructure sectors against climate change, that is, adaptation, is possible with an effective urbanization policies in order to reduce the city-originated negative effects that trigger climate change.

The main question here whether the spatial plans of different scales (e.g., landscaping plan, Master zoning plan, Implementation development plan), which are the main basis of the formation of cities are integrated to climate change-friendly, green building and green infrastructure applications that are sensitive to climate change and respond to change.

Therefore, the construction and implementation processes of city plans and climate change action plans should be considered together.

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THE RELATIONSHIP BETWEEN CLIMATE CHANGE ADAPTATION AND DEVELOPMENT

Prof. Dr. Mehmet Somuncu

1. INTRODUCTION

Development is a local and social balanced improvement process and structural development of countries, regions and communities that could be realized under economic, social, cultural and environmental conditions. Development could be named as a process of change that could be measured and monitored with indicators related to life quality and change in the combination of production elements in addition to increases in production elements and production, which is different from the fact of economic growth (Turkey Environment Foundation, 2001). In this sense, the development includes the forward development of the economy and society, and meeting the needs and expectations of humanity is the primary goal of development (World Commission on Environment and Development, 1987).

The concepts of "growth", "development" and "progress" have been used as synonyms, as they contain equivalent formations. However, the developments after the Second World War highlighted that the phenomenon of economic growth is not sufficient alone in the national development process, and that this should be balanced with social, cultural, environmental and spatial dimensions in other areas of life. These changes, which paved the way for the "sustainable development" understanding in one aspect, directed the development approach from "economic growth" to "social development". Such approaches, especially after the 1970s, have been reflected in the development and modernization literature, paving the way for the transparency of these concepts. Today, the fact that these concepts do not contain the same meaning is accepted.

Before the 1970s, "development" and "progress" were largely seen as equal to increases in national income. When the main purpose of development was to transform the structure of production and employment in line with industry and services sectors rather than agriculture, “per capita national income” was used as the main indicator of the changes in the country's welfare in accordance with this approach. However, while the developments after the 1960s emphasized the inadequacy of this approach, the need to redefine the concept of development emerged in the 1970s. The new approach, which aims to define development with its human, social, cultural, environmental and spatial dimensions besides the concept of economic growth, emphasized that poverty, unemployment, income distribution and regional imbalances should be considered within the definition of development.

Economic growth, measured by income increases, is a narrow-scope criterion that cannot adequately explain social development, but can only explain the expansion of demand. On the other hand, the concept of development refers to a whole, in other words, the level of "social development", In which economic developments such as physical capacity and income increase, as well as their distribution among income groups and between regions, and social and cultural accumulations, are turned into indicators.

These definitions underline the following fact: The phenomenon of development has a multidimensional feature that includes structural changes in social, political, cultural and similar institutions throughout the country. With this understanding, the development covers the progress in the economic, social, political and cultural structures of the country and forms a whole (Tümertekin & Özgüç, 2015).

Climate change adaptation can be defined briefly as the process of adaptation to current or expected climate conditions and impacts. In another definition, it is the process of strengthening, developing and implementing strategies to combat the effects of climate events (risks), to gain benefits and to manage their effects.

Adaptation has the potential to mitigate the impact of climate change. Integration can be achieved by societies, institutions, individuals, governments. Economic, social or environmental drivers are motivated in many ways, such as social activities, market activities, local or global interventions.

Climate change is a sustainable development problem. Planning about the effects of climate change and managing the risks arising from these mean supporting the sustainable economic growth of countries. The strategies developed to adapt to the impacts of climate change draw attention to the risks, and the possible benefits of climate change are not adequately referred to. However, in some sectors, especially in the agricultural sector, awareness of the possible benefits of adaptation to climate change has recently started to develop. In addition, unlike efforts to reduce emissions, many measures for adaptation provide local benefits before long (Ministry of Environment and Urbanization, 2012).

Before establishing the link between the countries' situation in the face of climate change and climate change and development, it is useful to briefly take a look at the economic and social situation of the world at the macro level.

Thirty years ago, half of the developing countries lived in extreme poverty, today the rate is down to a quarter. Fewer children are malnourished and the risk of premature death is even lower. Access to modern infrastructure is more common in developing countries. In middle-income countries where per capita income which is critical to progress is doubling, there is rapid economic growth driven by technological innovation and institutional reform. However, the needs continue to be enormous (The World Bank, 2010).

Today, poverty reduction and sustainable development remain the main global priorities. A quarter of the population of developing countries currently lives on less than $ 1.25 a day. One billion people lack clean drinking water, 1.6 billion people are without electricity and 3 billion people are without adequate sanitation. A quarter of all children in developing countries are malnourished. Eliminating these negativities and meeting the needs should be the priorities of development assistance that will contribute to the development of both developing countries and these countries. However, it is a fact that with climate change, development will not be easier, it will become more difficult. Climate change complicates these challenges (The World Bank, 2010).

2. RELATIONSHIP BETWEEN CLIMATE CHANGE AND DEVELOPMENT

Scientific evidence clearly shows that climate change is a serious and urgent issue.

The world's climate is changing rapidly, mainly as a result of increases in greenhouse gases caused by human activities. Most climate models show that doubling pre-industrial greenhouse gas levels is likely to drive the Earth to a rise in global average temperatures of 2–5 °C. This greenhouse gas level will likely be reached between 2030 and 2060. A global warming of 5 °C would be far beyond the experience of human civilization. Several new studies show that the chances of warming being higher than 5 °C are up to 20%. If annual greenhouse gas emissions remain at the current level, concentrations will be higher than pre-industrial levels by 2100, meaning a 3–10 °C warming awaits the world based on the latest climate projections. Some of the effects of climate change could further increase warming by triggering the release of additional greenhouse gases. This poses a real risk for higher temperature changes. Higher temperatures cause plants and soils to absorb less carbon from the atmosphere and dissolve the permafrost, releasing large amounts of methane. Analysis of warming events in the distant past shows that such feedback can increase warming 1-2 times more by the end of the century (Stern, 2007).

Climate change will have some positive effects for a few developed countries due to moderate amounts of warming, but the high temperatures threatening the world in the second half of this century will be very damaging. In regions of higher latitude such as Canada, Russia and Scandinavia, climate change can bring net benefits up to 2 or 3 °C, through higher agricultural yields, lower winter mortality, lower heating requirements and an increase in tourism potential. But these areas will also experience the fastest warming rates with serious consequences for biodiversity and local livelihoods.

Developed countries at low latitudes will be more vulnerable. Regions with scarce water will face serious difficulties and increased costs. Recent studies show that a 2 °C rise in global temperatures leads to a 20% reduction in water availability and crop yields in Southern Europe, and when mountain snow masses melt by 25 - 40%, a more uneven water supply in California.

A study in the US initially predicts a balance in benefits and costs (± 1% GDP), but GDP decreases even in the most optimistic scenarios when global temperatures exceed 3 °C. In this case, the poorest sections will be the most vulnerable. Low-income people are more likely to live in low-quality housing in high-risk areas, and less resources are required to deal with climate change, including the lack of comprehensive insurance coverage (Stern, 2007).

As a result of all these phenomena, the effects of the changing climate are already being felt, with more drought, more floods, stronger storms and more heat waves, which divert individuals, businesses, governments and resources from development. Second, climate change will pose increasingly serious challenges to development. Today, there are climate models based on scientific data that the temperature increase, which has reached 1 °C compared to the pre-industrial period, will increase by 5 °C or more by the end of the century, leading to many different weather events, stressful and changed ecosystems, many species will be doomed to extinction and all island countries may face the threat of flooding. There are major challenges even in keeping it around 1i5-2 °C compared to the best efforts of the global pre-industrial era, as even this requires a major global effort for compliance (IPCC, 2018; The World Bank, 2010). For this, high-income countries can and should reduce their carbon footprint. Because they cannot continue to fill the atmospheric common space with emissions released, unfairly and unsustainably. However, developing countries, whose average per capita emissions are one-third of high-income countries, need major expansions in energy, transport, urban systems and agricultural production. If followed using traditional technologies and carbon densities, these much-needed expansions will generate more greenhouse gases and therefore more climate change. The question, then, is not how development will be more resilient to climate change, but how to pursue growth and well-being without causing "dangerous" climate change. Therefore, climate change must be addressed urgently. Because climate change threatens all countries and developing countries are the most vulnerable. Estimates suggest that 75 to 80 percent of the damage costs caused by a changing climate will be borne by developing countries. It is estimated that warming above 2 °C above pre-industrial temperatures can cause permanent decreases in GDP of 4 to 5 percent for Africa and South Asia. However, most developing countries do not have sufficient financial and technical capacity to manage increased climate risk. In addition, they depend on climate-sensitive natural resources for direct income and prosperity. Most of these countries are also located in tropical and subtropical regions exposed to climate change (The World Bank, 2010).

3. RELATIONSHIP BETWEEN ADAPTATION TO CLIMATE CHANGE AND DEVELOPMENT

As noted above, climate change poses major challenges to society, especially in developing countries. Thus, the impacts of climate change can reverse decades of human development gains and threaten the achievement of the Millennium Development Goals. While many developing countries remain the most vulnerable to these future threats, their capacity to adapt to the impending climate impacts is limited. The negative effects of climate change are already being felt and experienced. More frequent and intense droughts, floods and other extreme weather events in many regions, including our country, are expected to worsen over time. This will lead to adversities, socio-economic impacts and affect people's health, well-being, livelihoods and quality of life (UNDP, 2018).

Measures to be taken against climate change follow two interrelated paths. The first is to mitigate the negative consequences, namely the reduction of greenhouse gas emissions, and the other is to adapt to the effects. Even if the world manages to limit and gradually reduce its greenhouse gas emissions, it will take time for the planet to recover from the greenhouse gases currently in the atmosphere. This situation shows that even if global emissions reduction efforts yield successful results, it is absolutely necessary to adapt to the effects of climate change.

