



Rural-Urban Transitions: Water Governance in Sri Perumbudur

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Table of Contents

I. Introduction	... 5
II. Scope of the Study	... 7
III. Results.	... 9
IV. Discussion.	... 17
V. Policy Recommendations	... 24

I. Introduction

As cities worldwide continue to experience unprecedented growth and expansion, the traditional dichotomy between urban and rural areas is becoming increasingly blurred. This transformation has given rise to distinctive peri-urban zones—transitional regions that exist at the interface between city and countryside, characterised by a complex amalgamation of urban and rural characteristics. These areas represent a new frontier in urban development, presenting both unique opportunities and significant challenges for urban planners, policymakers, and local communities.

The emergence of these "cities without cities"¹ reflects a fundamental shift in urban morphology, where the conventional boundaries of metropolitan areas dissolve into a continuous gradient of development. These peri-urban regions are distinguished by their hybrid nature, featuring a diverse mix of land uses that span residential, agricultural, and industrial activities. This heterogeneous character creates a dynamic landscape where urban services and traditional rural practices coexist, often in tension with one another².

However, these transitional zones frequently face substantial challenges that threaten their sustainable development. Peri-urban communities typically struggle with limited access to essential municipal services, inadequate infrastructure, and insufficient resources³. The rapid pace of urbanisation often outstrips the capacity of local governments to extend services and infrastructure to these areas, creating disparities in basic amenities such as water supply, sanitation, transportation, and healthcare facilities.

The significance of addressing these challenges cannot be overstated, particularly as global urbanisation trends continue to accelerate. According to United Nations projections⁴, the world's urban population is expected to grow significantly in the coming decades, with much of this growth occurring in peri-urban areas. This demographic shift amplifies the urgency of developing comprehensive strategies to manage these transitional zones effectively.

Therefore, sustainable development in peri-urban areas requires a nuanced approach that recognises their unique characteristics and specific needs. Traditional urban planning frameworks, designed primarily for dense city centres or rural areas, often prove inadequate when applied to these hybrid spaces. Success in these regions demands innovative solutions that can balance urban development pressures with environmental conservation, agricultural preservation, and community needs.

This report examines the critical challenges facing peri-urban communities of Sri Perumbudur, Chennai and explores potential strategies for fostering their sustainable development. Through this research, we aim to identify practices and approaches that can help create more resilient and equitable peri-urban

¹ Keil, R. (2022). *Zwischenstadt| Inbetween City*. Thomas Sieverts, *Cities Without Cities: An Interpretation of the Zwischenstadt, 2004*. In *Critical Planning and Design: Roots, Pathways, and Frames* (pp. 139-146). Cham: Springer International Publishing.

² Tiwari, P., & Vajpeyi, P. (2023). Knowledge mapping of research on peri urban areas: A bibliometric analysis. *GeoJournal*, 88(5), 5353-5364.

³ Pugh, R., & Dubois, A. (2021). Peripheries within economic geography: Four "problems" and the road ahead of us. *Journal of Rural Studies*, 87, 267-275.

⁴ <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

zones. The findings and recommendations presented here are intended to inform policy decisions and planning initiatives that can better serve these vital transitional areas and their growing populations.

As cities continue to expand and evolve, the development of peri-urban areas will play an increasingly crucial role in shaping the future of human settlements. Understanding and effectively addressing the challenges these regions face is essential for creating more inclusive, sustainable, and resilient urban environments that benefit all members of society⁵.

⁵ Gebhardt, D. (2014). Building inclusive cities. Challenges in the multilevel governance of immigrant integration in Europe. Washington, DC: Migration Policy Institute

II. Scope of the study

The study adopts a multidimensional approach to understanding Sriperumbudur's complex peri-urban transformation and its implications for water governance. By examining the intersection of urbanisation, industrialisation, and water management, this research aims to provide comprehensive insights for sustainable development.

The first objective focuses on mapping Sriperumbudur's peri-urban evolution through a holistic lens. This involves analysing how industrial development, particularly through SIPCOT's initiatives, has reshaped local socio-economic dynamics. The research examines land-use changes, demographic shifts, and the resulting tensions between agricultural heritage and industrial aspirations. Special attention is paid to how these transformations have influenced water access, distribution, and quality across different social groups.

