**Assessing Crop Yield Response to Compound Hydroclimatic Extremes in Arid Region**

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**ABSTRACT**

Agricultural productivity in arid regions is highly sensitive to hydroclimatic conditions. However, the impact of compound hydroclimatic extremes, such as simultaneous droughts and heatwaves, on crop yields during Kharif and Rabi crops remains inadequately understood. Here, we analyze the changes in the different crop yields (Kharif and Rabi) over the arid region of Rajasthan using the observed datasets from 1985-2005. Our analysis reveals a conspicuous and robust correlation between the production of Kharif crops and variations in temperature and precipitation in the region. We found that the Kharif crops, sown in the monsoon season and harvested in the autumn, exhibit high sensitivity to compound hydrological extremes. The yield of Kharif crops (cereals, oilseeds, and pulses) reduced significantly due to drought and heatwave in the region. However, the scenario is notably different when we analyze the Rabi crops (cultivated during the winter season). We found that the correlation between crop production and climatic variables (precipitation and temperature) is comparatively weaker. The Rabi crops seem to be less influenced by fluctuations in temperature and precipitation, suggesting a greater resilience to these environmental changes. Moreover, the poor correlation between crop yield and climate variables may be associated with human-intensive irrigation (using groundwater and canals) and less precipitation in the region. Overall, the Kharif crops in the region are more vulnerable due to compound hydroclimatic extremes compared to Rabi crops. Therefore, more efforts need to be made for the climate-resilient Kharif crops in the region, which will be severely affected by a warming and dry climate in the future.

**Keywords:**Crop yield; Kharif; Rabi; Drought; Heatwave; Arid region.

1. **$INTRODUCTION**

India has seen a substantial increase in average temperatures, primarily due to greenhouse gas-induced warming, partially offset by anthropogenic aerosols and land use changes. During the summer monsoon season (June to September), India has experienced a noteworthy decline in precipitation. Researchers widely agree, based on various data sources and climate models, that the radiative effects of anthropogenic aerosols in the Northern Hemisphere have significantly countered the expected precipitation increase from greenhouse gas warming, contributing to reduced summer monsoon rainfall. These climatic shifts, marked by droughts and elevated temperatures, are a significant factor in decreasing crop yields.Implementing sustainable agricultural practices, promoting climate-resilient crop varieties, and developing adaptive strategies are imperative to mitigate potential disruptions to food supply chains.

1. **DATA and METHODS**

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| where (Production)i is the production for ith year, Ti is the average temperature for ith year (for the considered months) and Pi is the total precipitation for ith year (for the considered months).  http://www.cazri.res.in/crop1.php |
| 1. **Result** |
| **Rabi Crop Variation**    Yr  Yr.  Yr. | |

It is evident that in certain years such as, 1991, 1997 and 1998 and a clear pattern emerges where an increase in precipitation and a decrease in temperature results in a higher total production.

Conversely, in years such as 1987, 1993, 1999 and 2002 a decrease in precipitation and an increase in temperature lead to a lower total production

| Kharif Crops Variation    Yr.  Yr.  Yr. |
| --- |

It is evident that in certain years such as 1990, 1992, 1994, 1996, 2001, and 2003, a clear pattern emerges where an increase in precipitation and a decrease in temperature results in a higher total production.

Conversely, in years such as 1987, 1991, 1998, 2002, 2004 and 2005 a decrease in precipitation and an increase in temperature lead to a lower total production.

1. **CONCLUSIONS**

Our analysis reveals a conspicuous and robust correlation between the production of kharif crops and variations in temperature and precipitation. Kharif crops, sown in the monsoon season and harvested in the autumn, appear to exhibit a high degree of sensitivity to climatic shifts. These crops, which encompass a wide range of cereals, oilseeds, and pulses, respond significantly to changes in both temperature and rainfall patterns. However, the scenario is notably different when we turn our attention to rabi crops, cultivated during the winter season. Here, the correlation between production and climatic variables is comparatively weaker. Rabi crops seem to be less influenced by fluctuations in temperature and precipitation, suggesting a greater resilience to these environmental changes. This divergence in sensitivity underscores the importance of distinguishing between kharif and rabi crops in climate-resilient agricultural strategies and resource allocation, as it highlights the need for tailored approaches to mitigate the impacts of climate variability on crop production throughout the agricultural calendar.

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