In the Fourth and Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC); it is stated that adaptation studies are of great importance in terms of managing the effects of climate change, and that adaptation to climate change is the only tool to take measures against the effects caused by emissions in the historical process (IPCC, 2007; 2014a; 2014b). This situation raises the agenda to take measures for adaptation to climate change, and it is emphasized that it is important to adopt a strategic approach at the regional and country scale as well as at the global scale and to harmonize between various sectors and management levels in order to ensure that these measures are taken on time and more effectively. At the point reached today, since it is not possible to fully compensate for the effects of greenhouse gas emissions in the world, more and more attention has been given to the second path, the need to adapt to the effects of climate change. Essentially, adapting to the effects of climate change aims at making people's livelihoods, economies and natural systems less affected by changes due to climate, and in some cases to benefit from adaptation. Among the measures to be taken for adaptation; there are important issues such as increasing the agricultural sector's resistance to drought; reduction of flood and flood risks through increased storage and infrastructure management; the integrated management of water resources and the protection of ecosystems. In addition, in some cases, mitigation of the negative consequences of climate change, that is, reduction of greenhouse gas emissions, and adaptation strategies can be closely linked and complementary to each other (Ministry of Environment and Urbanization, 2012).

Climate change adaptation is crucial to dealing with the inevitable effects of climate change that are already committed to the world. Adaptation will be particularly important in developing countries that will be most and soon be affected by climate change. Because adaptation can reduce the negative effects, but it cannot solve the climate change problem alone. Therefore, compliance should be addressed with mitigation. However, there will be costs even in adapting to climate change. For example, it is a cost for farmers to switch to more climate-resistant but less efficient crops.

There are limits to what can be achieved with adaptation. Because as the magnitude and speed of unabated climate change increases, the relative efficiency of adaptation will decrease. Natural systems have clear limits on the rate at which species and ecosystems migrate or adapt. There are limits for human societies too. For example, the fact that the rise of sea level makes nation states, especially some small island countries uninhabitable, reflecting this limit. Therefore, in the fight against climate change, adaptation and mitigation are two important parameters that support each other and should be carried out together. Without strong and early mitigation, the physical limits of compliance and costs will increase rapidly. However, adaptation can, in most cases, provide local benefits that, unlike mitigation, occur without long latencies (Stern, 2007).

4. ECONOMY FOR ADAPTATION TO CLIMATE CHANGE

The cost of not investing in proven policy insights for more effective adaptation to climate change, improved national adaptation plans, environmental protection and disaster risk reduction, is high. According to a 2015 study by the Brookings Institute, "without mitigation," climate change could reduce global GDP by over 20% by 2100 - roughly 5-10 times greater than current estimates (The Brookings Institution, 2020); (UNDP, 2018). This is even greater in both the least developed countries and middle-income countries, meaning that the impact of climate change is growing significantly, where weakness, instability and risk increase. This increased risk then combines, putting interconnected sectors such as energy, manufacturing and agriculture at greater risk. With all these serious costs in mind, it becomes much cheaper to invest in improved planning, smarter evidence-based decision making, integrated ecosystem and environmental protection, and proactive disaster risk reduction. Therefore, investing in more effective climate change adaptation is wise. By accelerating country-level efforts for climate management, countries that are highly vulnerable to climate change can support the realization of Nationally Determined Contributions and development goals for food security and poverty reduction, lower risks, and sustainable economic development (UNDP, 2018).

In a world competing for demand for scarce resources, critical questions must be asked to create the most effective policy response to climate change. What is the impact of the magnitude of climate change on a sector such as agriculture? To what extent will households be affected by this? Where are these changes expected? What types of adaptation interventions will bring the highest returns in terms of social welfare improvements? At the same time, considering that if adaptation is carried out early, resources may be wasted, on the contrary, too late adaptation will increase vulnerability for populations at risk and perpetuate poverty traps and can be much more costly, it is important to make correct decisions about where and when to make adjustment investments. Recently, the need to show the benefits and costs of adaptation options has become important. Policy makers are more concerned with finding optimum answers that maximize net benefits. A more rigorous understanding of the benefits and costs of adapting to a changing climate has become necessary not only to justify donor funding, but also to strengthen the capacity to identify, evaluate and adapt to climate change (UNDP, 2018).

Climate change adaptation and climate change mitigation are inextricably linked. Contributions to adaptation have follow up effects to progress the mitigation and the mitigation has follow up effects to alleviate need for adaptation. Take agriculture, for example. Changes in precipitation patterns, rising temperatures, droughts and floods mean that some crops will fail and farmers will have to plant, harvest and market their crops differently. Many estimates suggest that we need to feed more than 2 billion new populations by 2050. Therefore, changing climate scenarios and climate change adaptation economy will require limiting emissions growth in order to achieve improved productivity and food security. Following food in the value chain, this can affect energy (both biofuels and the energy market) directly to livelihoods linked to agriculture, as well as economic sectors such as transport, production, exports. Compliance solutions will need to be considered across value chains and respond to market development needs (UNDP, 2018).

Climate-related disasters are extremely costly. Not only in terms of lost lives, but also overall economic losses. According to a report by Rogers and Tsirkunov, 'Raising all hydrometeorological information production and early warning capacity in developing countries will save an average of 23,000 lives annually due to disaster mitigation and provide additional economic benefits between USD 3 billion and USD 30 billion per year. With improved weather, hydro-meteorological and climate services, weather index-based insurance is also becoming a real possibility for small-scale farmers. With insurance, farmers can invest in higher-yielding agricultural inputs without fear of financial ruin in the event of a drought. Some estimates suggest that this could increase their income by 200 - 300%. For most developing country farmers, this is the difference between living above or below the poverty line (UNDP, 2018).

Estimates of climate change and adaptation costs vary in global studies, depending on the sub-sectors covered, the assumptions made and the climate change level modeled (generally below 3 °C). Many do not take into account critical threshold points - unpredictable and non-linear events in the world's biophysical systems - and large-scale change. The latest estimates say these previous numbers are too low. At the global level, compliance costs are likely to be two to three times higher than current global estimates by 2030 and potentially four to five times higher than 2050, according to the 2016 UN Environmental Compliance Gap Finance Report. Previous global estimates of adaptation costs in developing countries are between US $ 70 billion and US $ 100 billion per year for the period 2010-2050. However, as usual losses will reach 2.2% of global GDP in 2100, the national and industry literature reviewed in this report will show that compliance costs will be between $ 140-300 billion by 2030 and $ 280-500 billion by 2050. (UNDP, 2018).

Considering these numbers, it is clear that the public sector alone cannot finance climate change adaptation efforts. The private sector will also need to step up, be actively involved in planning and development processes, and become a key driver in building resilience for its region. Take, for example, climate information and early warning systems. These services are generally perceived as a service that is under the responsibility of the public and provided by the public. However, when the issue is approached with a new approach that encourages public-private partnerships, it is seen that the public interacts with a wide range of private sector actors from manufacturers to cloud-based big data companies in climate services. Interventions such as skills training, capacity building and access to finance will help farmers diversify their crops to climate-resistant local varieties and expand their businesses to new markets (UNDP, 2018). However, climate change requires substantial financial support from the international community to create the environments and transformative change necessary to adopt new policies, adaptation efforts involving multiple stakeholders, and achieve low-carbon climate goals.

5. CONCLUSION

Scientific evidence reveals that climate change is a serious global threat and requires an urgent global response. It is also a fact that the benefits of acting vigorously and early in the fight against climate change and the benefits of actions far outweigh their economic costs. Climate change affects fundamental aspects of life for people around the world, and as the magnitude of the impact of climate change grows, adversities will increase, especially for developing countries and countries that are more exposed to climate change. There will be difficulties in accessing other natural resources, especially water, in food production and supply, and health and other environmental conditions will deteriorate. Hundreds of millions of people may suffer famine, water shortages and floods as the world warms. As stated at the beginning of the subject, all these will affect the countries that are already facing various difficulties in terms of development more negatively. According to reviews using results from official economic models, it is estimated that, if not measures are taken, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year and forever. Given a wider range of risks and impacts, damage estimates may rise to 20% or more of GDP (Stern, 2007). Therefore, there is a direct relationship between adaptation to climate change and development. For example, actions such as reducing greenhouse gas emissions to avoid the worst effects of climate change are likely to limit costs to around 1% of global GDP each year. Issues and/or opportunities for development and climate change are intertwined and need to be tackled together. For example, water availability, agricultural and industrial production, employment affect livelihoods and quality of life dependent on natural resources. With this perspective, it requires the consideration of sustainable development in the most general framework and climate change in particular in development approaches (plans and strategies). Climate change vulnerability depends not only on climate change, but also on the chosen development approach and its ability to adapt to changes.

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SCOPE, TYPES AND METHODS OF ADAPTATION TO CLIMATE CHANGE

Assoc. Prof. Dr. Çiğdem Coşkun Hepcan

1. CLIMATE CHANGE ADAPTATION CONCEPTS

Climate is in a state of change ever since the world has existed. Ecosystems and human communities have developed some solutions to provide the climate change adaptation in the past periods. However, after the industrial revolution the rate of the climate change is much higher than the past periods.

Climate change adaptation, in a way, is to define solutions for a future which is difficult to predict where there are uncertainties using technology and information and to provide benefit.

Climate change adaptation could be reactive or proactive (Lecocq and Shalizi, 2007).

- Reactive adaptation: They are the most commonly used adaptation actions in the world. They include solutions for an occurred climate effect. Solutions do not eliminate the effects but reduces the level of impact and helps recovery process. For example, building irrigation systems when rain is insufficient or compensation of the affected groups by insurance after a serious drought period are examples for the reactive adaptation.
- Proactive adaptation: They include solutions developed based on estimates for a climate effect which has the potential of occurring but did not occur yet. As there are uncertainties such as the intensity, time and distribution of the effect, proactive adaptation has a more complicated system than the reactive adaptation. Without having this information, it is quite difficult to identify, for example, flood management plan strategies and planning approaches. Proactive adaptation is also a system based on advance technological capabilities. Flood protection levees are an example of proactive adaptation actions.

Producing of proactive solutions against climate change is limited with the level of information on climate change, the willpower of the political structure to produce solutions and the community's level of perception of the climate risks.

2. CLIMATE CHANGE ADAPTATION TYPES AND METHODS

Climate adaptation facilitates the protection ecosystems, natural systems, community and individuals, helps the economy to become resilient and utilize potential opportunities by managing the risks caused by climate effects.

Adaptation types and methods are identified special to the field for which solution is to be produced by taking into consideration the needs caused by the climate risks and vulnerabilities (Noble et al., 2015).

Aims of adaptation options are as follows:

- To acknowledge the effect and deal with the losses that are caused or will be caused by the risks,
- To balance the risks by sharing (by using insurance and similar measures),
- To avoid exposure the climate risks,
- To develop solutions using new approaches (for example, to develop approaches that turn changing climate conditions to opportunity),
- To provide benefit, and
- To increase climate resilience.

