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Climate change and the politics of monsoon governance in India: Institutional responses to increasing rainfall variability

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Abstract
Climate change has emerged as one of the most significant challenges affecting the Indian monsoon, leading to increasing rainfall variability, delayed monsoons, extreme weather events, and growing water insecurity. Traditionally regarded as a seasonal environmental phenomenon, the monsoon has increasingly become a critical governance concern with far-reaching socio-economic and political implications. This paper examines how climate change is reshaping monsoon patterns in India and analyses the political and institutional dimensions of monsoon governance. It argues that the consequences of rainfall uncertainty are not solely the result of climatic changes but are also influenced by governance capacities, policy choices, environmental degradation, and resource management practices. The study highlights issues such as urban water stress, environmental degradation, deforestation, and the vulnerability of communities dependent on monsoon rainfall. Drawing upon secondary sources, policy documents, government reports, and contemporary examples from different parts of India, the paper evaluates the effectiveness of existing institutional responses in addressing the challenges posed by increasing rainfall variability. It concludes that strengthening climate governance, improving inter-institutional coordination, promoting sustainable environmental practices, and enhancing adaptive capacities are essential for building resilience against the growing uncertainties associated with climate change and the Indian monsoon.

Keywords: Climate change, monsoon governance, rainfall variability, climate governance, water security, India

Introduction

Climate change has emerged as one of the most pressing global challenges of the twenty-first century, significantly affecting ecological systems, economic activities, and human societies across the world. Rising global temperatures, changing precipitation patterns, and the increasing frequency of extreme weather events have raised serious concerns regarding environmental sustainability and human security. Scientific evidence indicates that the pace and intensity of climate change have accelerated significantly in recent years. According to recent climate assessments by the United Nations Pulse, the period from 2015 to 2025 represents the warmest decade ever recorded, while each of the past nine years has witnessed record-breaking ocean heat content. Climate projections further suggest that glaciers may disappear from nearly one-third of their current locations by 2050, while droughts could affect more than three-quarters of the world's population [1]. Furthermore, according to an analysis by scientists from NOAA's National Centres for Environmental Information (NCEI), global average temperatures in 2024 were approximately 1.29°C above the twentieth-century average, making it the warmest year in modern climate records. These developments highlight the growing urgency of understanding and addressing the environmental, social, and governance challenges associated with climate change [2].

Among the various consequences of climate change, alterations in rainfall patterns have attracted particular attention due to their direct impact on water availability, agricultural productivity, and socio-economic stability. Rising temperatures increase the atmosphere's capacity to retain moisture, altering the distribution, intensity, and timing of rainfall across different regions of the world. Since monsoons are driven by complex interactions between land, oceans, atmospheric circulation, and temperature gradients, even minor alterations in climatic conditions can significantly affect their behaviour. Rising sea surface temperatures, changing wind patterns, and increased atmospheric moisture have contributed to irregular monsoon onset, shifting rainfall distribution, and greater frequency of extreme rainfall events in many monsoon-dependent regions. Consequently, monsoon variability has evolved from a purely environmental concern into a broader socio-economic and governance challenge, affecting agriculture, water resources, food security, and human livelihoods. Among the countries particularly vulnerable to the impacts of climate change, India occupies a unique position due to its heavy dependence on the southwest monsoon.

According to the Press Information Bureau (2025) report, "The southwest monsoon constitutes the principal source of rainfall in India and a lifeline for the country's economy and ecology. It supports farming, fills rivers and lakes, and recharges groundwater. About 75 per cent of India's total rainfall comes during this season, making it essential for irrigation, drinking water, and even electricity generation through hydropower."The significance of the southwest monsoon becomes even more apparent when viewed in the context of India's socio-economic structure. Despite ongoing economic diversification, agriculture continues to support a substantial proportion of the country's population, with nearly 64 per cent of Indians depending directly or indirectly on agricultural activities for their livelihoods. However, only about 55 per cent of India's net sown area is supported by irrigation facilities, while the remaining agricultural land relies primarily on rainfall. Consequently, fluctuations in monsoon performance can have significant

implications for agricultural productivity, rural incomes, food security, and overall economic growth. A favourable monsoon generally contributes to higher agricultural output, increased rural consumption, and improved economic performance, whereas deficient or irregular rainfall can adversely affect these sectors [3].

