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Climate Change and its Effects on Water Resources

Issues of National and Global Security

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Preface

National and global security can be assessed in many ways but one underlying factor for all humanity is to access to reliable sources of water for drinking, sanitation, food production and manufacturing industry. In many parts of the world, population growth and an escalating demand for water already threaten the sustainable management of available water supplies. Global warming, climate change and sea level rise are expected to intensify the resource sustainability issue in many water-stressed regions of the world by reducing the annual supply of renewable fresh water and promoting the intrusion of saline water into aquifers along sea coasts where 50% of the global population reside. Pro-active resource management decisions are required, but such efforts would be futile unless reliable predictions can be made to assess the impact of the changing global conditions that would impart upon the water cycle and the quality and availability of critical water reserves.

Time is of the essence as relatively little is known about the likely effects of global warming, climate change and sea level rise on the world's renewable water resources. If the emission of greenhouse gases continues at currently projected levels, global temperatures would rise faster in this century than in any time during the last 10,000 years. For such a scenario, global climate models predict that many regions would experience drier summers, higher annual rates of evapotranspiration and a significant increase in the frequency of extreme events such as droughts and floods. One of the worst affected areas would be the Mediterranean Basin where 75% of the renewable water supply is currently derived from surface runoff (river flows) and the remaining 25% is obtained from groundwater (as represented by aquifer recharge). In this region, in the south of latitude 45°N, temperatures are expected to increase well above the global average and annual precipitation is projected to decline by 10–40%, causing a significant reduction in river flows. In terms of groundwater, aquifer recharge rates are expected to fall by as much as 50–70% due to the combination of lower rainfall and increased evapotranspiration.

Coastal areas are especially threatened. A rise in global atmospheric temperature would cause thermal expansion of the ocean, melting of mountain glaciers and small ice caps, and accelerate the ablation of the polar ice sheets. Predictions of sea level rise vary, but most models suggest that ocean levels could rise by up to a meter by the end of this century, with some regions experiencing far more severe impacts. Rising sea-levels would reduce aquifer recharge along low-lying coasts due the

landward transgression of the sea and cause saline groundwater to advance in land where it would compromise the quality of fresh groundwater reserves.

In September 2010, the effects of climate change on water supply and the potential threats to resource sustainability and long-term water security became the focus of attention for 50 specialists who were invited to Izmir, Turkey to contribute their knowledge and experience to an Advanced Research Workshop (ARW) conducted under the auspices of NATO's Science for Peace and Security Programme. Over a period of three days, 40 research papers were presented on a wide range of important topics dealing with climate change and water-security concerns at the national, regional and global levels. The papers stimulated considerable discussion and intellectual debate, and highlighted the complexity of the problem and the urgent need for the development of modeling tools that could reliably predict the potential impacts of global warming on water supplies. Also, valuable discussions took place on the formulation of strategies for adaptation and mitigation. These discussions further drew attention to the differences between groundwater and surface water resources in the way that they respond to climate change, and generated agreement on the need to manage the water resources of a basin holistically to derive optimal benefits. In terms of water security, this was seen to lie at the interface among scientists, engineers, economists, and politicians and demonstrated the need for all stakeholders to work co-operatively if strategies for sustainable resources management under conditions of climate change are to be both scientifically sound and acceptable to the public from social and economic perspectives.

Overall, the workshop provided a valuable platform for urgently required dialogue on the impacts of climate change on the global water resources, the long-term resource management goals at global and local scales, data requirements and the scientific and technical advances necessary to achieve success. The exchange of experiences and scientific thought produced creative ideas for potential solutions, but more importantly sowed seeds for strong future international scientific collaboration towards a common goal of a vital global significance.

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Contents