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Drought Frequency under a Changing Climate in the Eastern Mediterranean: the Beka'a Valley, Lebanon

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The United Nations' Intergovernmental Panel on Climate Change (IPCC) 4th assessment report predicted a 20% to 25% reduction in precipitation by the year 2050 in the Mediterranean Region in addition to an estimated 1.5 °C to 2.5°C increase in temperature. The combination of these parameters may lead to extended periods and frequencies of drought.

Drought is a natural phenomenon and its persistence defines its severity starting with the relatively low impact meteorological drought to the more sever agricultural and hydrological droughts and ultimately peaking with the socioeconomic drought. Drought indices have been used assess the potential economic, social and environmental impact of droughts. Some of the more common indices are the Palmers Severity Drought Index (PSDI), Standardized Precipitation Index (SPI) and Reconnaissance Drought Index (RDI).

Lebanon lies in the eastern Mediterranean and relies substantially on food production from the Beka'a Valley. Over the past years irrigated agriculture has been increasing and so has the reliance of the rural communities on its revenues. Nearly 70% of Lebanon's available fresh water sources are used in agriculture. Any decrease in the amount of precipitation along with an increase in temperature can lead to droughts and would result in a significant prolonged reduction in agricultural output which would lead to a decrease in income to rural communities and could possibility lead to civil strife or unrest.

The objective of this paper is to assess the impact of the predicted climate change on the frequency of drought in the Beka'a Valley (and subsequently on Lebanon) using one of the commonly used drought indices. The Reconnaissance Drought Index (RDI) was chosen due to its specificity to the Mediterranean and its simple data requirements where it only requires precipitation and temperature data, the latter reflected as evapotranspiration.

Temperature and precipitation data was collected for the period 1970 – 2007 and the RDI results indicated that drought frequencies are tending to increase. In an attempt to project drought events according to the IPCC report predictions, eight scenarios were built through manipulating precipitation by reducing it up to 40% and increasing evapotranspiration up to 20% using a dataset of six near normal years (in terms of precipitation, i.e. no drought). No deviation from the near normal conditions were observed until the precipitation decrease and associated evapotranspiration increase reached 30% and 10% respectively. Subsequently drought frequency doubled from one event in six years to two, and then four until ultimately (precipitation reduction at 40% and evapotranspiration increase to 20%) reaching six years of drought in the six-year bracket.

This information will be useful in helping Lebanon develop its national drought management plan and improving its overall water resources management. Some detailed recommendations will be presented as to how these two issues will be incorporated in the current and improved institutional and legal frameworks.