The second objective investigates the evolving water governance landscape. This includes documenting the transition from traditional water management practices to current institutional frameworks. The research examines how various stakeholders - from government bodies to industrial users and local communities - participate in and influence water governance decisions.

The third objective centralises community perspectives and experiences. Through participatory research methods, the study captures local narratives about changing water access, quality concerns, and governance challenges. This bottom-up approach ensures that community voices, especially those from marginalised groups, inform our understanding of water governance realities and needs.

The final objective synthesises these findings into actionable policy recommendations. By integrating insights from institutional analysis, stakeholder perspectives, and community experiences, the research aims to develop context-sensitive solutions for sustainable water governance. These recommendations focus on promoting equitable access, enhancing institutional coordination, and building resilience in water management systems, while acknowledging the unique challenges of peri-urban contexts.

a. Methodology

Our research methodology combined extensive literature review, field observations with both quantitative and qualitative data collection approaches, conducted over six months through four systematic site visits to Sriperumbudur. This multi-faceted approach enabled a comprehensive understanding of the region's water governance dynamics and peri-urban transformation.

The quantitative component utilised advanced geospatial analysis through open-access data layers. We developed detailed mapping analyses to track critical environmental and developmental parameters, focusing particularly on land use transitions, land cover modifications, and the changing health status of local water bodies. These spatial analyses provided crucial insights into the physical transformation of the landscape over time.

The qualitative research encompassed in-depth interviews with key stakeholders across the governance spectrum. We conducted detailed discussions with local authority figures, including the Panchayat

president and secretary, technical officials such as the Assistant Engineer at the Pollution Control Board, and traditional resource users like livestock grazers. This was complemented by extensive Focus Group Discussions (FGDs) conducted across 14 sample villages and with communities dependent on four significant lakes, including two recognised biodiversity hotspots. These discussions provided invaluable insights into local perspectives, traditional practices, and emerging challenges in water resource management.

Priority Villages	
Nemili	
Pennalur	
Kolathur	
Pillaipakkam	
Pondur	
Mambakkam	
Vadamangalam	
Mathur	Up-stream Villages
Eraiyr	Up-stream Villages
Vaipoor	Up-stream Villages
Kovur	Downstream Villages
Thandalam	Downstream Villages
Irاندankattalai	Downstream Villages
Polichalur Kiramam	Downstream Villages

Legend
Up-stream Villages
Downstream Villages
 Around Sriperumbudur

List of villages

This mixed-methods approach allowed us to triangulate findings and develop a nuanced understanding of both the technical and social dimensions of Sriperumbudur's peri-urban water governance challenges.

III. Results

a. India's Accelerating Urban Transformation: A Demographic Analysis

India's urban landscape underwent a remarkable transformation in the first decade of the 21st century, as evidenced by the 2011 census data. The urban population reached 377 million, marking a significant milestone in the country's demographic evolution. Most notably, the decadal growth rate of urban population surged to 31.8%, nearly doubling from the previous decade's 17.6% recorded in 2001. This dramatic acceleration in urban growth reflects profound changes in India's demographic and socio-economic patterns.

This unprecedented urban growth can be attributed to four primary factors, each contributing distinctly to the transformation of India's urban landscape. Natural population increase continues to play a fundamental role, as existing urban populations grow through births exceeding deaths. This organic growth is supplemented by substantial rural-to-urban migration, as people move to cities seeking better economic opportunities, education, and quality of life.

Two administrative factors have also significantly influenced urban population statistics. The reclassification of rural settlements into urban areas, based on changes in population density, economic activities, and infrastructure development, has expanded the urban footprint. Additionally, the extension of existing urban boundaries to accommodate growing populations and urban sprawl has incorporated previously rural areas into urban zones.

