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Late Holocene vegetation history and monsoonal climate change from the Core Monsoon Zone of India

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ABSTRACT

To understand the vegetation response to climate change and the Indian Summer Monsoon rainfall (ISMR) variability during the Late Holocene (approx. 2.5 ka), pollen analysis was conducted on a 1.2-m-long lacustrine sediment profile from the Korba District of Chhattisgarh, central India, within the core monsoon zone (CMZ). The pollen evidence suggest that between approx. 2500 and 1950 cal yr BP, open tropical deciduous forest vegetation occupied the landscape under a warm and relatively less humid climate, coupled with decreased ISMR. Between approx. 1950 and 1035 cal yr BP, a warm and relatively more humid climate prevailed, along with moderate ISMR, leading to the transition of the existing vegetation to an open mixed tropical deciduous forest. Between approx.1035 and 220 cal yr BP (CE 915–1730), the mixed tropical deciduous forest became established under a warm and humid climate with increased ISMR, coinciding globally with the Medieval Climatic Anomaly (MCA). Mixed tropical deciduous forest expanded and transformed into a dense mixed tropical deciduous forest between approx. 220 cal yr BP to the present (CE 1730 onwards). This transformation occurred under a warm and relatively more humid climate, accompanied by intensified ISMR, aligning with the Current Warm Period (CWP). Gradual forest transformation from open vegetation to dense mixed tropical deciduous forests, as well as in the ISMR has been observed since the last approx. 2.5 ka in central India. Cereal-based agricultural practices and other anthropogenic activities have been documented in the study area since approx. 2.5 ka, with an accelerated pace observed from 1035 cal yr BP to the present.

1. Introduction

Vegetation, one of the most important components of terrestrial ecosystems, serves as a natural link connecting the land and the atmosphere. It plays a crucial role in sustaining soil moisture, balancing the terrestrial carbon cycle, and regulating the climate system (Ciais et al., 2005; Cyr et al., 1995; Gao et al., 2017; Newbold et al., 2015). The study of evolutionary patterns, driving mechanisms, and predictive control of vegetation under environmental changes is a significant focus in global change research, and has attracted global, regional, and local attention (Chen et al., 2013; Mao et al., 2016; Gao et al., 2017; Liu et al., 2021; Kar and Quamar, 2019, 2020;, Mohanty et al., 2024; Quamar, 2022a; Quamar et al., 2021, 2024 and references cited therein). Generally, climate factors, such as temperature, precipitation, and sunshine duration are intrinsic natural forces that determine vegetation growth (Piao et al., 2011). Humans or anthropogenic influences are also there on the distribution pattern of vegetation, besides the climatic conditions (temperature, precipitation), soil characteristic and altitude (Faegri and Iversen, 1964; Sun and Wu, 1987; Gasse et al., 1991; Chen et al., 2006; Ivanov et al., 2007 and references cited therein). Pollen, a product of the vegetation itself, is derived from sediments found in peatlands, swamps, coastal areas, lakes, and marine bases. Fossil pollen analysis contributes to understanding paleoenvironmental changes during the Quaternary Period (Bradley, 2015). It serves as a crucial proxy for assessing past environmental conditions by determining vegetation history and land use characteristics (Behre, 1990; Bakker et al., 2013; Roberts et al., 2016). Lakes are closed basins that accumulate sediments at their bases, providing a continuous record, which serve as crucial data sources enabling the high-resolution assessment of local and regional climatic changes. It is well established that data on paleovegetation, derived

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