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Crop Water Demand under Climate Change Scenarios for Western Rajasthan

R.K. Goyal, Anurag Saxena, P.C. Moharana and C.B. Pandey
Central Arid Zone Research Institute, Jodhpur 342 003, India

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Abstract: Climate change due to greenhouse effect is expected to cause major changes in natural eco-system of some of the areas. The change in climate is likely to profoundly influence hydrological cycle viz. precipitation, evapotranspiration, soil moisture, etc. Evapotranspiration (ET) being the major component of hydrological cycle will affect crop water requirement and future availability of water resources. The most visible signature of climate change is rise in temperature by few degrees varying over different regions. Temperature being principle source of energy, will have major effect on ET and consequently on water demand. The study has been conducted for hot arid zone of western Rajasthan. Penman-Monteith model was used for the estimation and sensitization of ET. Study suggests that as small as 1°C rise in temperature from normal will enhance the annual ET demand from minimum of 35 mm for Ganganagar district to maximum of 96 mm for Jaisalmer district. Enhanced ET would primarily be a consequence of higher air and land surface temperature. The increase in ET demand will have a direct bearing on total water demand for irrigation. The rise in temperature by 1°C will cause an additional annual water demand of 1570.9 Mm^3 for the entire western Rajasthan based on net irrigated area of 31,64,512 ha. The total available utilizable ground water for western Rajasthan is 3516.9 Mm^3 and rise of 1°C in normal temperature will put additional stress of 44% on existing groundwater resources based on present land use pattern. An attempt has been made in the present study to estimate the water demand under climate change scenario for the hot arid zone of western Rajasthan.

Key words: Evapotranspiration, water resources, global warming, climate change.

Global climate change has emerged as a major scientific and political issue in last two decades. Global warming issue was first discussed in United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro, during 3-14 June, 1992 and reported a rise by few degrees in average annual temperature worldwide. There are sufficient evidences to show that earth's temperature has risen by more than 0.5°C since 1880 and continues to rise at a faster rate (Martinez-Austria, 1994). Another most visible evidence of global warming is rise in sea-level, which could be up to 1 m over next hundred years (Schneider, 1989; Houghton *et al.*, 1990). Keeping in view the evidence of global warming, the World Meteorological Organization (WMO) formed the Intergovernmental Panel on Climatic Change (IPCC) in 1988, which called on different experts organized into working groups to analyze the possible effects of this phenomenon. Since the formation of IPCC, various studies are going on worldwide to understand/predict the effects of global warming on the various aspects of ecosystem (Ravindranath and Sukumar, 1996; Liu *et al.*, 1997; Mendelsohn and Dinar, 1999; Mathauda *et al.*, 2000; Roos *et al.*, 2002; Mall *et al.*, 2004). The main reason for global warming is increase in concentration of greenhouse gases in the atmosphere. The important greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and tropospheric ozone (O_3). The major sources of these gases are combustion of fossil fuels, agriculture and land use changes (Singh and Kumar, 1997). Global warming due to greenhouse effect is expected to cause major changes in climate of some areas. The change in climate is likely to have a profound effect on hydrological cycle viz. precipitation, ET, soil moisture, etc. (Nemec and Schaake, 1982; Gleick, 1986; Bultot *et al.*, 1988). ET being the major component of hydrological cycle will affect crop water requirement and future planning and management of water resources. Following the approach of Martin *et al.* (1989) and Rosenberg *et al.* (1989), an attempt has been made in the present study to understand the implications of global warming

*E-mail: rkgoyal24@rediffmail.com