This multifaceted growth presents both opportunities and challenges for urban planners and policymakers. The rapid urbanisation rate necessitates careful consideration of infrastructure development, housing provisions, and essential services to ensure sustainable urban development. Understanding these growth drivers is crucial for developing targeted policies that can effectively manage urban expansion while ensuring quality of life for the growing urban population.

b. Sriperumbudur: Industrial Transformation and Periurban Development

Sriperumbudur represents a compelling case study of periurbanisation in India's rapidly industrialising corridors. Located in proximity to Chennai, this former village has undergone a dramatic transformation over the past two decades, emerging as a significant industrial hub. The region spans 642 square kilometres, with a distinctive rural-urban composition where rural areas constitute 535.98 km² and urban areas cover 106.31 km². This spatial distribution reflects its transitional nature, caught between rural roots and urban industrial development.

The area's total population of 510,836 demonstrates a nearly balanced rural-urban demographic, with urban residents numbering 290,040 and rural inhabitants at 220,796. This population distribution highlights the region's hybrid character, typical of peri urban zones in transition.

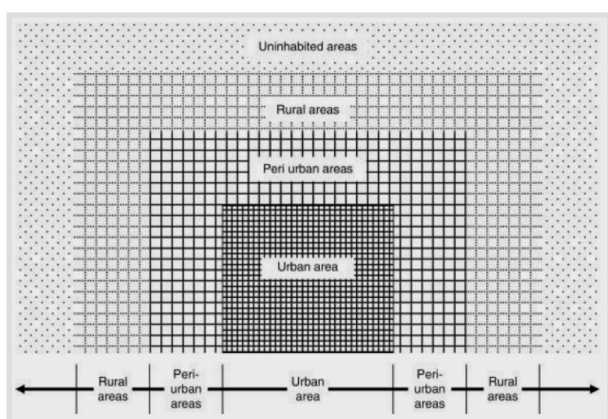
The catalyst for Sriperumbudur's transformation has been the State Industries Promotion Corporation of Tamil Nadu (SIPCOT), which has strategically developed three industrial parks in the region: Irungattukottai, Sriperumbudur and Oragadam

These industrial parks have attracted major automotive manufacturers and auxiliary industries, establishing Sriperumbudur as a key node in Tamil Nadu's industrial landscape. The town's strategic location near Chennai has facilitated this industrial growth, making it an attractive destination for manufacturing investments.

Despite its industrial prowess, Sriperumbudur exhibits characteristics typical of periurban areas in transition. The town's social development has not kept pace with its industrial growth, leading to what has been described as a "lukewarm profile" in terms of quality of life and social infrastructure (Mott McDonald 2012: 7). This disparity between economic development and social progress exemplifies the challenges faced by rapidly industrialising peri urban areas.

The region's geography and resources play crucial roles in its development pattern:

The influx of migrant workers to support the industrial growth, leading to the emergence of informal settlements. These factors have created a complex mosaic of rural, urban, and transitional elements within Sriperumbudur, posing unique challenges for urban planning and resource management. Addressing the needs of both the industrial workforce and the existing rural population will be crucial for fostering sustainable and equitable development in this rapidly transforming peri urban region.