Questions to be answered when deciding on adaptation types:

- What must be done?
- How much and to what extent it must be done?
- When it must be done?

Adaptation types are classified in scientific literature in different ways. In EU Adaptation Strategy, adaptation measures are grouped under two headings as hard adaptation and soft adaptation (Sovacool, 2011; Noble et al., 2014):

- Hard adaptation defines technological and structural solutions. Even though these solutions that are classified as grey and green adaptation are developed to reach the same goal, they have completely different characteristics regarding the used materials, methods and operation techniques. Grey adaptation includes structural and engineering solutions developed to mitigate the effects caused by climate change. Green adaptation defines solutions that aim to increase the adaptation capacity and resilience of natural ecosystems with ecosystem based (or nature based) approaches.
- Soft adaptation, on the other hand, includes political, legal, social, managerial and economic measures such as developing information technologies, establishing institutional and social capacity, identifying policy and strategy, strengthening the coordination among institutions, supporting scientific researches on climate change and its effects, increasing searches for innovative technology and integrating adaptation factor to the existing mitigation strategies.

Adaptation types are grouped under three main headings in IPCC reports, different than EU Adaptation Strategy. They are structural/physical adaptation, social adaptation and institutional adaptation (Table 1) (Noble et al., 2014).

In IPCC classification, hard adaptation types are defined as structural/physical adaptation and are divided into four groups as engineering solutions, technologic, ecosystem based solutions and services. Soft adaptation types are grouped under two headings as social adaptation and institutional adaptation.

Adaptation types are considered with different points of view in these two classification systems that are essentially quite similar to each other. Due to the reasons that EU Adaptation Strategy draws a general framework and our country's adaptation strategies use hard and soft adaptation terms, the details of EU Adaptation Strategy classification are given in this document.

Table 1: Adaptation types and some adaptation options

Adaptation Types	Options
Structural/ Physical Adaptation	Engineering solutions Coastal protection structures, building codes, floating houses, transport and road infrastructures, water storage, disaster shelters Technological Genetic techniques, climate risk maps, early warning systems, renewable energy technologies, food protection and storage facilities, building insula-tion, rainwater harvesting, efficient irrigation Ecosystem based solutions/ nature based solutions Ecological restoration, terrestrial and aquatic ecosystems conservation & restoration, protection and rehabilitation of sandbanks, blue-green infra-structure, supporting biological diversity, wetland and floodplain conserva-tion & management, natural resource management, afforestation and refor-estation, plant code practices, adaptive land use management
Social Adaptation	Services Social safety nets and social protection, food bank and distribution of food surplus, local administration services such as water treatment and cleaning, basic public health services, enhanced emergency medical services, vaccina-tion programs, international trade Educational Integration of climate adaptation to education system, sharing local and tra-ditional knowledge, participative learning, learning over social communica-tion networks Informational Mapping risks and vulnerabilities, early warning and response systems, systematic monitoring and remote sensing, participatory action research and social learning, participative scenario development, monitoring climate data, development of climate models, communication through media Behavioral Individual adaptation, emergency evacuation planning, human security, mi-gration, health, protection of natural resources and ecosystems, reliance on social networks, traditional agricultural practices

Adaptation Types	Options
Institutional Adaptation	Economic Financial incentives including taxes and subsidies, government assistances, insurance, disaster insurance policy, revolving capital, payments for ecosys-tem services, water taxes, loans to small scale operations, disaster contin-gency funds, cash transfers Laws and regulations Land zoning laws, protected areas, protected areas, hunting quotas, building standards, laws supporting disaster risk mitigation, international treaties, water regulations and agreement Government policies and programs National and regional adaptation plan, regional and local adaptation plans, water management plans, disaster planning and preparedness, city-level plans, regional plans, environmental arrangement plans, landscape plans, basin plans, integrated coastal zone management, ecosystem based man-agement, natural resource management, fishing management, community based adaptation

Source: Noble et al., 2014

2.1. Hard Adaptation

Hard adaptation includes engineering solutions and ecosystem based solutions developed against present and possible effects of the climate change.

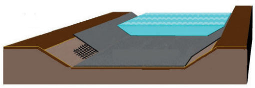
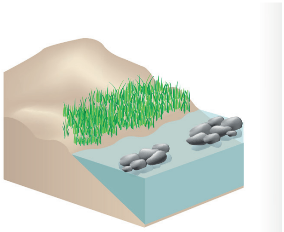
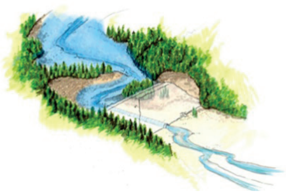
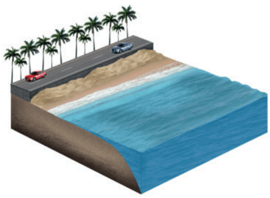
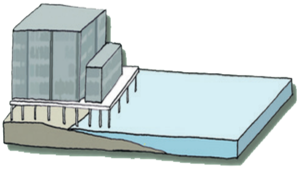
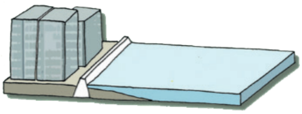
Engineering Solutions (Grey Adaptation)

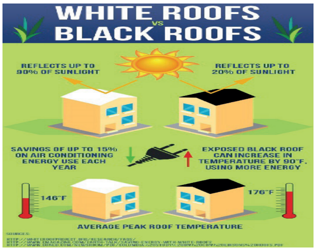
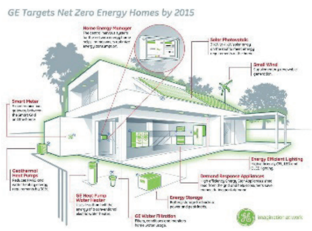
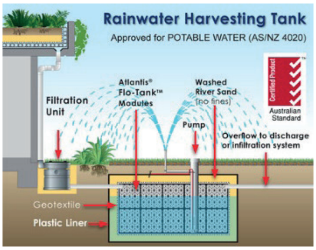
Engineering Solutions are the most commonly used approach in the world against climate effects. The priority goal of engineering solutions is to control the effect of climate change with structural measures. For this reason, ecologic priorities are generally overlooked.

Even though engineering solutions are dependent on the scale, they are complicated measures that can produce effective results at high cost in a short time. For example (Table 2), the following may be listed among engineering based solutions;

- Building breakwaters, flood barriers and flood berms at coastal strips using non-natural materials such as concrete, steel, etc.
- Converting riverbeds into concrete channels for flood prevention
- Building dams on rivers
- Building wind protection barrier around agricultural lands
- Building concrete irrigation channels
- Building sewerage and waste water (grey water) collection channels
- Building water cisterns
- Building walls by using concrete, steel, etc. material to prevent landslides
- Covering roofs and roads with light colored materials or painting them to reflect the sun lights
- Building barriers in cities to protect the buildings and infrastructure systems against flood
- Raising roads against floods and rising of sea level
- Constructing buildings on columns, thus raising them against rising of water level, and
- Constructing smart building systems for the purpose of reducing the consumption of energy and natural resources.

Table 2: Some examples of engineering solutions

	Taking river beds into concrete channels for flood prevention (http://alphasoil.com/content/e197/index_eng.html)
	Building breakwaters in the sea (https://www.habitatblueprint.noaa.gov/living-shorelines/)
	Building dams on rivers (https://kananaskistrails.com/flood-control/2013/)
	Raising roads above sea level (Miami, USA) (https://sealevelrise.org/solutions/)
	Constructing buildings on columns (https://sfpublicpress.org/news/searise/2015-07/four-ways-to-guard-against-sea-level-rise)
	Building breakwaters, flood barriers on coasts using non-natural materials (https://sealevelrise.org/solutions/)

<table>
<tr>
<td>
</td>
<td>Covering roofs and roads with light colored materials or painting them to reflect the sunlight (https://visual.ly/community/Infographics/home/white-roofs-vs-black-roofs)</td>
</tr>
<tr>
<td>
</td>
<td>Constructing smart building systems for the purpose of reducing the consumption of energy and natural resources (https://www.treehugger.com/sustainable-product-design/ge-introduces-green-gizmo-home.html)</td>
</tr>
<tr>
<td>
</td>
<td>Building water cisterns (https://atlantiscorporation.com.au/rainwater-harversting/)</td>
</tr>
</table>

The feasibility of engineering solutions is determined by their estimated lifetime and implementation costs. (Koetse and Rietveld, 2012). Also, they need regular maintenance and repair based on the severity of the climate impacts. Therefore, budget should be allocated for maintenance in the management processes.

They need to be replaced or entirely removed when they complete their functions. This situation brings forth new costs and the management problems of the materials that may turn into wastes. It is not possible to produce permanent solutions with these short term applications that provide temporary benefits.

Another disadvantage of engineering solutions is that these applications, which directly affect the ecosystems, may cause undesired consequences while developing a solution for a problem. For example, sea walls were built to protect the coasts from erosion and floods because of the damage caused by a storm in 1953 at southern coasts of England. However, these seawalls caused the interruption of coast sedimentation movement and damaging of coastal ecosystems and resulted in coasts being weaker (Adger et al., 2009; Turner et al., 2010).

Besides these, scientific works are underway on technologic projects for pumping the carbon in the atmosphere to the underground. However, as in all engineering applications, the effects of these projects on the environment and operation of natural ecosystems should be diligently investigated. Applications implemented with good intentions may cause irreversible losses and consequences.

Ecosystem Based / Nature Based Solutions (Green Adaptation)

Ecosystem Based Adaptation (EbA) is an approach that uses biodiversity and ecosystem services as part of a holistic adaptation strategy to assist human beings to adapt to climate change, by reducing vulnerabilities and increasing resilience of both human and natural systems (IUCN, 2014).

> Ecosystem Based Adaptation is a nature based solution that reduces vulnerability and builds climate resilience by using biodiversity and ecosystem services (IUCN, 2014).

Green adaptation includes applications which aims to control the effects that are or will be caused by the climate change by utilizing ecosystems (ecologic systems) and which produce effective and permanent results in short, medium and long term.

In the scientific literature Ecosystem-Based Adaptation (EbA) is also expressed using different names such as Nature-Based Solution, Ecosystem Based Approach and Nature Based Approach.

Nature based solutions is a general concept that covers different nature based approaches based on ecologic priorities called with different names such as ecosystem-based mitigation (EbM), eco-disaster risk reduction (eco-DRR), Green

Infrastructure (GI) and natural climate solutions (NCS) (Nature, 2017; Griscom et al., 2017; Seddon et al., 2020).

