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Assessment of impact of climate change on rice and wheat yield in sub humid climate of Bihar

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ABSTARCT

The present study deals with the impact of temperature and CO_2 projection obtained for different time periods 2020, 2050 and 2080 using HADCM3 factors on the productivity of rice and wheat crop at four stations viz. Pusa, Purnea, Sabour and Patna of Bihar using InfoCrop model performed. The results showed that the simulated yield of rice and wheat decreased in the range of 1.1-9.2 %, 6.1-13.2 % and 15.9-22.4 % from baseline in 2020, 2050 and 2080 respectively over the stations. Decrease in simulated yield in wheat was observed in the range of 3.5-21.1 %, 14.0-37.9 % for 2050 and 2080 for all the stations.

Key words : Climate change, rice, wheat, simulation studies, CO_2 conc., temperature rise

The climate sensitivity of agriculture is uncertain, as there is regional variation of extreme temperature and rainfall, the crop and cropping system, soils and management practices.Inter-Governmental Panel on Climate change (IPCC) Fifth Assessment Report concludes that increasing numbers of warm days and decreasing numbers of cold days have been observed, with the warming trend continuing into the new millennium (IPCC 2014).General Circulation Models (GCMs) and Special Report on Emission Scenarios (SRES), show that higher temperatures will lead to lower rice yields as a result of shorter growing periods. However, carbon dioxide (CO_2) fertilization may at least in part offset yield losses in rice and other crops. In the Indo-Gangetic Plains of South Asia there could be a decrease of about 50% in the most favourable and high-yielding wheat area as a result of heat stress at two times CO_2 (IPCC 2014). Elevated CO_2 besides affecting the crop also affects the environment, which in turn may either beneficial or damaging effect on agricultural production (Rosenzweig *et al.*, 1998). Changes in temperature play a crucial role in determining crop productivity (Fiscus *et al.*, 1997). Decline in potential yield of wheat and rice is linked to negative trend in solar radiation and an increase in minimum temperature in the Indo-Gangetic Plains of India (Pathak *et al.*, 2003). With subsequent rise in temperature reduced the yield of wheat and enhanced CO_2 was unable to counter balance the decline in wheat yield (Abdul Haris *et al.*, 2013). Decision support systems (DSS) or crop models provide a way, where the relative effects of these variables on crop growth and yield can be studied in particular combinations on regional basis. The present study deals with the effects of climate change on *kharif* and *rabi* season crops (Rice and wheat) for Bihar which might help to adopt suitable farming techniques to maximise agricultural production in this high potential region. It also provides insights into possible changes in the cropping pattern and adaptation options for future.

MATERIALS AND METHODS

Bihar is located in the alluvial plains of India and is situated between 24°N and 27°N, 83°E and 88°E with a height of 52 m amsl having normal rainfall of 1243.7 mm. Four different station stations were selected representing different zones (Pusa zone I; Purnea zone II; Sabour zone III A; Patna zone III B).Daily data for air temperature and rainfall from four representative centres were collected for the period 1955-2010 for Pusa and Sabour and 1969-2010 for Patna and Purnea. Meteorological, crop and soil data used for the simulation studies were collected from India Meteorological Department, Pune; Rajendra Agricultural University, Pusa and Bihar Agricultural University, Sabour.

IPCC describes future scenarios for the period 2010-2039, 2040-2069 and 2070-2099 referred to as 2020_s, 2050_s and 2080_s respectively. The General Circulation Model was used in the study ($HADCM_3$) for the A_2 scenarios (The A_2 scenario describes a heterogeneous world with a focus on self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population). The generic crop