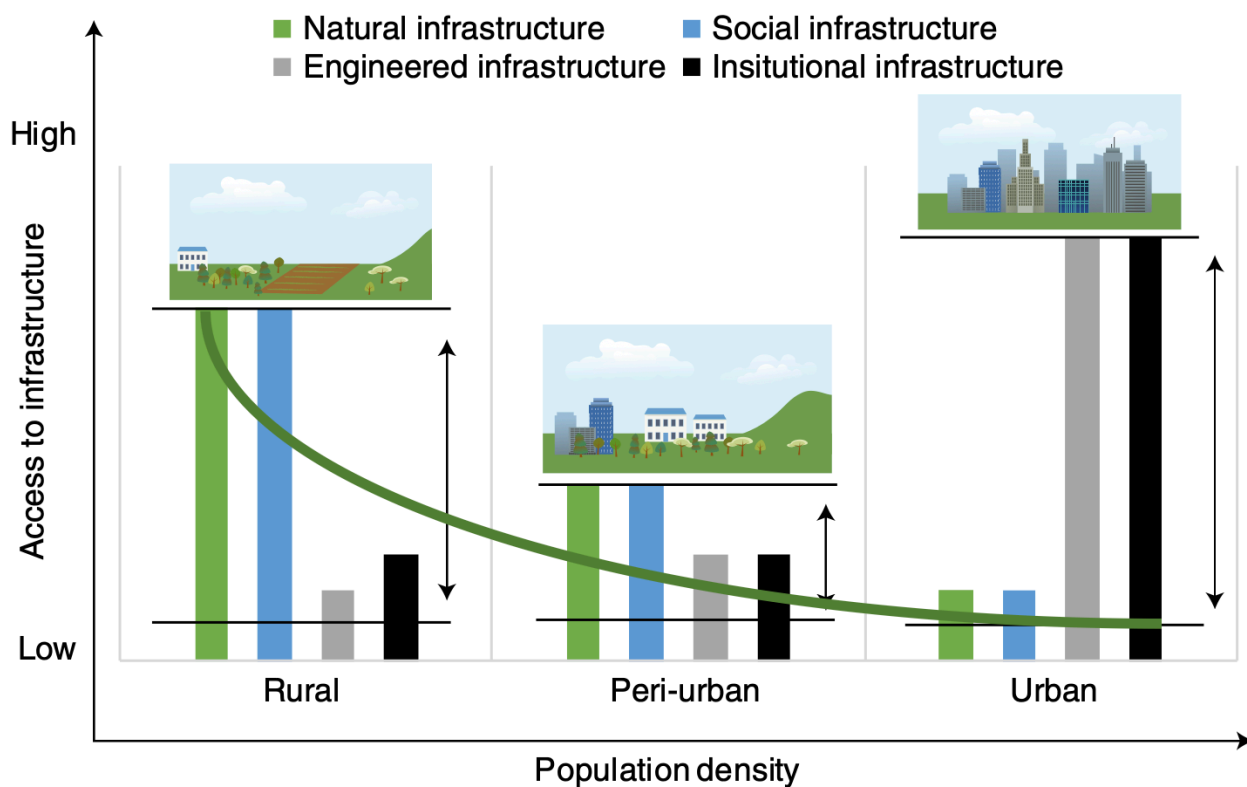
The significant population in peri-urban areas challenges the traditional urban-rural dichotomy, highlighting the need for further policy and programmatic evolution within the peri-urban interface. (Mbuligwe (2011))

The integration of Sriperumbudur within the Chennai Metropolitan Corporation's jurisdiction presents both opportunities and challenges. This administrative integration can facilitate coordinated urban planning, infrastructure development, and service delivery across the region. However, it also requires balancing the diverse needs and interests of the industrial, rural, and transitional communities within Sriperumbudur. Effective governance and inclusive decision-making processes will be crucial in ensuring that the region's development benefits all its residents, while preserving its unique rural-urban character and natural resources.

The extensive SIPCOT-managed industrial lands in Sriperumbudur have catalysed rapid economic

growth, but also pose challenges in terms of land-use planning, environmental sustainability, and social equity. Integrating these industrial hubs with the existing rural and urban fabric requires a comprehensive approach that balances development priorities, community needs, and ecological preservation. Innovative policies and collaborative governance models will be crucial in steering Sriperumbudur's transformation towards a more sustainable and inclusive future, where economic progress and social well-being go hand-in-hand.

The rapid land-use transformation from agricultural to industrial purposes in Sriperumbudur has disrupted traditional livelihoods and ecosystems. Addressing the needs of displaced farmers and mitigating the environmental impact of industrialisation will be crucial for achieving sustainable development. Innovative approaches, such as integrating green spaces and promoting eco-industrial parks, can help balance economic growth and environmental preservation. Fostering inclusive decision-making processes that give voice to diverse stakeholders will be essential in shaping Sriperumbudur's future as a thriving, equitable, and resilient peri urban region.



Source: Hutchings, Paul, et al. "Understanding rural–urban transitions in the Global South through peri-urban turbulence." *Nature Sustainability* 5.11 (2022): 924-930.

These factors create a complex development scenario where industrial growth must be balanced with environmental conservation and social development needs, particularly given the area's role in Chennai's water security through the Chembarambakkam Lake.

