

Israel Adaptation to Climate Change Policy

ICCIC 1st Report

Executive Summary

In accordance with a decision of the Israeli Government (No. 474 – June 2009), in March 2011, the Ministry of Environmental Protection established a knowledge hub, the **Israeli Climate Change Information Center** (ICCIC). The mission of ICCIC is to assemble the existing knowledge and scientific research regarding adaptation to climate change, identify research gaps and define the risks and consequences of climate change in various sectors. According to the findings, the ICCIC will suggest a national policy for each of the sectors. Furthermore, the ICCIC will integrate Israel's knowledge and technologies as a basis for implementation and marketing purposes both locally and abroad.

Adaptation policy is becoming a key issue of the post-Kyoto 2012 international climate policy agreement. The difficulties in implementing national and international mitigation policies and the increasing awareness of climate change phenomena eventually gave impetus to science and policy research on adaptation.

The ICCIC team

Prof. Emeritus Mordechai (Moti) Shechter,

Head of ICCIC

Founder of Natural Resource & Environmental Research Center (NRERC) at the University of Haifa, and presently Dean of the School of Sustainability at the Interdisciplinary Center – Herzliya)

Prof. Arnon Soffer,
leader of Geopolitical team

Department of Geography and Environmental Studies at the University of Haifa

Prof. Shechter and Dr. Ruslana Rachel Palatnik,

leaders of the Economic team

NRERC

Prof. Haim Kutiel,
leader of the Climatic research team

Department of Geography and Environmental Studies at the University of Haifa

Prof. Nurit Kliot,
leader of the Water Resources team

Department of Geography and Environmental Studies at the University of Haifa

Prof. Manfred Green,
leader of the Public Health team

School of Public Health at the University of Haifa

Prof. Marcelo Sternberg,
leader of the Biodiversity team

Department of Molecular Biology & Ecology of Plants at Tel Aviv University

Prof. Guedi Capeluto,
leader of the Green Building team

Faculty of Architecture and Town Planning at the Technion

Prof. Ofira Ayalon,
acting director of ICCIC

Director of NRERC and Head of environmental cluster at The Neaman Institute

The first report of the ICCIC was finalized on September 2011. The report was prepared by professional experts who each had a special steering committee for each subject. The committees include experts from the academic centers as well as relevant government ministries and industry. The goal of these groups was to perform as a multi-disciplinary think tank that will support the working procedures. The report reflects the existing knowledge regarding the implications of climate change on the State of Israel. It is based on global and local scientific research and professional publications. The report includes the identification of the existing research gaps and provides detailed recommendations about prioritized research requirements (short-term and long-term). This will enable the Ministry of Environmental Protection and other Ministries to set priorities for the required research.

The full report (in Hebrew) is constructed as follows: First, in the **climate** research section, the predicted climate changes in the next 50 years are described by decade. This is followed by the implications of climate change focusing on 4 areas:

- **The water sector**
- **Public health**
- **Biodiversity**
- **The urban environment and green building**

Finally, the scientific knowledge is reviewed in two multidisciplinary areas, **geo-strategy** and the Israeli **economy**.

Highlights from the main report

Climate Change:

The northern part of Israel is characterized by a Mediterranean climate, whereas the southern part of Israel has an arid climate, with a narrow strip in between having a semi-arid climate. In these areas of different climatic zones, frequent weather changes are common since the effects of climate systems have different synoptic characteristics. This fact is reflected by a great variation in temperature and in changes of rainfall.

The IPCC (Intergovernmental Panel on Climate Change) report estimates that the expected climate change in the present century will lead to global warming. As a result, the global temperature is expected to increase by 1.8 to 4 degrees Celsius by the end of the 21st century, depending on the different scenarios of greenhouse gases (GHG) emission. During the 21st century, serious climate changes are expected all over the world and in the Mediterranean basin in particular. The climate forecasts in Israel show an average warming of 0.4 to 0.8 degrees Celsius per decade for the coming century, varying according to the area and the season. Total rainfall is expected to decrease in most areas, although this trend is not statistically significant. Moreover, the frequency of extreme weather events, drought years, floods and heat waves are expected to increase. The main effect of the anticipated changes is the increased uncertainty and diversion from 'business as usual' (BAU) weather. These changes may have major effects on various sectors, primarily on the water sector, public health, biodiversity and the urban environment. In addition, they are expected to influence geostrategic scenarios as well as on the GDP and the social welfare in Israel.

