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Global Climate Change Projections and Turkey

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ÖZET

Günümüzde nüfus artışı nedeniyle fosil yakıt kullanımındaki artış küresel olarak zarar verici bir boyut kazanmıştır. Havadaki karbondioksit miktarı; nüfus artışı, teknolojinin gelişimi ve endüstrinin büyümesi nedeniyle hızla artmaktadır. Bu durum, yeryüzünde tutulan sera gazı miktarını arttırır. Seraların yeryüzündeki etkisi nedeniyle iklim değişikliği gerçekleşir. Bu değişikliğin hem ekolojik hem de ekonomik açıdan önemli sonuçları olması beklenmektedir. Uzmanlar tarafından oluşturulan, dünyadaki tüm canlı grupları etkileyecek olduğu düşünülen iklim değişikliği senaryoları bulunmaktadır. IPCC (Hükümetler Arası İklim Değişikliği Paneli) raporlarına göre, Akdeniz havzası iklim değişikliğinden en fazla etkilenen bölgeler arasındadır. Küresel iklim senaryosunu dikkate alarak plan yapmak zorunda olan ülkelerden biri de Akdeniz havzasında yer alan Türkiye'dir. Küresel iklim değişikliğinin IPCC projeksiyonları ile hazırlanan çalışmada, Türkiye'nin durumu ele alınmaktadır. Çalışmada, iklim değişikliği senaryoları ışığında Türkiye'nin durum değerlendirilmesi gerçekleştirilmiştir.
Anahtar Sözcükler: İklim Değişikliği, Senaryolar, Küresel Isınma

ABSTRACT

Nowadays the increase in the use of fossil fuels due to population growth has gained a globally damaging dimension. The amount of carbon dioxide in the air increases rapidly due to population growth, the development of technology and the growth of industry. This increases the amount of greenhouse effect gas held on the earth. Due to the greenhouse effect on the earth, climate change occurs together. This change is expected to have significant consequences both ecologically and economically. There are various scenarios prepared by experts on climate change that will affect all living groups in the world. According to the IPCC (Intergovernmental Panel on Climate Change) reports, the Mediterranean basin is among the regions most affected by climate change. One of the countries that have to make plans taking into account the global climate scenario is Turkey, where in mediterranean basin. In this study, prepared by the IPCC projections of global climate change and Turkey's situation is handled. In the light of climate change scenarios for Turkey 's state of being evaluated by a scientific perspective.

Keywords: Climate Change, Scenerios, Global Warming

INTRODUCTION

Global climate change has become one of the most important issues that the whole world focuses on in recent years. Climate change is defined in United Nations Framework Convention on Climate Change (UNFCCC) as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by two organizations under the United Nations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), to assess the dangers posed by climate change caused by human interventions [5]. Climate modeling studies are being conducted to better understand the future climate condition. As global climate modeling studies are not

sufficient in terms of resolution or details, downscaling studies on a regional or national scale are being conducted and higher-resolution and more detailed information are obtained.
The general consideration is that the adverse effects of climate change will be much more than its positive effects. Different groups composed of scientists are developing various scenarios. All of these scenarios are based on the fact that the global climate change will result in global warming. The obvious reason is that the global average surface temperature has been increasing in parallel with the increase in the concentrations of carbon dioxide and other greenhouse gases in the atmosphere [3]. The increase in global temperature rise in the last century is around 0.8 ^{0}C [7].

MATERIAL AND METHODS

SRES-IPCC (Special Report on Emissions Scenarios - Intergovernmental Panel on Climate Change) scenarios lead the scenarios on climate change. The scenario family of IPCC includes 4 main scenarios named as A1, A2, B1 and B2. The Global Scenario Group (GSG), another scenario group has developed 3 different scenarios. The GEO-3 Group, on the other hand, has developed four different scenarios based on the acceptances of Markets First, Policy First, Security First and Sustainability First. Four different scenarios were developed under the heading of ecosystem assessment scenarios. These scenarios are named as Global Orchestration, Order from Strength, TechnoGarden and Adapting Mosaic.

