EDITORIAL

Indian Monsoon: A Clarion Call for a Systems Approach and Dialectical Thinking

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July, the middle of the main monsoon season in India, brings much-anticipated rains that drench the heat of the summer. The Indian monsoon is one of the oldest recorded weather phenomena, eagerly tracked and studied by researchers across the country. It directly affects the water availability and well-being of more than a billion people. Its origins and processes are still a matter of scientific debate, and the predictability of its strength, variability, and distribution is constantly evolving. It is a classic example of a complex and dynamic system, whose seasonal changes in wind direction cause more than two-thirds of all rain in South Asia. The differential heating of land and sea, the flow of moisture from the oceans, atmospheric pressure, and the subcontinent's topography are only some of the factors affecting the monsoon. We now know that atmospheric phenomena occurring across the planet, such as the Intertropical Convergence Zone and El Niño Southern Oscillation, affect the monsoon as well.

The monsoons are a time of celebration across India, denoting rejuvenation, fertility, and prosperity. During this time, floods inundate the riverbanks and deposit fertile silt, leading to bumper harvests that have sustained our agrarian civilization. It has inspired folklore, art, literature, and music. The monsoon's beauty and joy are celebrated in classical literature such as *Meghdoot*, in folk art such as *Warli*, during festivals such as *Teej* and *Onam*, in Hindustani classical ragas such as *Megh Malhar*, and in popular cinema and music.

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However, the arrival of the monsoon in contemporary times also brings news of devastation and death. So far, the 2025 monsoon has been marked by an early onset, unusually rapid movement, abrupt halts, and localised disasters. Intense rains have triggered landslides (a record 598 landslides have been reported in Mizoram alone), severed transport links across the Himalayan states, and washed away homes. Himachal Pradesh reported 85 fatalities in one monsoon spell, according to the Himachal Pradesh Disaster Management Authority, with 54 of them directly caused by rain-related incidents such as landslides, flash floods, and cloudbursts, and the rest due to related road accidents. How do we make sense of the much-awaited and celebrated monsoons becoming a period of disaster and despair?

The twin crises of climate change and the limited imaginaries of development are shaping culturally embedded phenomena that define Indian weather. The influence of climate change on the monsoons is little understood, other than the experience of their unpredictability. The impact of specific developmental activities is less of a mystery. An already complex system of moisture-laden winds is now interacting with significant landscape changes, including heat islands, expanding urbanization, hollowed-out and blasted mountains, bare and exposed slopes, re-directed river flows, and encroached riverbeds, creating a recipe for disaster. A narrow developmental path follows the flows of capital, especially in the Himalayas. Four-lane highways tunnelling through the young mountain range obliterate the need to follow winding mountain curves, compressing time, ironing out local ecological features. Glacial rivers are short-circuited by the "development" of their more expansive floodplains, and their direction of flow is changed to produce hydropower in run-of-the-river projects. Riverbeds in dry seasons and years appear as prime flat land to accommodate an increasing population, the tourist influx, and an expanding economy. Long-settled rock structures and vegetation cover are disturbed, each event slowly chipping away at the stability of this complex, young mountain system, one blast at a time.

Each change—four-lane roads, dams, diverted rivers, mining, tunnelling, and urban expansion—appears as a discrete event. In the best-case scenario, sustainable development has meant that each event is justified by a narrow cost–benefit analysis of its specific social and ecological impact within a limited lifecycle, and new plantations may or may not compensate for the loss of long-established biodiverse ground cover. This fragmented approach to sustainable development leaves us unprepared for heat pockets in the summer, floods and cloud bursts in the monsoon, and smog and poor urban air quality in the winter, until the retreating monsoon brings our attention back to urban floods in the southern states. Disaster management

follows each event, while the devastation to human and more-than-human life caused by our seasonal disasters never enters the financial and ethical assessments of our mega-development projects.

The 2025 monsoon is yet another urgent call to rethink the cumulative and interactive impacts of our multiple development activities on dynamic planetary systems such as the Indian monsoon. A systems approach that can account for numerous and cumulative dynamic feedback loops, and dialectical thinking that can envision emergent processes from systemic contradictions, is essential for human survival. Such an approach has been a driver of ecological economics, which is also a humble effort of this journal that seeks to understand ecology, economy, and society as an integrated and dynamic system.

Taking this interdisciplinary approach, our first research article in this issue (by R Mohan Raj, R Indhar Saidanyan, B Parthiban, and S Chandrasekaran) examines the ecological, social, and economic impact of the invasion of the Sailfin catfish in the Cauvery and Vaigai river basins in Tamil Nadu. An unanticipated consequence of keeping exotic fish as pets in aquaria is the loss in abundance of native comparator fish, which, in turn, results in economic loss and changes in occupation among fishing communities.

In the second research article, Mohanasundari Thangavel and Nihal Singh Khangar engage with the balance of resource efficiency and environmental sustainability in rain-fed agriculture in Madhya Pradesh. Using lifecycle assessment to quantify the environmental impact of crop production, and the data envelopment analysis–directional distance function to evaluate efficiency, they report a 22% potential for improving eco-efficiency in rain-fed food crop farming using government data from 2021–22.

Charles Dwumfour Osei highlights the role of environmental literacy in shaping green agricultural production behaviour among vegetable farmers in Ghana in the third research article. In this emerging economy, the author shows that despite low environmental literacy, farmers are willing to practice sustainable agriculture. In our "Insights from the Field" section, Mugdha Khandelwal shares the positive gendered collateral impacts of solar photovoltaic pump (SVP) adoption in tribal districts in Chhattisgarh. By reducing the time and drudgery of water collection—which is typically a woman's burden—SPVs have empowered women to rest and engage in other productive work. This has also reshaped the time-use patterns of both men and women.

Two new books, *Economics of Mineral Mining in India* (S Mohammed Irshad, Palgrave Macmillan, 2024) and the *Oxford Handbook of Environmental and Natural Resources Law in India* (Philippe Cullet, Lovleen Bhullar, and Sujith Koonan, 2024), are reviewed in this issue by Arpita Bisht and MK Ramesh, respectively.

Last but not least, we carry a warm and glowing tribute to Prof U Shankar, one of India's renowned economists, who was a pioneer in the field of environmental economics and a visionary institution builder who established the Madras School of Economics—written by his student and a senior economist in this field, G Mythili.