There are two key modes of action in response to climate change. The first one is mitigation of the phenomenon through various prevention tools, especially human intervention to reduce use of energy sources that cause GHG emissions. The second is adaptation of human and natural systems as a response to the phenomenon, in order to minimize the damages to various systems. Due to the understanding that the current mitigation measures will not prevent climate change and that the temperature

will, most likely, increase by 2 degrees Celsius on average, a variety of adaptation measures should be prepared.

The water sector is expected to be directly affected by climate change. A significant reduction is evident in the Kineret water basin, as a result of the reduced precipitation in Northern Israel. In addition, in the south of Israel, a clear trend of reduction in the amount of precipitation has been observed. In contrast, at the center of Israel, there is no significant trend in the amount of precipitation. The changes in the nature of the precipitation and a rise in extreme weather events will increase flooding and runoff and will reduce the recharge of ground water resources. The gap between the natural water supply and the demand for water will be filled by sea and brine water desalination as well as increased wastewater treatment in higher standards so that they will suit all kind of crops. Nevertheless, desalination and wastewater treatment require an excessive and expensive use of energy that would increase emissions of conventional pollutants and GHGs. Moreover, considerations of environmental and water sources pollution should also be included.

The current scientific research in the water sector focuses on the effects of climate change on the reduction of water supply and its deterioration in quality. Also, as human actions affect the water supply in Israel in combination with natural physical climate changes, they are included in the survey (for example, water demand, energy consumption and planning).

The health sector is affected in several ways by the climate, both directly through physical influences (heat waves, for example) and indirectly through the effect on chronic and infectious diseases and on mortality and morbidity from external causes. The effect of climate on the mechanism of chronic diseases is not fully understood, but it is known that extreme weather conditions (heat, cold, humidity) increase the frequency of appearance of different diseases, such as cardiovascular and respiratory diseases. Climate change affects the presence and behavior of different vector-borne infectious diseases. These changes are shown by a seasonal pattern that is displayed by many of these diseases. While some of the factors responsible for this seasonality are known, a major part of the phenomenon is not yet explained. Other climate factors, such as ultra-violet radiation (a correlation exists between the climate change and temperature rise, and the reduction of ozone layer in the atmosphere), affects the

appearance of other diseases, such as cancer and cataracts. Climate also affects mortality and morbidity rates as a result of other factors such as car accidents, fires, nutritional condition and more.

The health sector in Israel is expected to be severely influenced by the climate change. According to the World Health Organization, there are three possible health outcomes to climate change: First, direct outcomes that occur mostly as a result of extreme weather. Second, outcomes that occur due to environmental and ecological changes, caused by climate change. Third, outcomes due to trauma, infections or psychological and nutritional effects amongst the weak and the immigrating population, as a result of economic migration caused by climate change.

The direct health consequences of climate change will be reflected by an increase in the volume and frequency of hot and cold waves, increasing the burden on the human body and changing the seasonal pattern and geographic distribution of chronic and infectious diseases.

The environmental and ecological changes that will occur as a result of climate change are expected to increase the frequency of natural phenomena such as droughts and floods, which will seriously affect the health of population residing in the area (disease outbreak, water infection, damage to the sanitary infrastructure, etc.). All the expected health outcomes of climate change, as described above, might force migration of the human and animal populations (amongst them animals that can be transmitters of diseases) to other parts of the world. This process might also lead to a change in the geographical distribution of diseases.

