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Assessing Impact of Climatic Variability on Crop Yields in Rajasthan

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Abstract: The paper analyzes yield sensitivity of major rainfed crops namely pearl millet, sorghum and maize to climatic variability in Rajasthan, the driest state of India. The yield time series data for the three selected crops were compiled for all 32 districts of Rajasthan from 1990 to 2006. For each crop only those districts where area sown under the crop was more than 5000 ha were included in the analysis. Consequently we included 14 districts for sorghum, 17 for pearl millet and 16 for maize and district wise monthly maximum temperature during crop season, wet day frequency and total precipitation as the basic climate variables. The effect of technological progress was removed by de-trending the productivity. The district-wise sensitivity estimates were grouped more homogeneously using multivariate cluster analysis. The yield of analyzed dryland crops was highly sensitive to weather variables. The increase in rainfall and number of rainy days would result in yield increment in most of the districts and *vice-versa*. Maximum temperature was found to influence the yields negatively in most of the districts. Finally we suggest research and development options for climate adaptation for different clusters of districts.

Key words: Weather sensitivity, climatic variability, dryland crops, climate impact.

Warming of climate system and its effects are likely to affect global livelihood and environmental systems in various ways (IPCC, 2007). Since climatic factors serve as direct inputs to agriculture, any change in climatic factors is bound to have a significant impact on crop yields and production. There is a considerable research focus on the impact of climate change on agriculture. Studies have shown a significant effect of change in climatic factors on average crop yield (Dinar *et al.*, 1998; Seo, and Mendelsohn, 2008; Mall *et al.*, 2006; Cline, 2007). However the impact of climatic factors on mean crop yield has not been investigated much especially in agriculture based developing economies where there is likely to be more serious repercussions in terms of food security, inequality and economic growth. Uncertainties in weather create risky environments for crop production, farming systems and food supply. The way climate change will affect agricultural productivity is expected to vary depending upon various factors including geography and technology levels. While an overall significant damage of 3.2% is expected in the global agriculture production by the 2080s under business as usual scenario, it is found that the losses may even go up to 15.9% if the carbon fertilization effect is not realized. The developing countries, predominantly located near the lower altitude, are most likely to incur a much greater loss roughly quantified at 21% (Cline, 2007). In developing countries, climate change will cause yield declines for the most important crops and South Asia will be particularly hard hit (IFPRI, 2009). Many studies in the past have shown that India is likely to witness one of the highest agricultural productivity losses in the world in accordance with the climate change pattern observed and scenarios projected. Climate change projections made up to 2100 for India indicate an overall increase in temperature by 2-4°C with no substantial change in precipitation quantity (Kavikumar, 2010). The projected agricultural productivity loss for India by 2100 is 10% to 40% after taking carbon fertilization effect into account (Agrawal, 2008). Many simulation-based crop growth models have been developed to examine the vulnerability of agriculture to climate change (Hoogenboom, 2000) particularly for situation of developed temperate countries. Many studies (Parry *et al.*, 1999; Darwin, 2004; Olesen and Bindi, 2002; Adams *et al.*, 2003; Tsvetsinskaya

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