



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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SHORT ABSTRACT

In the last few decades, climate change has emerged as a major threat to natural systems. Climate change has affected the climatic patterns around the globe and is affecting the hydrology and ecohydrology in different river basins. These changes are anticipated to aggravate in future. Therefore, it is essential to assess the capacity of our natural systems to withstand these hydroclimatic changes. The concept of resilience, defined as the ability of the ecosystem to absorb the disturbances and sustain the same functioning under disturbed conditions, has emerged as a tool to understand the response of the system to disturbances. In this study, a framework is developed for the resilience analysis of the terrestrial ecosystems in India to droughts. The framework uses the ecosystem water use efficiency (WUE_e) as an indicator for the ecosystem functioning. The framework is applied at multiple scales (river basin, district, land cover and climate type) for the resilience analysis of the terrestrial ecosystems. The ecosystem resilience analysis revealed that six out of 22 basins and 241 out of 634 districts were resilient to droughts. Forests were found resilient to droughts, which contributed to the higher resilience of forest dominated regions. Out of 30 states and UTs, only 10 had more than 50% resilient area, which were mainly located in the lower Himalayan region. Further, WUE_e and its controlling factors are studied in detail. Large variation in WUE_e is found for different parts of the country. WUE_e was higher in the lower Himalayan regions and northeast India. In contrast to the decreasing trend in global WUE_e , an increasing trend was found for the country average WUE_e . Precipitation was the main climatic factor affecting WUE_e in the western, central and eastern India; Temperature in the mountainous Himalayan regions; and Solar radiation in some parts of northeast and northwest. The negative impact of development activities on primary production was found for four forest-dominated states (3 in northeast and 1 in north).

In addition to ecosystem resilience analysis, a hydrological resilience analysis was performed in the Teesta river basin in Indian Himalayan regions. Two resilience measures (deviation and recovery time) were used for the resilience analysis. Analysis of changes and trend in precipitation, temperature and climate extremes (23 indices) was performed in the basin for past and future climate. Four general circulation models (GCMs) were used to obtain the projected scenarios of precipitation and temperature under two representative concentration pathways (RCPs) in eight sub-basins of the Teesta river. Increase in precipitation and temperature was found in the basin for all the projected scenarios. Hydrological modelling (Soil and Water Assessment Tool) was used to simulate the hydrological processes in the basin for both past (1951-2010) and projected (2011-2100) climates. The simulated streamflow had an increasing trend in the basin for different projected scenarios. Drought analysis using standardized precipitation index (SPI) indicated a decrease in drought events in future. The resilience analysis revealed an increase in the basin's resilience to maintain streamflow under less precipitation conditions.

Climate change is affecting the pattern of precipitation and temperature around the world. Analysis of changes in precipitation, temperature and climate extremes is also performed for India at 0.5-degree grids. The outputs from 20 GCMs were corrected for bias using the observed data for four climate change scenarios (i.e. RCPs). Precipitation and temperature were found to increase under projected climate in India; however, there was large spatial heterogeneity in the changes in both precipitation and temperature. Higher increase in precipitation was found in Western parts of the country whereas a higher increase in temperature was found in Himalayan regions. Study of the climate extremes revealed an increase in extreme warm events such as warm nights, warm days, tropical nights and summer days, and decrease in extreme cool events such as cool nights, cool days, ice day and frost days. Substantial increase in precipitation extremes was also found for different parts of the country. This study provides a framework for resilience analysis, which can be applied in different parts of the country. This study facilitates the identification of the most sensitive regions in the country for ecosystem management and climate policymaking, and highlight the need for taking sufficient adaptation measures to ensure the sustainability of ecosystems.

