iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: https://doi.org/10.22214/ijraset.2026.81080

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

Piped Dreams in a Warming Desert: Assessing the Climate Resilience and Social Equity of Water Governance in Western Rajasthan

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Abstract: ***Water scarcity in Western Rajasthan has traditionally been framed as a biophysical outcome of aridity and climatic variability. This article challenges that view by arguing that scarcity in the Thar Desert is a socionatural phenomenon, shaped by governance failures, infrastructure paradigms, and entrenched social hierarchies. Using a Political Ecology framework and the concept of the Hydrosocial Cycle, the study examines the transition from indigenous water systems to large-scale interventions such as the Indira Gandhi Nahar Pariyojana (IGNP) and policy initiatives like the Jal Jeevan Mission (JJM).***

The findings show that while these interventions have contributed to increased vegetation cover, they have also produced ecological degradation in the form of waterlogging and salinity. At the same time, governance failures—including corruption and institutional bias—have reinforced unequal access, particularly for marginalized communities. The study further shows a "social architecture of thirst," where access to water is structured through caste and gender, creating conditions of ecological exclusion.

The article argues for a shift toward rights-based and procedurally fair water governance, emphasizing the need to treat water as a common rather than a purely economic resource.

Keywords: Water governance; Political ecology; Hydrosocial cycle; Climate change; Rajasthan; Gender inequality; Caste; Jal Jeevan Mission; Indira Gandhi Canal

I. INTRODUCTION

In the desert regions of Barmer, daily life continues to be shaped by the search for water. In many villages, women begin their day before sunrise, walking long distances to collect water for household use. This routine reflects a broader reality across Western Rajasthan, where access to water remains uncertain despite the expansion of infrastructure (Down to Earth, 2024).

The burden of water collection often falls disproportionately on women, who may spend four to six hours each day transporting water. This "time poverty" has significant social consequences, including reduced educational opportunities for girls and limited participation in paid work (UNICEF, 2020; Jadhav, 2020). At the same time, nearby industrial operations receive substantial and relatively reliable water allocations, highlighting a contrast between domestic scarcity and industrial consumption (ETV Bharat, 2026). This article uses such contradictions to examine the broader dynamics of water governance in the Thar Desert. It argues that water scarcity in Western Rajasthan cannot be understood solely as a natural outcome of aridity. Instead, it is produced through the interaction of ecological constraints, governance structures, and social hierarchies.

Drawing on Political Ecology and the Hydrosocial Cycle, the study analyzes how water distribution is shaped by power relations and institutional arrangements (Johnston, 2003; Linton & Budds, 2014). It further situates these dynamics within the context of climate change, which is intensifying water stress through rising temperatures and increasing variability in rainfall (Dhara et al., 2025; Agrophysics, 2018). The objective of this article is to assess whether current water governance systems promote equitable access and climate resilience or whether they reproduce existing inequalities in a changing environmental context.

II. WATER, POWER, AND INEQUALITY IN THE THAR DESERT

The analysis of water scarcity in Western Rajasthan must move beyond physical availability to consider how access is shaped by social and political factors. Political Ecology highlights that scarcity is not simply a natural condition but is produced through unequal control over resources (Johnston, 2003). In the Thar Desert, water distribution reflects existing hierarchies of caste, gender, and economic status.

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The burden of water collection is heavily gendered, with women spending several hours each day fetching water in areas where supply remains unreliable. This labor reduces time available for education and income-generating activities and contributes to long-term social disadvantage (UNICEF, 2020; Jadhav, 2020).

Caste further structures access to water. In many rural areas, Dalit communities face restrictions in accessing common water sources due to entrenched notions of purity and pollution (IAR Consortium, 2021; Savariyar, 2025). Infrastructure placement often reflects these hierarchies, with marginalized settlements located at the periphery of supply networks. Economic disparities also shape access. Wealthier households are able to secure water through private borewells or tanker services, while poorer households depend on uncertain public supply. This has led to the growth of informal water markets, where water is increasingly commodified (Sarkar & Singdha, 2020).

The Hydrosocial Cycle provides a useful framework to understand these dynamics, emphasizing that water flows are shaped by social relations and power structures (Linton & Budds, 2014). In this context, water becomes not only a resource but also an indicator of inequality. Thus, water scarcity in Western Rajasthan reflects a broader pattern of social exclusion, where access is decided not only by environmental conditions but also by entrenched structures of power.