Being familiar with these scenarios is of great importance for modeling the ecosystems in the future. These scenarios are the most important basic group of sources we have today to predict the geographical structures, compositions, distributions and productivity of communities in the future.

Sources of Climate Change Scenarios

Basic sources of developed scenarios are population growth rate, rate of industrial development, fossil fuels, economic development, rate of technological advancement. These factors are significantly important because they would affect the future concentration of greenhouse gases and carbon dioxide in the atmosphere. Other factors include justice, equality, education and traditions. These secondary factors are variables which are less effective on the amount of the gases emitted to the atmosphere, but they are affected by the climate change.

1- SRES-IPCC Scenarios

By means of these scenarios, potential changes in climatic parameters have been tried to be determined and they also include the processes of developing policies and making decisions with respect to these changes expected in the atmosphere. The scenarios mentioned in the Special Report on Emission Scenarios (SRES) are used in 3rd and 4th Assessment Reports of IPCC. 3rd report of IPCC covers the period between 1997 and 2001, and the 4th one covers the period between 2001 and 2007 [5]. These scenarios are named as A1 (A1T, A1B, A1F1), A2, B1 and B2. All of these scenarios assert that the temperature on the surface layer of the atmosphere will increase [3], [4]. After drawing up the 4th Assessment Report in the Netherlands, IPCC made some amendments to the 5th Assessment Report and re-determined the outlines. The scenarios developed with this new approach have adopted the parallel assessment method instead of the sequential assessment method like SRES which takes a long time to complete. In this method, climate models are in parallel with socio-economic models and emission models and thus time is saved [5].

Scenario A1: Population growth will continue until 2050 (9 billion) and then it will gradually decrease. Meanwhile, economic growth will continue, and the world will be further globalized. In a globalizing world, social and cultural interactions will increase, and the world will become more technological. As a result of these developments, the carbon dioxide concentration of 380 ppm in 2000 will reach to 800 ppm and this will result in a 3 ^{0}C increase in the temperature in the later 21st century [3].
A1T: It is based on non-utilization of fossil energy sources. This is the most optimistic scenario. This scenario suggests that the temperature increase at the end of the 21st century will be minimum 1.4 ^{0}C and maximum 3.8 ^{0}C [3].

A1B: It draws attention to utilization of all energy sources and their balanced consumption. It points out that more effective technologies will develop, and they will be integrated into human life. According to this scenario, the temperature will increase by minimum 1.7 ^{0}C, maximum by 4.8 ^{0}C at the end of 21st century [3].
A1F1: It draws attention to utilization of fossil energy sources. This scenario indicates the most pessimistic consequence. It states that the temperature will increase minimum by 2.4 ^{0}C, and maximum by 6.4 ^{0}C [3].
Scenario A2: Local identities will be preserved but the world will be more heterogeneous. Changes in economic income level will be slow and population growth will continue. The carbon dioxide concentration of 380 ppm in 2000 will be 700 ppm in 2080 and the temperature will increase by 2.8. ^{0}C [3].
Scenario B1: It predicts that economic growth will be fast and there will be positive developments in information-service economy. According to the scenario, the world will be more integrated in the future and pollutants will diminish and ecological systems will be preserved. The population will reach its highest level (9 billion), then will decrease gradually. While the carbon dioxide concentration was 380 ppm in 2000, it will be 580 ppm in 2080. Minimum 1.1 ^{0}C and maximum 2.9 ^{0}C increase is expected in temperature [3].
Scenario B2: It suggests that there will be local socio-economical and environmental solutions and the population will consistently grow. The carbon dioxide concentration of 380 ppm in 2000, will reach 550 ppm in 2080 and the temperature will increase by 2.1 ^{0}C by the end of 21st century [3].