The increasing variability and unpredictability of monsoon rainfall demonstrate that climate change is no longer merely an environmental concern but a significant governance challenge. While a considerable body of literature has examined the scientific and climatic dimensions of monsoon variability, relatively less attention has been paid to the political and institutional mechanisms required to manage its consequences. As changing rainfall patterns affect agriculture, water security, disaster management, and livelihoods, understanding the effectiveness of governance responses becomes increasingly important. This necessitates an examination of how institutions are adapting to growing monsoon uncertainty and whether existing policy frameworks are adequate to address emerging climate-related challenges.

Against this backdrop, this study aims to examine the impact of climate change on monsoon variability in India and analyse the institutional responses adopted to address increasing rainfall uncertainty. It further seeks to evaluate the governance challenges arising from changing monsoon patterns and identify policy measures that can strengthen climate resilience.

The study adopts a qualitative research methodology based on secondary sources. Data have been collected from government reports, policy documents, research articles, climate assessments, and contemporary examples related to rainfall variability, water governance, and climate adaptation in India.

Climate Change and Increasing Rainfall Variability in India

Recent years have witnessed increasing rainfall variability, delayed monsoon onset, prolonged dry spells, and extreme weather events across different regions of India. According to the India Meteorological Department (IMD), the all-India annual mean land surface air temperature in 2025 was 0.28°C above the 1991–2020 long-term average, making it the eighth warmest year since nationwide records began in 1901. The year 2024 remains the warmest on record, with temperatures 0.65°C above the long-term average. These observations indicate a continuing warming trend over the Indian subcontinent, consistent with broader global climate change. July, once a peak month for rain, is now showing a decline in rainfall, while September is becoming wetter. Furthermore, variations in the onset and withdrawal of the monsoon, coupled with the growing influence of climatic phenomena such as El Niño and La Niña, have contributed to greater uncertainty in rainfall distribution. These developments suggest that the challenge facing India is not merely the amount of rainfall received but also the increasing unpredictability of when, where, and how rainfall occurs [4].

Recent assessments further demonstrate that monsoon variability in India is characterised more by uneven spatial distribution than by a uniform decline in seasonal rainfall. A district-level analysis conducted by the Council on Energy, Environment and Water (CEEW) over the past four decades found that while India experienced 29 normal, eight above-normal, and only three below-normal southwest monsoon years at the national level, the district-level picture was considerably different. Nearly 30 per cent of India's districts experienced a high frequency of deficient rainfall years, whereas 38 per cent recorded a high frequency of excessive rainfall years. More significantly, around 23 per cent of districts—including New Delhi, Bengaluru, Jaipur, Indore, Kachchh, and the Nilgiris—experienced both recurrent deficient and excessive rainfall during the same period [5]. These findings suggest that national rainfall averages often conceal significant regional disparities, making rainfall variability and spatial unevenness more critical governance challenges than changes in total seasonal rainfall alone.

The spatial variability of rainfall is further evident at the river basin level, where recent studies have identified contrasting precipitation trends across India's major river systems. Several strategically important river basins, including the Ganga, Brahmaputra, Cauvery, Brahmani, and Pallar–Ponniyar basins, have experienced significant declines in both annual and southwest monsoon rainfall over recent decades. For example, the Ganga basin recorded a decline of approximately 6.3 per cent in annual rainfall and 6.6 per cent in monsoon rainfall, while the Brahmaputra and Cauvery basins experienced even greater reductions. In contrast, the Surma basin registered an increase in both annual and monsoon rainfall [6]. These contrasting trends indicate that the impacts of climate change are not uniform across the country. Instead, rainfall variability is becoming increasingly spatially differentiated, with some river basins experiencing persistent rainfall deficits while others receive above-average precipitation. Such uneven rainfall patterns have important implications for agriculture, ecosystems, river basin management, and regional climate adaptation.

The foregoing analysis demonstrates that climate change is altering the Indian monsoon not simply by affecting the overall quantity of rainfall but by increasing its spatial and temporal variability. The growing unpredictability of rainfall across districts and river basins indicates that national monsoon averages alone are no longer sufficient to understand the changing nature of India's climate. The increasing variability of the Indian monsoon extends beyond climatic and environmental changes, producing wide-ranging socio-economic consequences across the country. As rainfall becomes more uncertain in terms of its timing, intensity, and geographical distribution, its impacts are increasingly felt in sectors that depend heavily on predictable monsoon conditions. Agriculture, food security, rural livelihoods, water resources, and disaster management have become particularly vulnerable to these changing rainfall patterns.