Ecosystem based /nature based solutions is an approach that aims at protecting the ecosystems, rehabilitating them if needed and creating areas (systems) that resemble natural systems. It is based on the principle of producing solutions that have adaptation with and inspired by nature and instead of performing applications that destroy the nature. This is very important for using the natural resources effectively, mitigating climate change risks and creating climate resilient communities. It represents a human-centered holistic approach against climate change that attaches importance to the relation between human, nature and ecologic development. It has the flexibility of being applied in terrestrial and aquatic ecosystems at various scales and scopes (Figure 1).

Ecosystem /nature based solutions (IUCN, 2014; Naumann et al., 2014)

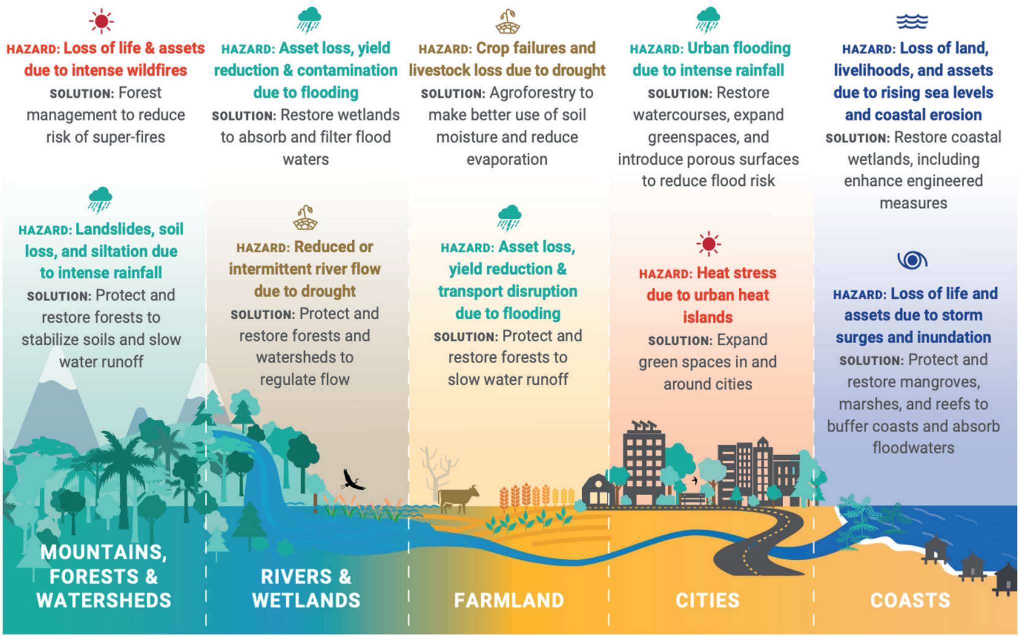
- Increase resilience,
- Reduce ecologic, social and economic vulnerability,
- Enable achievement of climate change goals by providing socio-economic benefits,
- Protect, repair ecosystems, improve their structures and ecologic functions
- Increase biodiversity
- increase ecosystem services and provide priority natural resource management,
- Provide multitude of benefits for sectoral and political adaptation goals,
- Support many adaptation-oriented policies,
- Strengthen the economic structure of the society, provide business and investment opportunities.

Health of the ecosystems directly affects the health of all living organisms. Therefore, human health depends of the health of the ecosystems.

The basis of the nature based approaches is based on the principle that all living organisms (especially humans) need healthily operating ecosystems and the benefits provided by these ecosystems (ecosystem services) in order to maintain their lives (Frantzeskaki, 2019; Seddon et al., 2020).

Natural ecosystems improve air, water and soil quality and play an important role in the adaptation process to the climate change by reducing the carbon emission in the atmosphere. Atmospheric carbon captured and stored by terrestrial and aquatic ecosystems is an important defense mechanism against global warming at global scale. For example, coral reefs, sea meadows and mangrove forests of coastal ecosystems capture high amounts of carbon and also protect the coasts from wave erosion and strong effects of tropical storms. These ecosystems break down the waves, sheltered the coastline and minimize the damages. Also, these ecosystems have a high biologic diversity. They enable the storm water to penetrate into the soils and to be filtered between soil layers. They feed underground and surface water resources. Wetlands capture the rain water like a sponge and help to prevent floods. These ecosystems also provide feeding and living environments for many organisms; they also make positive contribution to the health of all living organisms (Coskun Hepcan, 2019).

Figure 1: Ecosystem /nature based solutions



Source: Global Commision on Adaptation (2020)

Natural ecosystems are living systems and they are under the effects of constantly changing climate and environmental conditions. Therefore, these effects with various intensities, may cause disturbance and changes in the ecosystems.

All natural systems have resilience/flexibility against the effects of the disturbance. This resilience is directly proportional to the vegetation cover and biomass of these ecosystems. Biomass in the general name of all non-fossilized biologic material obtained from living creatures that are still alive or have lived recently. Biomass is not only vegetation cover; it includes multitude of organic and inorganic chemicals that are involved in protection, growth, reproduction, etc. processes in the ecosystems. The richer an ecosystem regarding biomass, the more resilient it is against disturbance. If the biomass of the ecosystem is low, its degree of being affected by disturbance will be high (Forman and Godron, 1986).

Nature based solutions are based on the principle of increasing the resilience of ecosystems and thereby to stabilize the provisioning of important services. The purpose of nature based solutions is not only to protect the nature and the natural ecosystems in their present conditions, but also improve the health and ecologic quality of natural ecosystems. What is needed for this is to protect, strengthen and enhance the resilience of the functional relations between ecosystem components and species. This can be accomplished by taking various measures such as protecting and rehabilitating the ecosystems. By this means, it is intended to prepare the ecosystems for the climate change, to ensure the continuity of the ecosystem services that are needed for all living creatures to maintain their livelihood, especially humans and to mitigate the adverse effects of the climate change (Naumann et al., 2014).

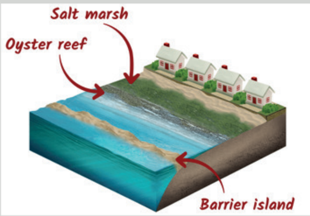
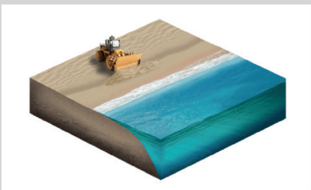
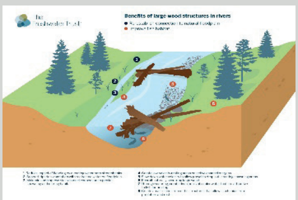
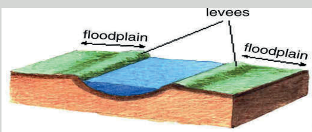
Nature based solutions is an approach that provides effective solutions with small interventions. The following can be listed among some nature based solution examples developed for terrestrial and aquatic ecosystems against the climate change.

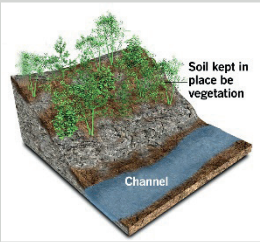
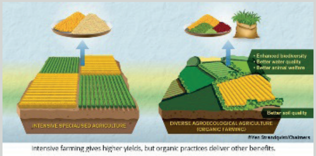
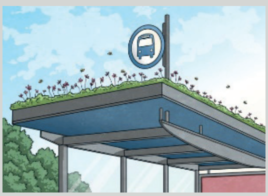
- Creating terrestrial and aquatic ecosystems to sequester and store the carbon in the atmosphere,
- Improving the riverbank ecosystems for protecting the river basins, preventing floods, erosions and landslides,
- Stabilization of coastal landscapes (restoration of coral reefs, creating oyster beds),
- Protection and rehabilitation of sand beaches,
- Rehabilitation of sea meadows,
- Restoration of flood plains by changing the places of flood levees,
- Wetland and water management,
- Slope stabilization,
- Prevention of release of exiting carbon reserves (such as decomposition of peat),
- Restoration of peats used for agricultural purposes,
- Implementing climate resilient agriculture (drought resilient agriculture in

dry regions),

- Climate friendly soil tilling and production of types resistant to drought in agricultural production, using green organic fertilizer,
- Providing habitat for plant and animal species and increasing biodiversity (protection of species and genetic resources),
- Improving the air, water and soil quality,
- Increasing the ratio of green areas in urban landscapes,
- Increasing tree cover in urban landscapes, and
- Increasing the pollinator diversity in urban landscapes.

Table 3: Some examples of ecosystem/nature based

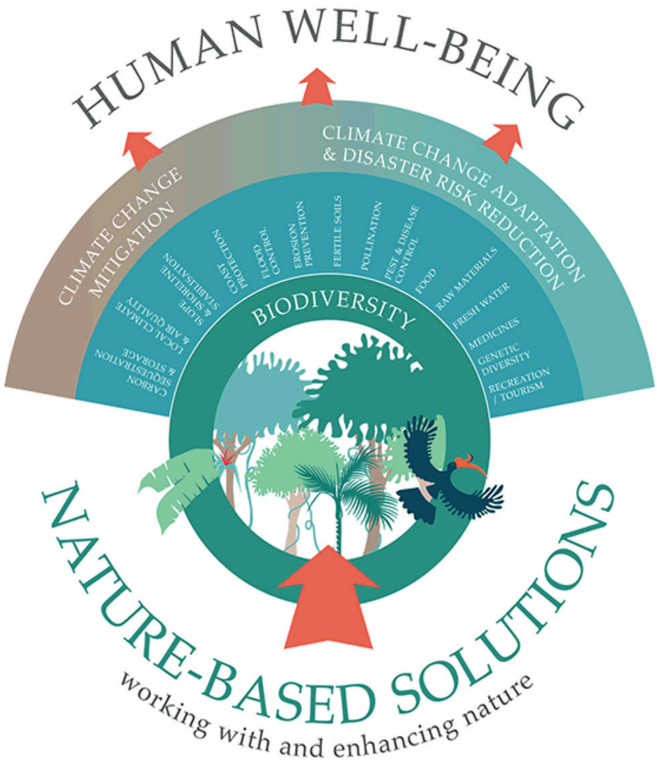
	Stabilization of coastal landscapes, (https://sealevelrise.org/solutions/)
	Protection and rehabilitation of sand beaches, (https://sealevelrise.org/solutions/)
	Protecting the river basins, (https://www.thefreshwatertrust.org/benefits-large-wood-structures-rivers/)
	Restoration of flood plains, (http://www.angelfire.com/hero/gerald_koh_s9029362a/floodplains.htm)

	Wetland and water management, (https://www.tncindia.in/changing-chennais-water-story-by-restoring-its-wetlands/)
	Slope stabilization, (https://www.latimes.com/visuals/graphics/la-g-how-debris-flows-happen-20151016-htmlstory.html)
	Climate resistant agriculture, (https://www.organicwithoutboundaries.bio/2020/03/25/dont-misrepresent-organic-farming/)
	Increasing the ratio of green areas in urban landscapes, (https://www.freepik.com/premium-vector/isometric-building-vector_4161520.htm)
	Increasing tree cover in urban landscapes, (https://atlaslab.com/wp-content/uploads/2018/08/3_atlaslab_Capitol-Canopy.jpg)
	Increasing the pollinator diversity in urban landscapes (https://www.twinkl.com.au/newsroom/story/bees-bus-stop)

Nature based solutions increase the people's quality of life by providing ecologic, economic and socio-cultural benefits and creates new business opportunities in different sectors (green business). For example, they provide investment and income opportunities in many sectors such as tourism, protected area management, forestry and agriculture. Inclusion of users into the solution process makes positive contribution to the strengthening of the interaction and bond between people and nature, increasing of awareness about the importance of these ecosystems and embracing and protection of the conducted application (Figure 2). Considering the ecosystems as open laboratories and education centers increase their social values in addition to these areas' ecologic values.

