Social and Ecological Vulnerability of Indian Sunderban Mangroves using DPSIR Framework

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The Indian Sunderban Delta (ISD), a UNESCO World Heritage site, home to world’s largest mangrove forests that span over India and Bangladesh, has recently been enlisted as the 27th Ramsar site in 2019. Mangroves, crucial for their biodiversity and ecosystem services, are highly vulnerable to changing coastal land use practices in developing countries. Anthropogenic ecosystem vulnerability and their significant impacts on human well-being have been recognized by MEA 2005, TEEB 2010, IPBES 2018 and researchers worldwide. The present study attempts to assess the vulnerability of human well-being due to mangrove ecosystem degradation in Sunderban Biosphere Reserve of the ISD using Driver-Pressure-State-Impact-Response (DPSIR) Framework. The primary anthropogenic drivers (D) with changing economic aspirations and fuel-wood dependency post-cyclone ‘Aila’, 2009, created pressure (P) as land-use, agricultural productivity, and salinity changes. Cumulative with the state (S) of urbanisation, mangrove-ecosystem dependency and awareness, these impacted (I) into deterioration of mangroves (diversity and health), human labour loss (health and migration), livestock losses, addressed by weak responses (R) in terms of awareness and restoration only in few pockets of the whole ISD. A comparative analysis in three zones, West, Central and East of ISD, suggests that though Drivers and Pressures are proportionately higher in the Central zone with increased tourism, development and a higher mangrove dependency, the Eastern portion of the delta bears larger share of Impacts, rising migration, and higher vulnerability of human well-being. The Western zone, developed historically, currently shares least mangroves among the three, but presents a better state of mangrove awareness and more positive local response towards mangrove conservation due to lesser land-use changes in last decade. The study suggests ecosystem-based management (EBM) focussed with awareness and participation of locals aiming at balanced sustainable development is the key for effective mangrove conservation and reducing vulnerabilities.

Key Words: Sunderbans, Ramsar Sites, UNESCO World Heritage Site, Biosphere Reserve, wetlands, land-use change, anthropogenic drivers, ecosystem-based management