Climate Change and the Politics of Monsoon Governance in India: Institutional Responses to Increasing Rainfall Variability

Traditionally, the Indian southwest monsoon was perceived primarily as a seasonal climatic phenomenon that governed agricultural cycles and water availability. Although fluctuations in monsoon performance have always been a characteristic feature of India's climate, the increasing influence of climate change has fundamentally altered the nature of this phenomenon. Rising temperatures, changing atmospheric circulation, and increasing rainfall variability have made the monsoon progressively less predictable in

terms of its onset, duration, intensity, and spatial distribution. As a result, the consequences of monsoon variability now extend far beyond environmental concerns, affecting multiple sectors that are critical to national development.

Furthermore, the governance dimension of the monsoon reflects the growing interaction between environmental change and public policy. Climate change has introduced new forms of uncertainty that cannot be addressed solely through traditional administrative mechanisms or historical rainfall patterns. Instead, effective monsoon governance requires adaptive institutions capable of integrating scientific knowledge into policymaking, coordinating responses across multiple levels of government, and balancing developmental priorities with long-term climate resilience. In this context, the politics of monsoon governance is concerned not merely with managing rainfall but with governing climatic uncertainty through institutions, policies, and collaborative decision-making processes.

Monsoon governance refers to the institutional, legal, and policy mechanisms through which governments anticipate, manage, and adapt to the uncertainties associated with changing monsoon patterns. It encompasses a wide range of activities, including climate forecasting, disaster risk reduction, water resource management, agricultural planning, infrastructure resilience, and climate adaptation. Unlike traditional approaches that focused primarily on responding to floods or droughts after they occurred, contemporary monsoon governance increasingly emphasizes preparedness, scientific forecasting, intergovernmental coordination, and long-term resilience.

The India Meteorological Department (IMD) serves as the principal national agency responsible for meteorological observations, weather forecasting, and climate monitoring in India. Established under the Ministry of Earth Sciences, the IMD plays a central role in monsoon governance by providing real-time weather information and seasonal forecasts that support decision-making across multiple weather-sensitive sectors. Its meteorological services assist agriculture, irrigation, aviation, shipping, fisheries, offshore energy operations, and water resource management by enabling timely planning and reducing climate-related risks. Furthermore, the IMD issues early warnings for extreme weather events such as tropical cyclones, heavy rainfall, thunderstorms, heat waves, cold waves, and dust storms, thereby strengthening disaster preparedness and minimizing the loss of life and property [7].

Rainfall forecasting in India is undertaken across multiple temporal scales, including seasonal forecasts, extended-range forecasts of up to four weeks, short- to medium-range forecasts of up to seven days, and nowcasts extending up to three hours. These forecasts are generated using advanced numerical weather prediction models that integrate satellite observations, weather radar data, and atmospheric and oceanic information [8]. Beyond weather forecasting, the IMD has increasingly become an important institution for evidence-based governance. Through the District Rainfall Monitoring System (DRMS), it generates daily, weekly, monthly, and seasonal rainfall statistics that are extensively used by policymakers to assess monsoon performance and formulate appropriate policy responses [9].

While accurate forecasting constitutes the first step in responding to increasing rainfall variability, effective monsoon governance extends beyond the generation of scientific information. Forecasts must be translated into institutional action through disaster preparedness, risk reduction, and coordinated administrative responses. Consequently, disaster management institutions play a crucial role in ensuring that early warning information is converted into timely interventions that minimize the impacts of climate-induced hazards.

The National Disaster Management Authority (NDMA), established under the Disaster Management Act, 2005, is India's apex institution responsible for formulating policies, plans, and guidelines for disaster management. In the context of increasing rainfall variability, the NDMA plays a significant role in strengthening monsoon governance by enhancing institutional preparedness for climate-induced disasters. Increasingly erratic monsoon behaviour has contributed to a rise in floods, cloudbursts, urban flooding, landslides, and droughts, requiring coordinated disaster management strategies rather than ad hoc emergency responses. The NDMA develops national guidelines, facilitates inter-agency coordination, promotes risk assessments, and supports early warning dissemination to reduce disaster risks associated with extreme rainfall events. It also works closely with the India Meteorological Department (IMD), State Disaster Management Authorities (SDMAs), and district administrations to improve preparedness and ensure timely evacuation and relief measures [10].

However, responding to rainfall variability is not confined to disaster preparedness alone. Since the southwest monsoon remains the backbone of Indian agriculture, effective governance also requires institutional mechanisms that strengthen agricultural resilience and reduce farmers' vulnerability to climatic uncertainty.