Nature based solutions bring together the goals of mitigation and adaptation, disaster risk mitigation, protection of diversity and sustainable resource management. All these benefits provided by the ecosystems meet the mitigation and climate adaptation goals developed for the effects of climate change. For example, nature based mitigation measures use ecosystem services for greenhouse emission reduction, protection and expansion of carbon sinks. In nature based adaptation, it is intended to use ecosystem services for mitigating the expected adverse effects of climate change such as changing of precipitation regime, flood, seasonal hot and cold waves and drought (Naumann et al., 2014).

Figure 2: Nature based solutions



Source: Nature Based Solutions Initiative (2020)

In addition to achieving political goals and finding solutions to the problems of the sector, nature based solutions provide ecologic, economic and social benefits at various scales. For this reason, they are defined as no-regret solutions. Even if effects of climate change different than the predicted ones occur, nature based solutions still continue to provide benefits. These approaches are usually low budget solutions and have the flexibility to adapt to the continuously changing climate change and related risks (Naumann et al., 2014).

For examples, ecologic improvement of a river bank ensures the greenhouse gas emissions to drop, adaptation capacity of ecosystems to increase and gain protection skill against the harms of the floods. Restoration of peat bogs regulates water balance in the landscape, provides habitat for endangered species and also makes significant contribution to decreasing greenhouse gas emissions and achieving national climate goals.

Rising of sea water temperature due to global warming, installing fish and seafood farms and sustaining damage due to excessive fishing make the coasts much more vulnerable and sensitive against the effects of climate change such as rising of sea level and severe storms.

Coral reefs, which are of the coast ecosystems, sea meadows and mangrove forests capture large amounts of carbon and also protect the coasts against wave erosion and strong effects of tropical storms. These ecosystems slow down the speed of the waves and storms with the ecosystem services they provide and prevent sea water (salt water) from entering interior parts of the shore and causing damage on coastal and inland ecosystems and urban areas or minimize the damages, and also, protect biologic diversity.

One of the engineering based climate adaptation works developed for areas of damaged or entirely destroyed coral reefs is to place large concrete balls, strengthened with the addition of micro silicon, to mitigate the damage the waves would cause at the shores. These balls allow living organisms such as planktons to live on them, but they do not have suitable conditions for other sea creatures to live. For this reason, biodiversity is low in these areas and they do not provide social benefit. Rehabilitation of reef ecosystems instead of using concrete balls creates habitat for many sea creatures to feed, find shelter and reproduce and slows down the rate of change. This ecologic solution also supports the local economy, because it allows usages such as fishing, tourism and recreation.

Coastal wetlands mitigate the possible effects of storms and rising water level by scattering a large part (approximately 90%) of the wave energy. By this means it helps to keep the water level at interior parts of the river estuarine. Wetlands hold the water like a sponge, prevents floods. For this reason, it is very important to protect the wetlands especially in and around the urban areas. Coastal wetlands and sea meadows are aquatic systems that also have carbon beds which help to reduce the greenhouse gas emissions in the atmosphere. Sea meadows (Posedenia oceanica) weaken the wave energy, prevent coastal erosion and provides for the stabilization of sand and sediments at the shores (Arkema et al., 2013).

Oyster beds at the shores disperse wave energy, like coastal wetlands. Coastal sand dunes work as buffers and barriers during storms.

The use of aquatic ecosystems as natural tools in the actions of climate change mitigation and adaptation will increase the chance of success in the short and long term. For this reason, it is important to protect marine and coastal ecosystems, increase their areas if possible and improve the quality of damaged ones. Marine and coastal ecosystems are natural systems that can be used to develop nature based solutions at the coasts.

Nature based solutions increase the ecologic, social and cultural flexibility of the coastal cities with the ecosystem services they provide. Participation is very important to enhance the effectiveness of nature and ecosystem based solutions.

With measures such as these, especially in water management and coastal protection but also in city and regional planning, new jobs can be created. In addition, shifts in forestry from monocultures to mixed forests, which are less susceptible to the impacts of climate change, can also be nature-based adaptation approaches (Naumann et al., 2014).

Nature based solutions are much more economic than the engineering solutions that can be developed for the same purpose in many situations. For example, the cost of building water treatment facilities is much higher than the budget needed to protect and restore the wetlands that filter the water naturally (Naumann et al., 2014). Similarly, developing sustainable storm water management solutions in cities with green infrastructure components requires less cost than the money spent for the construction and management of waste water collection systems.

The factors that affect the effectiveness of nature based solutions depend on the reactions that the ecosystems give against the effects of climate change, the pressure that the effects of non-climate origin put on the reactions of the ecosystems, the time frame needed for the effectiveness of ecosystem/nature based solutions to become apparent, temporal and spatial climates in natural systems and diversity of the segments that benefit from the solutions (Kapos et al., 2019).

Furthermore, protection and expansion of water basins lowers the cost of drinking water, prevents water pollution, and mitigates water shortage against drought caused by climate change (Naumann et al., 2014).

Nature based solutions can also be easily used together with engineering solutions (Naumann et al., 2014). As the principle of protection and management of natural and semi-natural ecosystems is adopted in nature based solutions, they can be integrated with green and blue infrastructure in cities; ecosystem based agricultural practices in agricultural landscapes and ecosystem management in natural landscapes (MEA, 2005). This kind of hybrid applications began to be preferred over engineering solutions in coast management and rainwater management.

With their properties of being applicable at local, national, regional, continental and global scale, being adaptable to local resources, providing solutions to the problems of more than one sector at the same time, having cost effectiveness and long service life, nature based solutions have superior features compared to engineering solutions.

Financing and management of nature based solutions

Even though climate change causes serious problems that affect the whole world, the budget al.,located to produce solutions to the effects of climate change is less than 5% of the total budget of the global economy. The ratio of nature based solutions in this budget is 1% (UN Environment. 2019; World Economic Forum. 2019).

In its latest report the Global Adaptation Commission stated that the benefit provided by the ecosystems obtained by the protection and restoration of mangrove forests is more than 10 times the budget al.,located for these works (Global Commission on Adaptation, 2019). However, insufficient budget is still considered to be one of the biggest obstacles for the implementation and monitoring of nature based solutions (Faivre et al., 2017; McVittie et al., 2017; Dale et al., 2019)

Various supports are being provided by national and international funds for the purpose of promoting and spreading of nature based solutions. IUCN (The International Union for Conservation of Nature), OECD (The Organization for Economic Co-operation and Development), UN (United Nations), IFI (International Financial Institution), The World Bank, EU (European Union) are implementing projects together with countries and local communities to promote the nature based solutions with application examples in the whole world. Furthermore, Global Environmental Facility, Green Climate Fund, Adaptation Fund and German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the International Climate Initiative (IKI) are providing fund support. Within the scope of HORIZON (European Structural and Investment Funds) and LIFE programs of the European Union, special invitations are made supporting the development of projects and practices that include nature based solutions at various scales in cities. The urgency of adaptation actions determines the priorities in utilizing these funds. Furthermore, generally additional financing by the applying entity is needed for the utilization of these funds. If a budget is not allocated by the public or private entity that makes the application, this constitutes an obstacle for the utilization of funds. In addition, the tendency of the public and private sector is to support short term implementations yielding fast results, rather than long term planning and management practices (Kabisch, 2016).

One of the basic reasons for this problem is the fact that the benefits provided by nature based solutions are not emphasized sufficiently at national and international level. Also, proper risk calculation and sharing must be done in nature based solutions. In many cases, investments borrow loans for the implementation of projects.

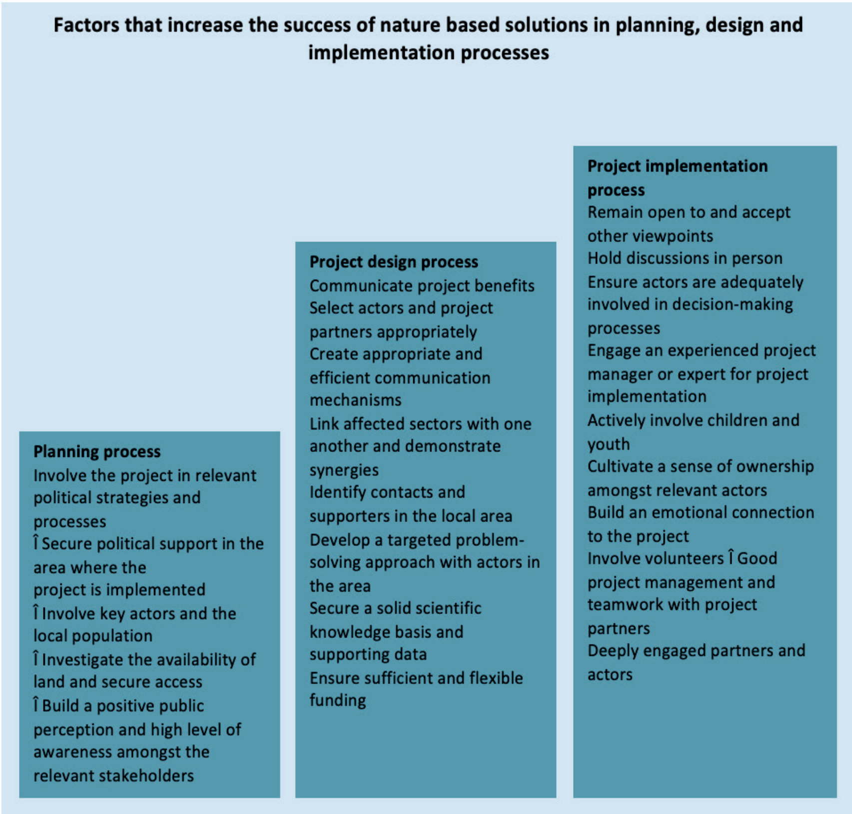
The goals of the countries that have growth-oriented economies include the implementation of large scale engineering projects with industrialization focus. Public and private sector actors that aim to produce economic growth and produce solutions in a short time do not consider nature based solutions as feasible projects (Kabisch et al., 2016).

