VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

In November 2000, Israel submitted its First National Communication to the Conference of the Parties to the United Nations Framework Convention on Climate Change. The report presents the national greenhouse gas inventory compiled for the year 1996, proposed mitigation options for reducing emissions in different sectors, a proposed climate change action plan, an overview of research and observation on climate change and a preliminary assessment of vulnerability and adaptation measures to climate change. Israel Environment Bulletin presented a short summary of the greenhouse gas inventory and of potential mitigation measures in its Summer 1999 edition (Vol. 22, No. 3).

Following is a short summary of the impacts, vulnerability and adaptation to climate change in Israel. The full report was commissioned by the Ministry of the Environment from the Blaustein Institute for Desert Research of Ben-Gurion University of the Negev. It was prepared by Prof. Uriel N. Safriel and Mr. Guy Pe'er. Special thanks to the authors for their permission to reproduce an abridged version of the report in this Bulletin.

Introduction

The following is a first attempt to assess how systems in Israel will react to climate change and suggest a number of potential adaptations. The assessments are based on a survey of literature and on interviews with Israeli scientists and policy makers. Various scenarios, based on the observation of climatic trends within the country and on national and regional climatological research and models, were developed in Israel (see box). However, these scenarios have a low reliability due to the complexity of climatic factors affecting the region. Therefore, the following assessments are expected to serve as hypotheses for directing future exploration and research.

In general, most of the impacts of climate change are expected to amplify projected impacts of anthropogenic stresses resulting from accelerated population growth and a higher standard of living; the relative contribution of climate change to the overall impact is not known. Therefore, measures to reduce the overall impact are, by default, adaptations to climate change.

Projected Climate Change Scenario for Israel for the Year 2100

Climate changes:

- Mean temperature increase of 1.6º-1.8ºC
- Reduction in precipitation of (-8)-(-4)%
- Increase in evapotranspiration of 10%
- Delayed winter rains
- Increased rain intensity and shortening of the rainy season
- Greater seasonal temperature variability
- Increased frequency and severity of extreme climate events

- Greater spatial and temporal climatic uncertainty

Related environmental changes:

- Sea level rise of 12-88 cm
- 560 ppmv of atmospheric CO_2 concentration by the year 2040-2065

Environmental Impacts and Adaptations

Hydrology: Increased rain intensity combined with a reduction in overall precipitation will increase surface runoff, soil erosion and salinization and will lead to desertification, especially in the Negev. Measures for combating desertification, such as afforestation, on the one hand, and rehabilitation and regeneration of natural vegetation, on the other hand, will help adapt to climate change. Water-sensitive urban planning and conservation and rehabilitation of natural vegetation in rural areas will serve as adaptations to potential damages to structures and crops which may result from flash floods.

Water supply may severely decrease, falling to 60% of current levels by 2100, and water quality may deteriorate due to increased sedimentation and salinization and reduced recharge of aquifers and surface reservoirs. Measures already adopted to counter the growing water scarcity in Israel, such as water conservation and generation of additional water sources, will also serve as future adaptations to climate change.

Fires: Delayed winter rains, lower soil moisture, increased evaporation and greater frequency and intensity of heat waves will increase the risk, intensity and frequency of woodland fires. This may offset the high potential for fire resistance and regeneration potential of many Israeli woodland species and may critically damage woodland ecosystems. Controlled livestock grazing or reintroduction of wild mammalian herbivores may serve as adaptive measures to reduce woodland dry matter.

Natural ecosystems: Since Mediterranean biomes are projected to shift 300-500 km northward and 300-600 m uphill with a 1.5^{o}C warming, the Negev ecosystems may be expected to replace Mediterranean ecosystems in Israel. Climate change, habitat fragmentation and natural limitations on dispersal may lead to the loss of natural populations or even species. At present, the vulnerability of different species and the impact of their loss on ecosystem services cannot be assessed.

The ecotone between the desert and non-desert regions of Israel, where peripheral populations of both ecosystems meet, is expected to show the first impacts of climate change. Since peripheral populations may be more resistant to climatic stochasticity than their core populations, they may be more resistant to climate change as well. Adaptations may, therefore, include conservation of ecotones as well as conservation of corridors between biomes, especially along the north-south axis of the country.

Additional impacts may include the following: arrival, establishment and expansion of invasive species which will become weeds or pests and transport more pathogens,

widening the desert barrier between Europe and Africa for migratory birds traveling through Israel, inundation of coastal ecosystems by sea level rise, degradation of coral reefs in the Red Sea due to increased temperatures and elevated CO_2, forest decline due to invasive pathogens, drought, and high frequency of fires, and increased tree mortality in planted forests. Afforestation with species and stocks that survived the severe droughts of recent years is an adaptive measure to prevent further deterioration.

An increase in atmospheric CO_2 (also referred to as CO_2 fertilization) will enhance photosynthesis in some (but not all) plants and allow for more rapid growth. However, although CO_2 may somewhat mitigate the effect of heat and drought, the overall effect of CO_2 enrichment is still poorly understood.

Socio-Economic Impacts and Adaptations

Agriculture: The impacts of climate change – from increased temperature variability to increased frequency of temperature extremes to increased rain intensities and floods – may endanger crops. Drought damages, increase in pests and pathogens and loss of biodiversity will also impact on agricultural yields. A delayed growing season will reduce Israel's advantage over colder countries in early exports of flowers, fruits and vegetables. Finally, fisheries may be affected by increased salinization, reduced oxygen pressure and frequent algal blooms. New crops and varieties, agrotechnological advances and revised water and investment policies are appropriate general adaptations motivated not just by climate change impact. Delaying seeding time in response to delayed winter rains is a specific adaptation to climate change.

Infrastructures: Sea level rise will increase erosion along Mediterranean beaches, damage coastal structures, harbors and archaeological sites, decrease hydraulic gradients and reduce the efficiency of power stations and municipal drainage systems. Adaptations include elevating port structures, protecting low coastal areas and beach front cliffs by breakwaters, raising outlets of power stations, improving drainage systems and introducing water-sensitive urban planning that promotes groundwater recharge.

In the Red Sea, sea level rise will not inundate extensive land areas but the narrow recreational beaches and transportation lines along the beaches may be affected.

Increased evaporation and decreased flow from the Jordan River to the Dead Sea may accelerate lowering of water level. This retreat will further decrease ground stability of the exposed coastal lake beds, with the potential to threaten structures and human life.

Energy: Energy requirements for winter heating and summer cooling of buildings will increase. Designing buildings and urban areas in ways that buffer temperature changes will serve as an adaptation for overall warming and the increased frequency of temperature extremes.

Human Health Impacts and Adaptations

Parasitic and climate-related diseases: Climate change may increase the risk of vector-borne diseases while degradation of municipal and industrial drainage systems will further enhance water-related epidemics such as malaria, cholera, dysentery, West Nile virus and Giardia. Climate-related diseases and mortality may increase, especially among the elderly, children, and those suffering from chronic diseases. However, given the level of medical care and standard of life in Israel, it is unlikely that climate-change related extreme events will adversely impact human health.