III. THE GEOGRAPHIC AND CLIMATIC CONTEXT

The physical environment of Western Rajasthan plays a critical role in shaping water availability. The region is characterized by low and highly variable rainfall, with most areas receiving less than 250 mm annually (Yadav et al., 2018). At the same time, hot temperatures and evapotranspiration rates result in rapid moisture loss, creating a persistent imbalance between supply and demand (India Meteorological Department, 2015).

Climate change has intensified these conditions. Rising temperatures are increasing water demand, particularly in agriculture, while erratic rainfall patterns reduce the reliability of water sources (Agrophysics, 2018; Rao & Poonia, 2011). High-intensity rainfall events, rather than steady precipitation, often lead to runoff instead of groundwater recharge (Down to Earth, 2025). This has created a paradox where increased rainfall does not necessarily translate into improved water availability. Instead, it contributes to soil erosion and the degradation of traditional water systems.

The region's hydrogeology further complicates water management. Impermeable subsurface layers restrict water percolation, limiting groundwater recharge and increasing vulnerability to both drought and waterlogging (Moharana et al., 2019). In canal-irrigated areas, this has contributed to rising water tables and soil salinity (Prasad et al., 2023). These environmental constraints form the backdrop against which governance systems operate. However, they do not fully explain patterns of scarcity, which are also shaped by institutional and social factors.

IV. WATER GOVERNANCE INFRASTRUCTURE

Water governance in Western Rajasthan is shaped by large-scale infrastructure and policy interventions, particularly the Indira Gandhi Nahar Pariyojana and the Jal Jeevan Mission. While these initiatives aim to address scarcity, their outcomes reveal significant ecological and institutional limitations. The IGNP was designed to transform the desert through canal irrigation. Although it increased agricultural production, it failed to account for the region's hydrogeological conditions. The presence of impermeable subsurface layers has led to rising groundwater levels, resulting in waterlogging and soil salinity (Moharana et al., 2019; Prasad et al., 2023). These processes have reduced the long-term productivity of irrigated land.

Water distribution within the canal system is also uneven. Head-end regions receive more reliable supply, while tail-end areas experience shortages (World Bank, 2017). This spatial inequality limits the project's effectiveness in addressing regional disparities. The Jal Jeevan Mission represents a more recent effort to expand access through piped water supply. However, implementation challenges have created a gap between infrastructure and actual service delivery. In many villages, pipelines exist but fail to provide consistent water supply due to technical and maintenance issues .

Governance failures, including corruption in procurement and implementation, have further undermined the program's effectiveness (Hindustan Times, 2026; Indian Express, 2026). As a result, many households continue to rely on alternative sources despite being officially covered under the scheme. At the same time, water allocation reflects broader economic priorities. Industrial users often receive more reliable access due to their contribution to state revenue, while domestic needs remain inadequately met (World Bank, 2017). This reinforces the perception of water as an economic resource rather than a basic right. Overall, current governance approaches have expanded infrastructure but have not ensured equitable or sustainable access, highlighting the need for more context-sensitive and accountable systems.

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V. TRADITIONAL WISDOM VS. MODERNITY

The limitations of contemporary water governance become clearer when contrasted with traditional water management systems of the Thar Desert. Historically, communities developed decentralized and ecologically adapted systems based on local knowledge and environmental constraints. Concepts such as *voj* (competence) and *savai* (collective responsibility) reflected an ethic of conservation and community-centered resource use (Mishra, 2001; Dissertation Ranjana, 2026).

Structures like *khadeens*, *tankas*, and *kuis* were designed to capture and store rainwater efficiently while minimizing ecological disruption. The *khadeen* system, for example, allowed water to accumulate and gradually percolate into the soil, supporting agriculture without causing waterlogging or salinity (La Vena & Ram, 2024). These systems were low-cost, decentralized, and aligned with the region's hydrogeology. Modern interventions, in contrast, rely on large-scale, centralized infrastructure that often overlooks local ecological conditions. Projects such as the IGNP and schemes like the Jal Jeevan Mission prioritize supply-side expansion, sometimes at the cost of long-term sustainability (Moharana et al., 2019; Policy Circle, 2025). This approach assumes that scarcity can be resolved through increased supply, rather than through efficient management and equitable distribution.