In terms of **biodiversity**, climate change might lead to serious changes in interspecific interactions and in geographical distribution of species, and will affect the biodiversity and ecosystem services. This is relevant both for fresh water ecosystems (including rivers, seasonal water bodies, springs and the Lake Kineret), marine ecosystems (Eilat Bay and the Mediterranean Sea) and to terrestrial ecosystems. It is important to note that even though the biota in our area are already adapted to uncertain climate conditions, further reduction in precipitation and its consistency, can lead to critical changes in the ecosystems and their functionality, mostly in the arid desert area.

When discussing biodiversity, it is important to mention that in the last decade, there has been an increasing number of studies dealing with the future effects of climate change on the flora and fauna, and ecosystem functioning. Nevertheless, only few of the studies dealing with this subject have been conducted in Israel. The review shows the current research regarding the effects of climate change on biodiversity in Mediterranean climate areas around the world, while emphasizing studies held in Israel and on its coastal line. The very few studies that have examined the effects of climate change on the richness and diversity of species in Israel showed unambiguous results that varied between different groups of organisms. The number of studies on the effects of climate change on fresh water systems is particularly low, probably because that the major and immediate threats to these ecosystems are human activities. Climate change will increase the pressure on these ecosystems, therefore increasing the severity of the deterioration.

Models predicting climate change effects on species range distribution, forecast that as a result of a temperature rise, the distribution areas of these species will change, and that they will move to areas where the temperature range will be similar to those where they exist today. One of the consequences of this change in the distribution range of species might be an increase in distribution of tropic arthropods and the spread of diseases by them.

Populations located at transition areas between Mediterranean climates and desert climates, are characterized by high genetic diversity. Therefore, these areas are of great importance in order to maintain biodiversity in the era of climate change. The differences in the genetic composition between populations from different habitats can be used for species conservation under stressed conditions. A minor effect on primary productivity reduction in Mediterranean grasslands might be expected.

In marine systems, the review emphasizes the major effects of invasive species in the Mediterranean Sea, a phenomenon that will probably accelerate with the warming of sea water. Another significant effect will be the destruction of the coastal abrasion platforms. The main threat to the systems in Eilat Bay is the coral bleaching which is the basis of the ecosystem of the reef.

The sector of **green building (sustainable building)**, is mostly perceived as one of possible paths to leverage mitigation of GHG emissions, since the building sector is responsible for about 40% of the global energy consumption and for a third of the GHG emissions. The numerous benefits of green building include reduced operating costs, lower energy output, improved health and productivity of people using the building, and reduced carbon emissions and therefore impact on climate change. However, the anticipated climate changes also require a conceptual change in the way buildings and cities can adapt (shade, wind exposure, thermal comfort, adjustment to extreme events such as floods and sea level rise, etc.). This sector also has the greatest potential for significant and profitable mitigation in consumption and emissions.

The life span of buildings is relatively long, and therefore, actions taken today have a substantial influence on emissions in both the short and long term. There is a clear interrelation between building and urban scales that should be considered in order to achieve successful results in this field. The urban system has a major influence on the single building performance and on the creation of a micro-climate in the city. The city morphology and orientation affect the urban network and the exposure of building facades, streets and open spaces to sun and wind, and may influence on the heat island effect. Moreover, these factors should be considered while combining solar systems for energy production in buildings (heating water, building integrated photo-voltaic (BIPV) and micro wind turbines) since the urban array has a major impact on the efficiency of these systems.

Well-designed cities can reduce the amount of GHG emissions while coping with environmental problems such as air pollution, waste and transportation as well as local economic development. Environmental gain can be achieved by promoting the use of alternative energy sources on one hand, and encouraging well designed cities which reduce urban sprawl and suburbanization, encourage mixed-uses, green buildings and better public transportation, on the other.

In the multidisciplinary field of the **geostrategic sector**, there are three major phenomena that are caused by climate change: water shortage, rising sea level and rising temperatures (warming, massive dehydration and an increase of extreme events). In addition, there are integrated subjects that will be affected by the

cumulative climate change effect. The implications can be divided in accordance with geographical aspect: the inner circle, the circle of neighboring countries (Muslim-Arab countries close to the first circle) and the rest of the world's countries.