In India, the Ministry of Agriculture is the nodal agency for drought management and agricultural adaptation. It prepares annual crisis management plans based on anticipated weather conditions and works closely with state governments to minimize the adverse impacts of deficient or erratic monsoons. Supporting institutions such as the Indian Council of Agricultural Research (ICAR) and the Department of Agriculture and Farmers' Welfare have developed short-duration and drought-tolerant crop varieties, which are disseminated to farmers through Krishi Vigyan Kendras (KVKs). These initiatives enhance farmers' adaptive capacity by reducing agricultural vulnerability to rainfall variability. Timely meteorological information provided by the IMD further supports agricultural planning by enabling farmers and government agencies to make informed decisions regarding cropping patterns and resource allocation [11].

Beyond agricultural adaptation, effective monsoon governance also requires sustainable water resource management to address the challenges posed by increasing rainfall variability. The Ministry of Jal Shakti plays a key role in promoting integrated water resource management through initiatives aimed at groundwater conservation, watershed development, river basin planning, and efficient water use. However, Shah (2009) argues, increasing rainfall variability has adversely affected natural groundwater recharge, while the continued overexploitation of groundwater has reduced the resilience of aquifers and their capacity to support agricultural livelihoods under changing climatic conditions. In addition, excessive groundwater extraction from deeper aquifers has increased dependence

on energy-intensive pumping, further raising environmental concerns. Recognizing the growing dependence of Indian agriculture on groundwater, Shah emphasizes that policymakers should adopt the proactive management of aquifer storage as a central component of India's water strategy. Such an approach would strengthen water security, improve resilience to climate-induced rainfall variability, and contribute to more effective monsoon governance [12].

At the policy level, India has adopted the National Action Plan on Climate Change (NAPCC), which provides an overarching framework for addressing climate-related challenges through eight national missions. In addition, State Action Plans on Climate Change (SAPCCs) have been developed to incorporate climate adaptation strategies into state-level development policies, reflecting the recognition that climate impacts vary across regions. Together, these frameworks promote the mainstreaming of climate adaptation into governance by encouraging coordination across sectors and levels of government. Rather than treating climate change solely as an environmental issue, these policy initiatives recognize increasing rainfall variability as a governance challenge requiring long-term institutional planning, adaptive policymaking, and collaborative implementation [13].

The institutional mechanisms discussed above demonstrate that India has progressively strengthened its governance framework to respond to the growing challenges posed by climate change and increasing rainfall variability. However, the effectiveness of monsoon governance depends not only on the existence of institutions and policies but also on their capacity to function in a coordinated, adaptive, and responsive manner.

While the institutional mechanisms discussed above demonstrate India's growing commitment to climate adaptation, scholars have argued that the effectiveness of these institutions depends on the quality of governance through which they operate. In this context, India's response to climate change is characterised by a system of multi-level governance in which responsibilities are shared among different levels of government and institutions. They argue that the State Action Plans on Climate Change (SAPCCs) are shaped by interactions between national, state, local, and international actors, highlighting the importance of coordination in climate governance. Furthermore, although India has made significant progress in developing institutional frameworks for climate governance through the State Action Plans on Climate Change (SAPCCs), several governance limitations continue to affect their effectiveness. They contend that, due to time and capacity constraints, many State Action Plans remain closely aligned with nationally prescribed guidelines rather than developing context-specific strategies suited to local climatic conditions. Drawing on the work of Joergensen et al., the study also emphasize that the effectiveness of climate governance depends upon strong policy coordination across subnational, national, and international levels. However, inadequate vertical and horizontal institutional linkages have constrained states' ability to innovate, build long-term institutional capacity, and contribute meaningfully to broader climate governance processes. As a result, despite the establishment of formal climate planning mechanisms, significant challenges remain in translating climate policies into effective and locally responsive governance [14].

The discussion above demonstrates that India has progressively strengthened its institutional response to increasing rainfall variability through scientific forecasting, disaster management, agricultural adaptation, water resource management, and climate policy frameworks. However, the effectiveness of these institutional mechanisms ultimately depends on their ability to function in a coordinated, adaptive, and context-specific manner. These institutional achievements and governance limitations provide the basis for the broader conclusions of this study.

Conclusion

Climate change has fundamentally transformed the nature of the Indian southwest monsoon, shifting it from a predictable seasonal phenomenon to an increasingly complex governance challenge. The findings of this study demonstrate that the principal impact of climate change lies not merely in changes in the overall volume of rainfall but in the growing spatial and temporal variability of monsoon precipitation. Increasingly erratic rainfall patterns, delayed monsoon onset, prolonged dry spells, and the rising frequency of extreme precipitation events have created new uncertainties for agriculture, water resources, disaster management, and rural livelihoods. Consequently, monsoon variability can no longer be understood solely through an environmental or meteorological perspective; it has emerged as a critical issue of public policy and governance.