The Lapodia model offers a useful example of how traditional knowledge can be adapted to contemporary needs. In 1977, Laxman Singh initiated the restoration of a village water system through community effort, leading to significant improvements in water availability and agricultural productivity (Karelia, 2019). The "Chauka" system developed in this context slows water runoff and enhances groundwater recharge, demonstrating the effectiveness of decentralized approaches.

However, it is important to recognize that traditional systems were not inherently equitable. Access to water in the past was also influenced by caste and social hierarchy (Agarwal, 2001). Therefore, the goal is not to romanticize traditional practices but to integrate their ecological strengths with contemporary principles of equity and rights-based governance. This contrast highlights a broader issue in water management: the dominance of technocratic solutions over context-specific, community-driven approaches. A more balanced framework would combine modern infrastructure with traditional knowledge, ensuring both sustainability and inclusiveness.

VI. DATA ANALYSIS & FIELD OBSERVATIONS

Field observations and empirical data provide insight into how water governance is experienced at the household level. One of the most significant findings relates to the time and labor involved in water collection. In districts such as Barmer and Jaisalmer, rural women spend between four to six hours daily fetching water, often traveling increasing distances during the dry season (UNICEF, 2020; Jadhav, 2020). This burden has direct economic and social consequences. Women engaged in water collection have limited time for paid work or education, reinforcing cycles of poverty. In some cases, livelihoods are directly affected. For example, interruptions in piped water supply force individuals to reallocate productive time toward water collection, reducing household income (Sarkar & Singdha, 2020).

The physical impact of this labor is also significant. Studies indicate high levels of fatigue, dehydration, and musculoskeletal stress among women responsible for water collection (MSSRF, 2025). Exposure to extreme heat further increases health risks, particularly in districts with high Heat Vulnerability Index scores. Reproductive health impacts, including menstrual irregularities, have also been reported at higher rates in these regions (The New Indian Express, 2025; MSSRF, 2025).

Caste-based exclusion remains a critical factor shaping access to water. Data suggests that a significant proportion of Dalit communities face restrictions in accessing primary water sources due to social norms and discrimination (IAR Consortium, 2021). In many cases, these communities are located at the periphery of infrastructure networks, increasing their dependence on alternative and often inferior sources. Instances of violence related to water access further illustrate the severity of this exclusion. Reports of physical assault linked to the use of shared water sources highlight how access to water is intertwined with issues of dignity and social power (The Ambedkarian Chronicle, 2024).

Participatory governance mechanisms have also shown limited effectiveness. Although policies mandate the inclusion of women and marginalized groups in water management institutions, their participation is often symbolic. Studies indicate that decision-making power remains concentrated among dominant social groups, limiting the impact of decentralization efforts (Agarwal, 2001; Sen, 2025). These findings demonstrate that water scarcity is experienced not only as a physical shortage but also as a form of social inequality. The burden of scarcity is disproportionately borne by those with the least access to resources and decision-making power.

VII. CONCLUSION & POLICY RECOMMENDATIONS

This study demonstrates that water scarcity in Western Rajasthan is not merely an environmental condition but a *socionatural phenomenon*, shaped by governance systems, infrastructure, and social hierarchies. While climatic factors impose real constraints, the distribution and management of water play a decisive role in determining who experiences scarcity and how.

Current governance approaches, characterized by large-scale infrastructure and centralized planning, have not adequately addressed these complexities. Instead, they have often reinforced existing inequalities while creating new ecological challenges. The persistence of unreliable water supply, despite extensive infrastructural investment, reflects deeper issues of accountability, prioritization, and institutional design. To move toward more equitable and sustainable water governance, several policy shifts are necessary. First, participatory institutions must move beyond symbolic inclusion to ensure meaningful decision-making power for marginalized groups. This requires strengthening accountability mechanisms and prioritizing vulnerable communities in resource allocation (Agarwal, 2001; Sen, 2025).

Second, there is a need to integrate traditional water management systems into contemporary policy frameworks. Decentralized approaches such as rainwater harvesting and community-based management can complement large-scale infrastructure and improve resilience (La Vena & Ram, 2024; Karelia, 2019).

Third, stricter regulation and monitoring of industrial water use are essential to ensure that economic priorities do not override basic human needs. Transparency and accountability in water allocation must be strengthened to prevent resource imbalances (Government of Rajasthan, 2023).

