

Two-decade long spatial–temporal study of vegetation dynamics over the Narmada river basin, India

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India is an agriculture dominated country, which requires well managed irrigation system across the river basins to benefit farmers. Narmada basin is one of the largest basins in India, having a large-scale implementation of irrigation network in the last few decades. A study of vegetation dynamics, along with associated environmental and surface parameters, is required for the sustainable development. However, only a few studies focused on the basin level and sub-basin level vegetation dynamics. The present study is focused on dynamically varying vegetation over spatial and temporal scales for Narmada basin and its sub-basins using MODIS normalised difference vegetation index (NDVI) data (2000–2021). Changes were observed in the fractional vegetation cover using MODIS vegetation continuing field (VCF) data, surface soil moisture using microwave remote sensing based derived soil moisture data and MODIS aqua day and night land surface temperature data. Time-series analysis revealed the increasing trend of NDVI at basin level and majority of sub-basins. An increase in fractional vegetation cover associated with improved vegetation condition was observed during the last two decades (2000–2020). Change in cropping pattern was observed over wide area across the basin, showing increase in the number of months with vegetation cover along with associated increase in yearly cumulative soil moisture and decrease in day and night temperature difference. The present study fills the gap area in the existing literature describing changes observed in the vegetation dynamic pattern over Narmada basin after the implementation of large-scale irrigation network during last two-decades.

Keywords: HydroSHED, MODIS NDVI, Narmada basin, vegetation dynamics, vegetation fraction.

to natural and anthropogenic factors is essential for improving the ecosystem of the river basins². River basins are witnessing development of command area and water management schemes all around the world. One of the largest basin development schemes in the world is Narmada basin development programme. A number of dams, such as Bargi, Barna, Indra Sagar, Kolar, Omakreshwar, Maheshwar, Bhagwant Sagar, Tawa Dam and Sardar Sarovar, have been constructed on the Narmada river and its tributaries during the recent decades.

Development is usually associated with issues that may affect the natural biodiversity of the basin. Comprehensive monitoring of vegetation and landscape is required for the sustainable development of Narmada basin. Remote sensing data and derived vegetation indices are widely used by various researchers to study different kinds of vegetation and their dynamics. Bhatt *et al.*³ evaluated the vegetation responses towards rainfall variability in the Gomati basin from 1901 to 2015 using high-resolution observed daily gridded rainfall and satellite-derived normalised difference vegetation index (NDVI) data. Liu *et al.*⁴ aimed to have a comprehensive understanding of land use and vegetation evolution of the Huaihe River Basin over the 30 years from 1985 to 2014 using remote sensing-derived NDVI data.

Despite the scientific and religious importance of the Narmada river, sufficient literature is not available describing the long-term assessment of its vegetation dynamics. The present study is a step towards filling this gap by providing the study results, which help answer questions like how to maintain this vegetation cover and so on.