2- RCP:

The scenarios developed with the new approach are called Representative Concentration Pathways (Demir et al., 2013). These scenarios are named as RCP3-PD (RCP 2.6), RCP 4.5, RCP 6.0, and RCP 8.5 [5].
When they are compared with SRES scenarios (Figure 1);
B2 and A1T scenarios among RCP scenarios are between the RCP 4,5 and RCP 6.0,
RCP 4.5 scenario shows parallelism with B1 scenario,
RCP 8.5 scenario provides values close to the values provided by A1F1 and A2,
RCP 6.0 scenario is similar to A1B,
but RCP 2.6 scenario is not compatible with any SRES scenario [5].

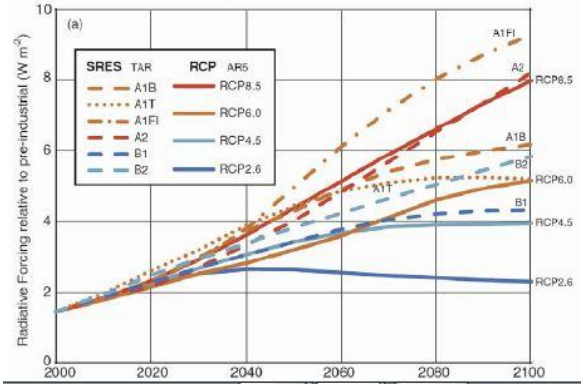

Figure 1. Comparison of SRES and RCP scenarios (IPCC).

Predictions related to RCP scenarios are as follows:
RCP 2.6: Carbon dioxide concentration is expected to be 442 ppm in 2050 and 421 ppm in 2070, and the temperature will increase by 1 ^{0}C. Global population will reach 9 billion by 2080, and there will be a small decreases until 2100. In terms of global economy, it will consistently increase till 2100 and will reach its maximum value pursuant to RCP scenarios.
RCP 4.5: Carbon dioxide concentration will increase slowly, and it will be 538 ppm in 2070. Temperature will increase by 1.8 ^{0}C. The population will reach its maximum in 2060 and be close to 9

billion, then by 2100 it will decrease to about 8 billion. By 2100, the global economy will grow to approximate the RCP 2.6 scenario.
RCP 6.0: Carbon dioxide concentration will increase more rapidly than stipulated in RCP 4.5 and reach 670 ppm in 2070. Increase in temperature will be 2.2 ^{0}C. The population will exceed 9 billion in 2100. The global economy will continue to grow until 2100, but the growth will not be the same as predicted in RCP 2.6 and RCP 4.5.
RCP 8.5: Carbon dioxide concentration will increase faster than predicted in RCP 6.0 and will reach 936 ppm in 2070. Temperature will increase by 3.7 ^{0}C. The population will consistently grow until 2100 and exceed 12 billion. The global economic growth will continue until 2100, but the lowest increase in all RCP scenarios will be experienced in this one. The growth will be in parallel with the growth in RCP 6.5 scenario.

3- Millennium ecosystem assessment scenarios:

This is a well-attended group with a different perspective. They have developed 4 scenarios. These are Global Orchestration, Order from Strength, Techno Garden and Adapting Mosaic scenarios. They are about the potential changes in ecosystems and their effects on humans [1,6].
Global Orchestration: This scenario is about global cooperation not only to improve the social and economic well-being of all people but also find solutions to environmental problems caused by global climate change. There is also a focus on the individual rather than the state in respect of protecting public goods and services. It also foresees a rapid growing world in terms of economy and increased gas emissions. It is predicted that the world's population will exceed 8 billion in 2050 but it will fall to around 7 billion by 2100. It is predicted that the surface temperature of the world will increase by minimum 0.6 ^{0}C and maximum by 3.5 ^{0}C by 2100.
TecnoGarden: It suggests a global world having advanced environmental technologies. It is expected that the world's population will be around 9 billion in 2050 but it will fall to around 8.5 billion by 2100. As compared to 2000, it is predicted that the temperature will increase by minimum 0.6 ^{0}C and maximum by 1.5 ^{0}C in 2050 and these figures will be 0.6 ^{0}C and 1.9 ^{0}C in 2100 respectively. This scenario provides the most optimistic consequence in the group [6].
Order from Strength: This scenario declares security as the most important factor and suggests a compartmentalized world. World population will approximate 10 billion in 2050 and reach up to 10.6 billion in 2100. As compared to 2000, it is predicted that the temperature will increase by minimum 0.6 ^{0}C and maximum by 1.7 ^{0}C in 2050 and the average increase will be 2.7 ^{0}C in 2100 [6].
Adapting Mosaic: It points out to a world which will be locally governed on a socioecological basis. World population will be around 10 billion in 2100. The temperature will increase minimum by 0.6 ^{0}C, maximum by 3 ^{0}C in 2100 [6].

4- Scenarios Developed by Global Scenario Group (GSG)

They have developed scenarios about the changes to occur by 2100 as Conventional Worlds, Barbarization and Great Transitions [6].
Conventional Worlds: **I**t includes two different variants. Details of these variants called Market Forces and Policy Reform are given below [6].
Market forces: This variant incorporates consistent population growth, economic growth and increased environmental problems. In this context, equality in the world will be disrupted and technological development will be slow and less.
Policy Reform: Population and economy will grow and environmental development will occur in this context. Technological developments will be rapid and the equality in the world will improve.
Barbarization: They are the most pessimistic scenarios developed by this group. There are two barbarization scenarios [6].
Breakdown Scenario: Population and economy will first grow and then collapse. There will be serious environmental problems, technology will regress and the concept of equality will be forgotten.
Fortress World: Technology will remain same, population will grow considerably first and then decrease. Economy will regress in time and environmental problems will increase rapidly.

Great Transitions: This is the most optimistic scenario developed by the group. There are two scenarios [6]. Eco-Communalism: Population will first increase and then decrease by 2100. Environmental conditions will rapidly improve and technology will advance.
New Sustainability Paradigm: Population, economy and environmental values will gradually increase and improve. In this context, equality will improve rapidly and technology will progress in direct proportion.

5- Global Environmental Outlook Scenarios (GEO-3):

4 scenarios were developed for the period of 2002-2032. The priorities of these scenarios are security and sustainability [6].
Markets First: National wealth is of priority in all industrializing countries. Market forces apply pressure on social and political life. While people get richer, secure financial status has priority over solution of environmental problems. Although foresighted people are in opposition to this approach, economical concerns suppress this opposition [6].
Policy First: Significant steps are taken by the governments to resolve social and environmental problems. Those who attach importance to economy and those to environmental values show parallelism with each other. Measures are taken for environmental problems with regulations such as carbon regulation and taxation and with international agreements. It is similar to SRES-IPCC A1B scenario [6].
Security First: This scenario recognizes that there are great inequalities in the world. Economic and environmental problems are increasing and persisting. Those who are rich and powerful care about their security in line with their interests and do not care about anything in the society other than themselves. It envisages a slow-growing economy and a regressing society. It is similar to SRES-IPCC A2B scenario [6].
Sustainability First: It is a scenario that cares about justice, equality, adopts sustainability as a principle, sensitive to the environment and aims at social development. It envisages a world where there is intergovernmental and intersocietal collaboration and political decisions are transparent. It is similar to the SRES-IPCC B1 scenario [6].