Nature based solutions bring together various actors with intersecting authority boundaries, creates synergy among different sectors and provides for the realization of different political goals at the same time (Naumann et al., 2014). For example, in the process developing rain water management solutions in water basins with nature based approaches representatives are assigned from local, regional and central governments as well as from local administrations. In order for this nature bases work to be managed successfully, which involves agriculture, forestry, environment, economy and transportation sectors, all stakeholders must work in full cooperation and coordination, even if their goals or priorities are different than each other (Dale et al., 2019).

Lack of political consistency, which emerges due to the presence of units that consider the adaptation as responsibility of others, is another management problem. However, effectiveness of nature based solutions is difficult to predict compared to other engineering methods and this is also seen as a problem. Other difficulties encountered in the process are that weak economy models are used in the evaluation of nature based solutions and presuppositions of the managements that engineering solutions will be more effective in climate adaptation and mitigation works (Finewood, 2016).

In order to deal with all these problems systematic research should be done on how communication will be made in interdisciplinary investigations, how the entities will be organized and how the process will be managed (Figure 3).

Figure 3: Factors that increase the success of nature based solutions



Source: (Naumann et al., 2014).

In line with the requirements and suitability of institutional and legal framework, insurance companies may be seen as potential investors in ecologic restoration. Climate risks began to be included in the policies of insurance companies. Insurance premiums are being re-arranged in this context. Taking into consideration that climate risks will decrease in the areas where ecologic improvements are made, therefore risks for health and immovable properties will fall, insurance companies may be seen as potential investors (Noble et al., 2015).

Nevertheless, there is a need for a new point of view where nature based solutions are integrated into climate and biodiversity crises. In this new approach, instead of unlimited growth for human welfare, it must be acknowledged that the flow of material and energy in ecosystems are needed for the ecosystems and for human health. Nature based solutions have a significant role for achieving sustainable development at global scale. However, their benefits may not be adequately appreciated without seeing the consequences of successful implementations.

As countries modify their climate policies (Nationally Determined Contributions), the priorities of their climate policies may change from reduction of greenhouse gas emissions to achieving the climate adaptation goals (National Academies of Sciences, Engineering, and Medicine 2019).

Nature based climate adaptation became quite an important issue for national and international policies. Paris Agreement emphasizes the need to make investment in the nature, with the simplest expression. In a parallel manner, in nature based solutions investment is already made to nature and natural resources.

When investment is made to nature with nature based solutions, requirements of many EU regulations are fulfilled at a low cost such as Habitat Directive, Bird Directive, EU Biodiversity Strategy, Water Framework Directive, EU Flood Directive, EU Water Framework Directive, European Adaptation strategy (Naumann et al., 2014).

Nature based solutions should be included in global, national and local adaptation policies, political strategies and action plans for possible mitigation and adaptation measures as much as possible. When the action plans and adaptation types for strategies are identified, nature based solutions suitable for these purposes should be investigated. Sustainability, adequate budget, economic and ecologic values and socio-economic benefits should be taken into consideration and their advantages compared to alternative engineering solutions should be carefully indicated.

Sharing the information and experience obtained from implemented project examples will be useful for developing and understanding nature based approaches. Cost effectiveness and long term social, economic, cultural and ecologic benefits will help to popularize the implementation of nature based solutions. It is intended to support multitude of projects at European and global scale for the purpose of proving their effects.

2.2. Soft Adaptation

Soft adaptation defines the non-structural adaptation actions developed against the effects of climate change. It includes the political, legal, social, managerial and economic measures taken to improve the adaptation capacity and increase the resilience. The following can be listed as examples of these measures (Noble et al., 2015; Talu, 2019; ÇŞB, 2011):

- Making legal regulations on the subject of adaptation,
- Making legal and administrative regulations for the protection and effective use of natural resources,
- Assigning a central authorization in the national legislation structure for adaptation works,
- Providing coordination among institutions, identifying duties and responsibilities,
- Organizing training courses for technical and administrative personnel in all public institutions for the purpose of enhancing institutional capacity,
- Organizing training and information programs for political representatives and executives working at central and local administration units,
- Organizing training courses for public sector managers and employees of every scale,
- Teaching climate adaptation courses in training programs at every stage of the education system,
- Using the press, visual media and social communication networks for sharing information on climate mitigation and adaptation measures
- Training the public and other groups on the properties of climate risks and how they should be managed,

- Making climate arrangements on the basis of sectors and thematic fields,
- Making risk projections according to sectors and thematic fields (for example, developing predictions on how heat waves may affect agricultural production, human health, transportation systems, operation of ecosystems)
- Organizing training courses for sectors,
- Developing guides for climate resilient solutions on sectors basis,
- Supporting climate friendly investments in all sectors,
- Converting public buildings into climate resilient structures,
- Developing emergency early warning systems and risk protection systems,
- Preparing emergency evacuation plans,
- Taking measures for the protection of environment and the public, improving socio-economic welfare,
- Mitigating the vulnerability of sensitive groups, developing community-based adaptation solutions for eliminating social inequality,
- Establishing communication networks needed for ensuring social resilience,
- Creating social capitals,
- Providing for social participation at adaptation stages, sharing information for improving individual and social climate awareness,
- Preparing national, regional and local adaptation plans,
- Providing economic incentives, disaster funds, loans, etc. supports within the scope of adaptation measures,
- Developing climate insurance and reserve plans for all sectors,
- Integrating adaptation solutions to physical plans,
- Enabling the utilization of national and international funds for developing adaptation measures,
- Establishing climate branches that work effectively with local administrations,
- Taking climate adaptation researches into the scope of high priority fields,
- Developing climate models, preparing climate vulnerability and adaptation analyses,
- Supporting climate mitigation and adaptation technologies,
- Providing coordination among non-government organizations, research entities, private sector and central and local administrations,

- National data collection,
- Preparing guide for climate resilient buildings in places under disaster risk (for example, arranging the ground floors of buildings as water holding areas when the water level rises in places where there is a flood risk),
- Preparing the list of plants that can be used in cities for climate resilient cities, and
- Creating programs for monitoring and evaluation of adaptation measures.

In conclusion, in order for the efforts for mitigation of ecologic, social and economic vulnerabilities caused by climate risks and increasing of climate resilience to yield results, proper and comprehensive adaptation types must be decided on and the process must be managed successfully.

Adaptation types have weak points and superiorities relative to each other. Compared to engineering solutions, ecosystem/nature based solutions combine many benefits in the same denominator because of the reasons that they have adaptation to natural systems and provide socio-cultural and socio-economic benefits in addition to ecologic benefits in the short, medium and long terms.

When hard and soft adaptation types are used together, political, legal and administrative supports will be provided for structural solutions and success of the adaptation actions will increase.

Considering that the climate crisis of today is caused by humans, it damages ecologic systems, all living organisms need ecosystems to maintain their livelihoods and need the benefits provided by them it is clearly seen that ecosystem based solutions must be prioritized in determining the adaptation types to achieve the adaptation goals.

3. CLIMATE ADAPTATION IN CITIES

Approximately half of the world's population lives in cities and they grow in an unsustainable manner under construction and development pressure. They are also the landscapes where effects of the climate change are seen most intensively (Coskun Hepcan, 2019).

Cities are part of the solution as much as they are part of the climate change problem. Being places where population, investments and infrastructure are concentrated makes it possible to develop low cost and effective solutions in cities (Satterthwaite et.al, 2007). For this reason, cities play an important role in efforts for mitigation and adaptation activities related with climate change yielding result (Tuğaç, 2014). Cities may, in a way, function as a laboratory as well as a practice site.

The success of the activities related with climate change is directly proportional to the success of climate change adaptation and greenhouse reduction activities in cities (Tuğaç, 2018). Every city has its own climate, natural, cultural demographic and ecologic characteristics, green area planning and design policy and practice, therefore a character peculiar to itself. For this reason, it will be appropriate to develop climate adaptation measures on the basis of the cities' original values (Coskun Hepcan, 2019). Also, climate adaptation measures taken at city scale are more effective and economic compared to individual measures (Satterthwaite et.al, 2007).

Increasing of building density and decreasing of natural ecosystems in cities reduce the resilience of the cities to climate change; therefore, cities get affected more severely by the extreme weather events caused by climate change. To increase the climate resilience of the cities, it is required to increase the amount of green areas in urban landscapes and strengthen the city regarding green-blue infrastructure. Cities need green infrastructure strategies that present the existing green-blue infrastructure potentials of the cities and that are aimed at both developing this structure and the goal of providing guidance for spatial planning processes. While it is required to protect and rehabilitate existing ecosystems in some cities, in some other cities new green areas need to be created.

Cities are in continuous interaction with the ecosystems in their immediate surroundings and it is not possible to consider cities isolated from their surroundings. For this reason, climate adaptation actions in cities must be prepared to include the ecosystems in the cities and in their immediate surroundings.

All green areas have resilience against the effects of climate change. This resilience varies depending on the ecologic properties of the green areas. As the natural qualities of green areas improve, so do their ecologic resilience. Ecosystems where ecological processes function healthily play an important role in increasing the climate resilience of the cities.

Local administrations have a significant responsibility in the implementation of climate adaptation actions in cities. For this reason, in many countries institutional structure of the local administrations is being re-designed and units are being formed to execute climate adaptation works. These units may be independent units or they may be offices working under planning units. Offices of Resiliency and Sustainability under City Planning Departments in New York and Florida states and Offices of Resilience in Atlanta and Rotterdam are among these. The main goal of these units is to make the cities have a climate resilient structure and their duties include the following:

- Identifying climate risks,
- Determining adaptation solutions,
- Conducting works for integrating adaptation methods with physical plans,
- Supervising the adaptation practices.