Despite the research gaps, it is evident that climate change may have major geo-strategic implications for Israel. Among the most important issues in this area are the changes of the balance of geostrategic forces, the water sector, immigration to Israel (inside, around and through), increased energy consumption, the food sector, defense system, etc.

Economics: climate change may influence the world economy in general and the Israeli economy in particular. There are few studies that have estimated the economic costs of climate change without mitigating actions and/or adaptation (BAU), and they indicate about changes in world GDP (gross domestic product) in accordance with the expected change in average temperature. The changes in the world GDP are estimated to 0.5% per year for the first half of this century, and growing up to 1-5% per year by the end of this century and beyond. The costs of adaptation, mitigation and climate change damage are related one to the other. For example, while the adaptation measures are more extensive, the damage might decrease and also the need for mitigation.

Economic assessment of the various adaptation measures has been extensively researched. However, most studies provide an evaluation at a global level or by regional aggregation, and not by state or sectorial levels. Mostly, these studies show higher adaptation costs for developing countries compared to developed ones. For this reason it is hard to learn from existing scientific literature about the expected costs of adaptation for a small-open-developed country like Israel. Related research focusing on the adaptation costs for Israel was not found in any scientific literature. Most of the existing economic studies for Israel focus on sea level rise or climate change impact on agriculture. For other sectors of the Israeli economy the information is limited. Few recent economic studies employ the "Top- Down" method of CGE (Computable General Equilibrium) or IAM (Integrated Assessment Models). These models are used to evaluate the cost of GHG mitigation programs for, or climate change damage cost in Israel.

In general, climate change related publications can be divided into two main groups: the first, studies that document changes in different climate factors that have been observed at different periods and in different areas. These studies are usually based on statistical analyses. The second group includes studies examining different scenarios based on trends in the variability of climatic parameters in the future, based on the models and assumptions found in studies in the first group. Even though the number of the published studies is rather large, their synthesis is very difficult or even impossible due to the data variability, the analysis methods and the time these studies were held. Accordingly, it may be concluded that there are large and variable scientific gaps in the knowledge of the effects of climate change in all areas.

General research and knowledge gaps

In the water sector, the main issues are precipitation variance (spread, quantity and extreme events) and their effect on recharge, the effects of rising temperature on evaporation and on the quality of water, the frequency and duration of draughts, runoff monitoring, water and food safety and in the urban area, savings and depreciation. In the health sector, the major gaps shown are mostly in the areas of climate change effects on heart diseases, respiratory diseases, cancer and cataracts, and infectious diseases transmitted by food and vectors. Regarding the biodiversity, it is difficult to assess the effects of climate change on ecosystems due to the lack of knowledge based on empirical research. In the multi-disciplinary economic section, the review indicates gaps in research relating to the empirical assessment of adaptation costs in Israel, sectorial studies, quantitative studies based on modelling adaptation strategy. Furthermore, there is a need to expand the research of the uncertainty in the climate change phenomenon and its effects on the cost of adaptation and policy measures, including the insurance sector.

There are other areas that have not yet been studied under the framework of the ICCIC, that have high vulnerability potential caused by climate change on one hand, and major effects on the Israeli economy, on the other hand. These include the energy and electricity sectors, agriculture, tourism, transportation, etc. Therefore, these areas also should be studied in the ICCIC framework.

In summary, this report includes a comprehensive review of research in key areas regarding climate change, and is expected to serve as a primary database for additional research and scientific work on this subject, with the assistance of the dedicated steering committees. It has to be noted that there are several issues and policy measures that are justified regardless of the issue of climate change adaptation. These issues will be further discussed in our future reports. Further research is necessary in order to define Israel's future policy in each sector, and the preparation required to implement it when needed, whilst giving the government the financial means to execute the chosen policy.