The study further demonstrates that India's response to these emerging challenges has gradually evolved from a reactive approach centred on post-disaster relief towards a more comprehensive framework of anticipatory and adaptive governance. Institutions such as the India Meteorological Department, the National Disaster Management Authority, the Ministry of Agriculture and Farmers' Welfare, and the Ministry of Jal Shakti, together with policy frameworks such as the National Action Plan on Climate Change and the State Action Plans on Climate Change, illustrate the growing recognition that climate resilience depends upon scientific forecasting, institutional preparedness, integrated water resource management, and long-term policy planning. These institutional initiatives represent important steps towards strengthening India's capacity to respond to increasing rainfall variability.

Nevertheless, the study also finds that the effectiveness of these institutional mechanisms is shaped not only by their existence but by the quality of governance through which they operate. Persistent challenges—including uneven implementation across states, limited institutional capacity, inadequate coordination among different levels of government, and insufficient integration of climate adaptation into broader development planning—continue to constrain the effectiveness of monsoon governance. As climate change generates increasingly localized and unpredictable rainfall patterns, governance responses must become more flexible, coordinated, and responsive to regional socio-economic and ecological conditions.

In conclusion, addressing the challenges posed by increasing rainfall variability requires a shift from managing monsoon-related disasters to governing climatic uncertainty itself. Building resilient institutions, strengthening intergovernmental coordination, promoting evidence-based policymaking, and integrating climate adaptation into sectoral development strategies will be essential for enhancing India's resilience to future climate risks.

Ultimately, the effectiveness of monsoon governance will depend not only on the country's scientific and technological capabilities but also on its ability to develop adaptive, inclusive, and coordinated governance systems capable of responding to the evolving realities of climate change.

References

1. United Nations. Climate change. United Nations Pulse. https://www.un.org/en/global-issues/climate-change
2. National Centers for Environmental Information. 2024 was the world's warmest year on record. National Oceanic and Atmospheric Administration, 2025.
3. Press Information Bureau. The Indian Monsoon. Ministry of Information and Broadcasting, Government of India, 2025. https://static.pib.gov.in/WriteReadData/specificdocs/documents/2025/jul/doc2025715586601.pdf
4. India Meteorological Department. Statement on the Climate of India during 2025. Ministry of Earth Sciences, Government of India, 2026.
5. Prabhu S, Chitale V. Decoding India's Changing Monsoon Patterns: A Tehsil-level Assessment. Council on Energy, Environment and Water (CEEW), 2024. https://www.ceew.in/publications/decoding-changing-monsoon-rainfall-patterns-due-to-climate-change-in-india
6. Ranade A, Gurrapu S. Long-term rainfall variability of Indian river basins in the context of global warming and climatic indices. Journal of Water and Climate Change,2025:16(3):910-933.
7. India Meteorological Department. India Meteorological Department. Ministry of Earth Sciences, Government of India. https://mausam.imd.gov.in/index_en.php
8. Press Information Bureau. Mechanism for prediction of rainfall. Ministry of Earth Sciences, Government of India, 2021.
9. Rajeevan M, Pattanaik DR. Evolution of monitoring and forecasting of southwest monsoon. MAUSAM,2025:76(1):125-138.
10. National Disaster Management Authority. National Disaster Management Authority. Ministry of Home Affairs, Government of India. https://ndma.gov.in/
11. Aijaz R. Monsoon variability and agricultural drought management in India. Issue Brief No. 51. Observer Research Foundation, 2013. https://www.orfonline.org/public/uploads/posts/pdf/20230608215550.pdf
12. Shah T. Climatic change and groundwater: India's opportunities for mitigation and adaptation. International Water Management Institute, 2009. https://cgspace.cgiar.org/server/api/core/bitstreams/9e50123d-20b8-4c12-a73f-b18391ab3e16/content
13. Dubash NK, Raghunandan D, Sant G, Sreenivas A. Indian climate change policy: Exploring a co-benefits based approach. Economic & Political Weekly,2013:48(22):47-61. https://www.researchgate.net/profile/Navroz-Dubash/publication/283176798_Indian_climate_change_policy_Exploring_a_co-benefits_based_approach/links/57c50bfc08aecd45141 6173/Indian-climate-change-policy-Exploring-a-co-benefits-based-approach.pdf
14. Jogesh A, Dubash NK. State-led experimentation or centrally motivated replication? A study of state action plans on climate change in India. Journal of Integrative Environmental Sciences,2015:12(4):247-266. https://doi.org/10.1080/1943815X.2015.1077869