In 2019, climate branches began to be founded in local administrations in Turkey.

Updated were mad in the administrative structures of the local administrations with the "Regulation Concerning the amendment of the Regulation Concerning Norm Positions Principle and Standards in Municipalities and Their Affiliates and Local Administration Associations" published in the Official Gazette dated 8 April 2020. It has been decided with this arrangement to found "Department of Climate Change" in metropolitan municipalities and "Climate change Branch Directorates" in municipalities. This arrangement is of importance for consolidating the authority at one center on the subjects of adaptation to climate change and greenhouse reduction by local administrations and for taking rapid steps towards the solution.

Adaptation solutions that can be implemented in cities include the following:

- Making the climate adaptation part of the local politics. Re-arranging the institutional legislation in this context,
- Making the climate adaptation part of the spatial planning process,
- Preparing construction plans to have the flexibility to respond to the climate effects,
- Preparing city climate adaptation plans,
- Preparing all units in public entities for climate adaptation,
- Making legal and administrative arrangements for developing nature based solutions in public entities,
- Prioritizing climate adaptation for all sectors,
- Ensuring active participation of individuals to adaptation processes using economic support, tax reduction, award, etc. mechanisms,
- Preparing climate models (temperature, precipitation, etc.) and risk maps of the city and developing adaptation solutions based on these models (example of Copenhagen),
- Identifying ecologic, social and economic vulnerabilities of the city Preparing heat island and flood maps of the city,
- Mitigating urban heat island effect (planting trees with large canopies in car parks, planting trees on streets, reducing the heat island effect generated by these areas),

- Integrating adaptation solutions to city plans,
- Encouraging the use of green roof practices,
- Considering the dry creek beds taken into concrete channels together with river corridors and flood beds and arranging them as blue-green corridors with ecologic rehabilitation works,
- Implementation of sustainable storm water management facilities such as bioswales, rain gardens, sponge parks, etc. (identifying sponge city approach),
- Increasing the permeable surfaces in the city,
- Reducing the urban heat island effect with the shading and cooling effect utilizing tree canopies; lowering the energy needed by buildings for heating and cooling with the use of green roofs and green walls,
- Protecting the natural ecosystems in the city,
- Making legal adjustments for using natural plant species that are adapted to the local climate conditions in the cities and thus, preventing the use of exotic plants that may cause harm to the ecology,
- Cooperating with academic institutions for the purpose of developing designs with climate adaptation in cities (for example, New York State Department of Environmental Conservation and Cornell University Landscape Architecture Department are working together on building "design studio with climate adaptation" where designs with adaptation can be developed),
- Developing innovative approaches for waste management and recycling (For example, stopping the use of plastic in beverage bottles and start using glass gradually),
- Developing measures to increase biodiversity (pollinator attracting plants, pollinator houses, bus stops with green roofs – example of Holland Utrecht city),
- Putting a regulation on traffic to reduce the use of vehicles in the city (dividing the city into zones and restricting the vehicle entrance to these zones for certain periods, reading license plates with cameras and applying fines to those who break rules),
- Encouraging the use of clean energy resources,
- Defining rules for the use of natural resources (for example, in Australia

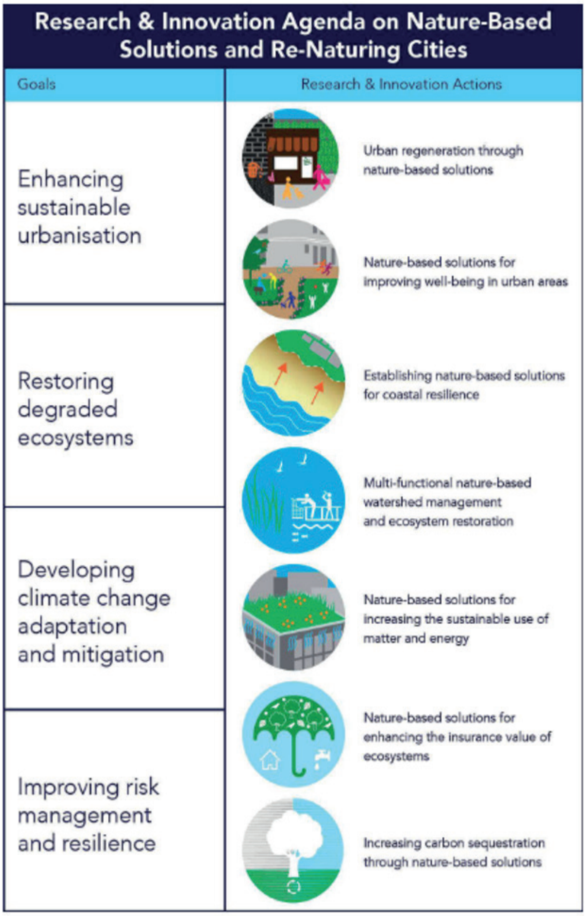
conditions have been defined for using water),

- Identifying the investment priorities for eliminating possible problems in climate caused risks
- Making activities and arrangements to change habits for making adaptation the responsibility of the individuals,
- Preparing risk identification emergency action plans for sectors for climate crises
- Identifying the risks that sectors may face and working on foresights about how a risk emerging in one sector may affect other sector (for example, identifying the possible effects of health sector on agriculture sector),
- Developing early warning systems for such as extreme events such as heat waves, severe rain, floods, bad weather conditions, dangerous solar radiation and fire and sending warning messages to mobile phones, TV, radio and social media,
- Identifying how drought will affect agriculture, determining product patterns, making transition to environmentally friendly soil tilling and agricultural production techniques and encouraging the adaptation of local products to these rules, and
- Mobilizing legal, managerial, administrative and financial instruments that will turn urban transformation practices to opportunities in the struggle against climate change.

Implementation of nature based solutions in cities

EU executes policies for member countries and prospective member countries to develop and implement nature based solutions and encourages the countries. In this context, four goals (enhancing sustainable urbanization, improving the restoration of degraded ecosystems, developing climate change adaptation and mitigation and improving risk management and resilience) and seven related sub-goals (city renewal using nature based solutions, nature based solutions for improving well-being in urban areas, establishing nature based solutions for coastal resilience, multi-functional nature based watershed management and ecosystem restoration, nature based solutions for increasing the sustainable use of matter and energy, nature based solutions for enhancing the insurance value of ecosystems and increasing carbon sequestration through nature based solutions) have been identified in order to help Europe to achieve its aim of being a world leader in responsible innovation, while meeting the needs of society (Figure 4) (Nature-Based Solutions & Re-Naturing Cities, 2015).

Figure 4: Innovative approaches to develop nature based solutions in cities



Source: Nature-Based Solutions & Re-Naturing Cities (2015).

Goals

Enhancing Sustainable Urbanisation

Currently, 73% of Europe's population live in cities and this is projected to increase to 82% by 2050, resulting in over 36 million new urban citizens (UN, 2018). In this situation, which means that approximately 36 million people will move to the cities, will cause problems of access to natural resources and fair economic growth in cities (European Commission, 2015).

While the desire to provide healthy and livable environments for people creates new business and production opportunities for many sectors, unfortunately it also increases the risks of converting natural and semi-natural areas for other land use types (especially construction), deterioration and pollution. In a sustainable urbanization model with nature based solutions there is a need for large natural areas in and around the cities. The reason for this is to benefit from the ecosystem services provided by ecosystems in these areas (Nature-Based Solutions & Re-Naturing Cities, 2015).

Sustainable city plans containing nature based solutions improve the ecologic qualities of the cities and increases the resilience of the cities against climate caused risks such as drought, flood and heat waves. Presence of natural areas also reduces the pressure on the natural areas in the vicinity of the cities. For example, treatment of waste waters in wetlands of natural character in the city will prevent the use of wetlands close to the city and keep them from being polluted (Nature-Based Solutions & Re-Naturing Cities, 2015) (Figure 5).

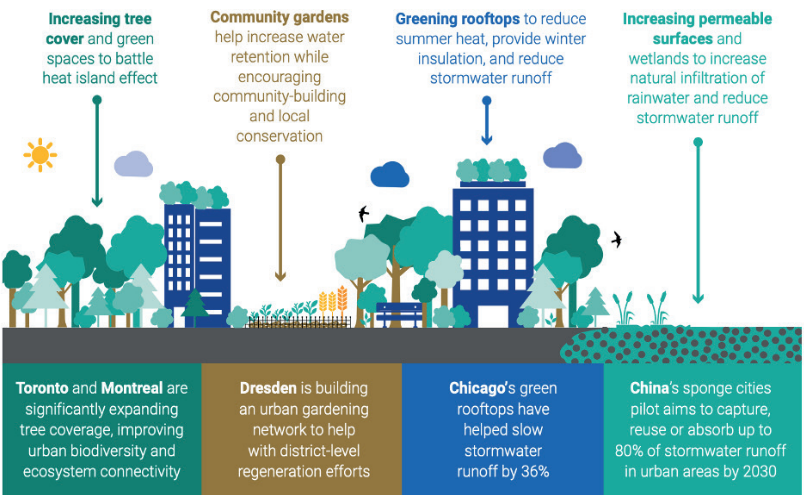
Nature based solutions support economic growth and stability in cities. Renewal of the cities' parts that are damaged and lost their functions within the scope of urban transformation taking into consideration ecologic concerns rehabilitates ecologic qualities of these areas, raises real estate prices, increases economic investments in these areas and raises the people's quality of life (Nature-Based Solutions & Re-

Naturing Cities, 2015).

Nature based solutions also make contribution to the social dimension of sustainable urbanization. For example, green areas make positive contribution to the physical and mental health of the people. It has been proven with many scientific studies that the rate of having cardiovascular, respiratory, diabetes, depression and similar diseases is quite low for people who have easy access to green areas and spend time in these areas regularly (Nature-Based Solutions & Re-Naturing Cities, 2015).

Furthermore, Covid-19 pandemic that broke out at the end of 2019 and declared global pandemic by World Health Organization in February 2020 has emphasized the importance of green areas in and around the cities for human health. Many studies showed that the number of individuals who caught this disease, which affects the respiratory system and the lungs, is high in cities where green area amount is scarce and air quality is low (Pieter and Andree, 2020). Amount of green areas in cities directly affects the human health. The benefits provided by green areas in quite important especially for sensitive groups such as elderly and children.