Finally, water governance must be aligned with climate adaptation strategies. Policies should address the gendered impacts of water scarcity and incorporate public health measures to reduce the physical burden on vulnerable populations (MSSRF, 2025).

In conclusion, achieving water security in the Thar Desert requires a shift from infrastructure-centric approaches to governance frameworks that prioritize equity, sustainability, and local participation. Recognizing water as a shared commons, rather than a purely economic resource, is central to this transformation.

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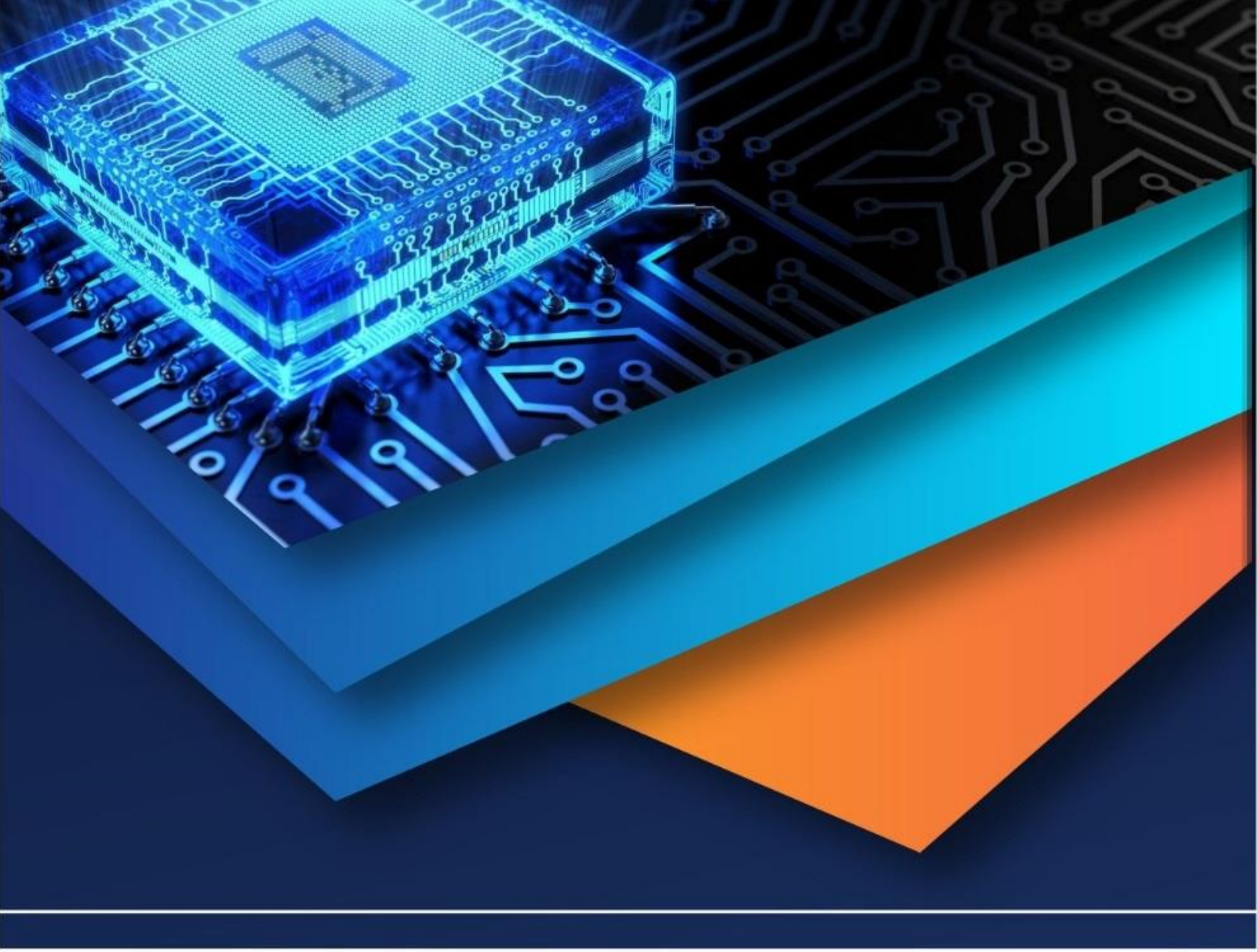

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