6- Turkey and Climate Change Projections:

According to the 5th assessment report of the IPCC, the temperature has increased all over the world since 1901 even if the rates are different. Turkey is located in Mediterranean Basin. Temperature increases in the region where Turkey is located (Eastern Mediterranean, Turkey, Black Sea, Caspian) are less than the increase in Europe, Asia and Africa. However, precipitation were decreased and many water sources were dried up in Mediterranean Basin since 1950. According to the 4th assessment report, the Mediterranean Basin was the most fragile zone. Although new scenarios are included in the 5th assessment report, it is seen that this situation has not changed. According to the latest report, temperature increases and insufficient precipitation in Mediterranean Basin will result in a decrease in water resources and cause serious problems on a national scale [8].
According to projections of future climate in Turkey;

- Temperature will increase in all seasons, summers will last longer than winters and thus precipitation will be less.
- While the winds in the north will increase and they will decrease in the east.
- Utilization of solar energy will increase in western part of the country, while it will increase slightly in other regions.
- As the sea level will rise, there will be problems in river deltas and low-altitude residential areas.
- Due to increasing temperature and decreasing precipitation, the number of regions having water scarcity will increase.
- Increasing rainfall in Eastern Black Sea region will result in increased landslide and decreasing snow cover will increase the avalanche risk.
- Duration of droughts and heat waves will increase.

CONCLUSIONS

As a result of migrations from east to west in our country presumed to have water stress, the pressure on water sources will increase per capita water will decrease. In addition, with migrations from rural areas to cities, heat islands are being formed and accordingly, warming increases in cities. Consequently, fragility of potential heat waves in summer months will also increase.
Rainfed agricultural lands will lose their sustainability and the agricultural sector will be interrupted. Thus, the amount of agricultural products will be reduced and prices will rise. This will threaten the food safety of our country.

For Turkey, where desertification will definitely increase, the future is rather pessimistic. As a result of water scarcity, the situation will be more dramatic especially if the population continues to grow. In order to eliminate the water scarcity in the basins, water will be refilled from other basins and this would lead to disturbance between the residents in the basins and they would lay claims to water sources.

All of these circumstances will adversely affect the quality of life of all living creatures, humans being in the first place and result in insoluble social problems [8].

In consideration of these predictions, the studies based on the projections of global climate change will form the basis to estimate the real-like future conditions and help to prepare the plans, make decisions and determine the measures in respect of the future. Therefore, it is necessary to observe the global changes in many fields such as population growth-decrease, industrial development and settlement and assess these changes on a national scale. Obtaining high-resolution digital data that is customized and detailed through sample fields is the most important factor in developing accurate scenarios [6].

REFERENCES

[1] Alcoma, J., Henrichs, T., Rösch, T. World Water in 2025. Global modelling and scenario analysis for the World Commission on Water for the 21 st Century. Center for Environmental System Research University of Kassel, Germany. 2000.
[2] Demir, Ö., Atay, H., Eskioğlu, O., Tuvan, A., Demircan, M., Akçakaya, A. Temperature and Precipitation Projections for Turkey in Accordance with RCP 4.5 Scenario. 3rd Congress on Climate Change in Turkey, Istanbul. 2013.
[3] IPCC. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to The Fourth Assessment Report of the Intergovernmental Panel of Climate Change. USA. 2007.
[4] IPCC. The physical science basis. Contribution of working group I to fifth assessment report on the intergovernmental panel on climate change. USA. 2013.
[5] MGM. Climate Projections and Climate Change in Turkey based on New Scenarios, Directorate of Research Department, Climatology Branch Office, General Directorate of Meteorology Printing House, Ankara. 2015a.
[6] Özkan, K. Global Climate Change Scenarios. Journal of Forest Engineering. Year: 47, Issue: 1-2-3. pp: 12-17. Chamber of Forest Engineers, Ankara. 2010.
[7] Özturk, K. Global Climate Change and Its Potential Effects on Turkey, Gazi University, Journal of Gazi Faculty of Education 22, Issue 1, 47-65. 2002.
[8] Türkeş, M., Şen, Ö. L., Kurnaz, L., Madra, Ö., Şahin, Ü. Recent Developments in Climate Change: IPCC 2013 Report. Sabancı University Istanbul. 2013.