Figure 5: Nature based solutions that can be implemented in cities



Source: Chu et al., 2019

The epidemic has also showed the inadequacy of green areas in and around the cities. During the epidemic, to reduce the infection risk of the disease authorities recommended people to exercise physical isolation in social medium, not to spend time in closed places like offices and shopping malls where people are present in crowded groups and not to use public transportation. After the announcement of these restrictions majority of the people living in cities turned to open spaces such as streets, parks, walkways, shorelines, building/housing complex gardens, etc. The urban green areas, which have a small ratio in settlement areas, began to be used by large number of people and it was not possible to keep the social distance in these areas. In the end, the use of open and green spaces was prohibited in cities. Considering that other epidemics may break out in the future with climate change, it will be appropriate to develop new approaches for increasing the ratio of green areas in cities in urban planning practices by utilizing the experience obtained in this process.

Moving nature-based solutions higher up the urban design and planning agenda is a major opportunity to prepare the cities for the future, providing an innovative ecosystems approach that can contribute to the resilience and economic growth of a city and to human well-being (Nature-Based Solutions & Re-Naturing Cities, 2015).

Improving the Restoration of Degraded Ecosystems

Urbanization and other human activities cause the destruction and damaging of many ecosystems. For example, 60% of the wetlands in Europe were entirely destroyed (Revenga et al., 2000). Unfortunately, the situation of the ecosystems in Turkey is not different than the continent of Europe.

Intensity of the pressures on ecosystems varies according to the ecologic properties of these areas and their geographical locations. However, regardless of their ecologic properties and geographical locations; agricultural intensification, grey infrastructure expansion, pollution of brownfield sites, hydrological modifications to water bodies, the intensification of forestry practices and, generally speaking, climate change appear as the most important practices that damage the ecosystems. These affect the ecosystems' ability to function, deliver ecosystem services and meet other challenges, such as water purification, soil erosion protection, flood damage control, carbon sequestration and the provision of liveable places and recreational opportunities that contribute to human well-being, economic stability and physical security (Nature-Based Solutions & Re-Naturing Cities, 2015).

Economic data shows that there is a loss of 3% of the gross national product (450 billion Euros) in European economy every year due to only the loss of biodiversity and natural resources. In order to prevent natural resources being damaged any further or being used in an unsustainable way, it has become the priority of Europe and many world countries to rehabilitate at least 15% of the damaged ecosystems (Nature-Based Solutions & Re-Naturing Cities, 2015).

There are many scientific evidences showing that rehabilitation of natural ecosystems reduced the possible risks and hazards and enhances the ecologic resilience. For example, rehabilitation of damaged natural sedimentation process by improving the coastal ecosystems protects the coasts against rising of sea water level and storm damage. Re-establishing forest ecosystems in areas are damaged and that lost their forest property prevents soil loss at sloped regions, allows rain water to feed the water resources, captures the carbon in the atmosphere and stores it.

In addition to increasing biodiversity, restoration/rehabilitation of these habitats makes contribution to the local tourism and resulting economic income and generates new business and education opportunities (Revenga et al., 2000).

Developing Climate Change Adaptation and Mitigation

Climate change has ecologic, economic and sociologic consequences. For example, it is estimated that the annual loss climate change on EU economy according to 2,5 °C scenario will be 20 million Euros, according to 5.4 °C scenario 65 million Euros. Mitigation of climate change effects means reducing CO_2 emissions and lowering energy demand on fossil based fuels; adaptation means reducing the severity of the effects (Nature-Based Solutions & Re-Naturing Cities, 2015).

Climate change is one of the effects that damage and destroy numerous ecosystems. Because climate change is a multi-faceted inclusive problem, it is required to develop integrated nature based solutions for the problems of different sectors that can meet the requirements on mitigation of climate change effects and adaptation. Integration of nature based solutions in cities with grey, blue and green infrastructure systems allows natural resources to be included in climate change mitigation and adaptation works. Also, zero waste approach and practices make positive contribution to natural resource management (Nature-Based Solutions & Re-Naturing Cities, 2015).

Restoration of flood areas is an example of successful climate change mitigation and adaptation project incorporating nature based solutions. In Holland, the Noordwaard plain, which was gained from the sea, was restored within the scope of `room for the river` project. Restoration protects 4 million people living in the area from flood and overflow risk caused by climate change, it also increases the recreation facilities and strengthened the economy (Warner et al., 2013).

Improving Risk Management Resilience

The implementation of nature-based solutions offers major opportunities to reduce the frequency and/or intensity of different types of hazards. Therefore, they should form part of a range of measures and actions in integrated risk management, as they can provide more advantages than conventional methods (Nature-Based Solutions & Re-Naturing Cities, 2015).

In order to guarantee for the politicians, executives and managers make investment in the implementation process, these benefits of nature based solutions should be made clear.

According to the data of Centre for Research on the Epidemiology of Disasters (CRED) approximately 1.3 million people died as a result of climate-related diseases between years 1998-2017 in the world, 4.4 billion people were affected and millions of dollars of damage was incurred (Erkan et al., 2019).

Predictions show that, unless measures comprising powerful adaptation policies and actions are not taken losses due to floods in coastal cities on the continent of Europe will be 17.4 – 25.4 million Euros in 2080 (1.9 Million Euros in 2014), losses due to river floods will be 97.9 million Euros (5.5 million Euros in 2014) (DG Environment, 2014).

Nature based solutions, which are fair-priced practices in the long term, began to become part of the development process for urban risk management plans. Numerous innovative approaches are being developed that blends nature based solutions with engineering solutions. Heat stress caused by the heat island effect in cities can be reduced by increasing the amount of green areas. Roof gardens and vertical gardens (green walls) can be used for the same purpose in areas where the building density is high. These practices can lower the surface temperature by up to 10 °C in Mediterranean climate region. Also, green roofs and vertical gardens provide other benefits such as reducing the risk of flood, lowering air pollution risk, decreasing energy consumption of buildings (by 10-15%) and improving the quality of life (Nature-Based Solutions & Re-Naturing Cities, 2015).

Recommended Research and Innovation Actions

Urban regeneration through nature based solutions

- Deserted regions and problematic areas that lost their functions in cities are potential sites for the implementation of nature based solutions. Nature-based solutions have an important role to play, for instance, through supporting the implementation and optimization of green, blue and grey infrastructure (Nature-Based Solutions & Re-Naturing Cities, 2015).

- Because of the reason that building density is high in majority of the cities, it is almost impossible to find suitable sites to create new green areas. Therefore, solutions should be searched for to make unused buildings or grey structure components parts of green infrastructure using nature based solutions. The Promenade Plantée in Paris, where old railroad viaducts were converted into elevated parks and green corridors, Highline park in New York and LowLine park, also in New York, where unused underground metro stations were converted to parks are among best known and successful examples of these implementations. Similarly, there are sustainable urban growth examples where unused land plots are converted to hobby gardens, old factories and waste storage sites to city parks and fair grounds. Urban transformation practices can be utilized as an opportunity for this purpose (Nature-Based Solutions & Re-Naturing Cities, 2015).
- Implementation of innovative nature based solutions in cities also allows testing of these solutions' ecologic, sociologic and economic effectiveness. This is important to modify these solutions when required (Nature-Based Solutions & Re-Naturing Cities, 2015).

Nature-based solutions for improving well-being in urban areas

- In cities where building density is high and green area amount is low, making nature based solutions part of city plans improves people's quality of life.
- Green areas being accessible in cities, people spending time regularly in these areas and making physical activities have positive effects on human health. Also, social communication gets better between individuals who spend time together in open spaces, crime rate drops and people feel safe (Coley et al., 1997).
- The biggest problem in the future for creating livable cities in the future will be integrating green areas into the cities as parts of the urban life (Hartig et al., 2014). For this reason, physical planners must develop innovative construction and green area solutions that will have flexibility against external effects, by using practices comprising nature based solutions in cities. Employing experts

from different professional disciplines, user and executives in planning and design may give nature based solutions this flexibility and innovative approach (Nature-Based Solutions & Re-Naturing Cities, 2015).

Establishing nature based solutions for coastal resilience

► Developing nature based solutions in terrestrial and aquatic ecosystems in coastal landscapes increases the resilience of these areas against risks such as rising of sea water level storms and coast erosion.

Multi-functional nature-based watershed management and ecosystem restoration

► Restoration of river banks and flood areas using nature based solutions lowers the risk of flood and drought, improves water quality and increases biodiversity. Especially restoration of river flood areas keeps the water inside the flood area and keeps carbon rich soils under the water, regulates sediment movements. These restoration works also allow recreational activities such as fishing, wildlife watching, swimming, canoeing and similar water sports and generates new business opportunities in different sectors (Nature-Based Solutions & Re-Naturing Cities, 2015).

Nature-based solutions for increasing the sustainable use of matter and energy

► Energy consumption of buildings can be lowered by planting trees and other vegetation in the immediate vicinity of the buildings. Green roof practices increase energy efficiency of the buildings.

Nature based solutions and insurance value of ecosystems

► Scientific methods and theoretical framework need to be developed to determine the insurance values of natural resources and integrate these values into risk management process. Insurance companies may cooperate with investment institutions for using nature based solutions to find innovative solutions in risk management. Calculating benefit/investment ratio of risk mitigation capacity in landscape management and repair can be a strategy. Here, the benefit is mitigated risk and land insurance policy values. Legal framework is the production of incentive measures that protect and increase the insurance values of ecosystems (Nature-Based Solutions & Re-Naturing Cities, 2015).

- A framework must be generated to present the risk mitigation capacities of ecosystems using climate models/scenarios. Afterwards, necessary economic approach must be developed to ensure the continuity of the values of these ecosystems, ecologic processes running in these ecosystems and ecosystem services provided from these ecosystems, to protect this value and improve it (Nature-Based Solutions & Re-Naturing Cities, 2015).

Increasing carbon sequestration through nature based solutions

- Carbon is captured and stored by terrestrial and aquatic ecosystems. In the last 30 years, the amount of carbon stored by these ecosystems is about one fourth of carbon dioxide emission of human origin (Settele, 2014). Reduction of greenhouse gas emissions and increasing the amount of carbon capture are among the mitigation goals of climate change. This goal can be achieved by increasing the amount of biomass in the ecosystems (Nature-Based Solutions & Re-Naturing Cities, 2015).

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