Sriperumbudur's experience highlights both the opportunities and challenges of peri urban development in India. While industrial growth has brought economic opportunities, the lag in social infrastructure and quality of life improvements suggests the need for more balanced development

approaches. The region's continued evolution will likely depend on how effectively it can integrate industrial growth with social development while managing environmental resources and maintaining its strategic role in Chennai's metropolitan expansion.

c. Institutional Architecture and Key Actors

The water governance landscape in Sriperumbudur reflects a complex, multi-tiered institutional architecture that spans national, state, and local levels, each playing distinct yet interconnected roles in water resource management. This institutional framework demonstrates both the complexity of water governance and the challenges of coordinating actions across different scales of authority.

At the national level, institutions such as the National Water Development Agency (operating under the Ministry of Water Resources), the Central Water Commission, and the Central Groundwater Board establish overarching policies and regulatory frameworks. These organisations provide technical guidance and strategic direction for water resource management across the country. Their policies and directives create the fundamental framework within which state and local institutions operate.

The state level governance structure in Tamil Nadu comprises several key departments, including the Water Resource Department, Public Works Department, Directorate of Town and Country Planning, and Chennai Metropolitan Development Authority. These institutions translate national policies into state-specific programs while managing regional water resources and infrastructure development. Their decisions significantly impact local water management practices and infrastructure development in peri-urban areas like Sriperumbudur.

The water supply system in Sriperumbudur operates through a diverse network of providers, reflecting the complex nature of water access in peri-urban areas. Government bodies such as the Tamil Nadu Water Supply and Drainage Board, Public Works Department, and village panchayats form the backbone of formal water supply infrastructure. However, the gaps in public service delivery have led to the emergence of private actors, including water lorries, water companies, and real estate developers, who play an increasingly significant role in meeting water demands. At the community level, water access and management often occur through a combination of individual household arrangements and community-managed water resource pools. This hybrid system reflects the adaptive strategies that communities have developed in response to the challenges of water access in rapidly urbanising areas.

d. Local Governance and Community Engagement

The local governance landscape is particularly rich in actors and interactions. Panchayats emerge as critical institutions, maintaining traditional responsibilities for natural resource management while adapting to new challenges posed by rapid industrialization. They play a vital role in managing water bodies, providing drinking water, and mediating resource-related conflicts at the village level. Their engagement with corporate social responsibility (CSR) initiatives has opened new avenues for infrastructure development, including tank restoration and RO water unit installation.

The industrial sector has emerged as a powerful actor in local water governance, both through its direct impact on land use and water resources and through CSR initiatives. While current CSR activities focus

primarily on basic infrastructure provision, there is significant potential for more comprehensive engagement with community water security needs. The transparency of industrial operations, particularly regarding land use and water consumption, remains a crucial concern for local stakeholders.

The role of citizen bodies, including Water Usage Associations, Farmers Groups, and Women's Groups, represents a critical dimension of local water governance. These organisations provide platforms for community participation and accountability in water management decisions.

This multi-layered governance framework highlights both the complexity of water management in peri-urban areas and the importance of coordinated action across different institutional levels. The challenge lies in harmonising the diverse interests and capabilities of these various actors while ensuring sustainable and equitable water access for all stakeholders in Sriperumbudur's rapidly evolving landscape.

e. Limitations of Current Governance Approaches in Peri-urban Areas

The current approach to governing peri-urban spaces, particularly in water management, reveals significant structural limitations that threaten sustainable development and resource management. These limitations stem from conventional governance frameworks that fail to acknowledge the unique hybrid nature of peri-urban zones, leading to a cascade of challenges that affect both environmental sustainability and social equity.

- **Problem of Scalar Fixation** - The persistent focus on planning within specific administrative scales, while maintaining rigid distinctions between rural and urban governance structures, fundamentally misaligns with the reality of peri-urban spaces. These areas, by their very nature, represent a fluid continuum between rural and urban characteristics, demanding governance approaches that can bridge this divide. The artificial separation of governance mechanisms creates blind spots in planning and implementation, particularly in managing shared resources like water bodies that span multiple jurisdictions.
- **Standardisation vs. Complexity** - The implementation of standardised institutional mechanisms, while administratively convenient, fails to address the complex and dynamic nature of peri-urban spaces. These one-size-fits-all approaches often prove inadequate in addressing the unique challenges that emerge from the rapid transformation of these areas. The diversity of stakeholders, varying resource needs, and complex social dynamics in peri-urban zones require more nuanced and adaptive governance frameworks.
- **Centralisation and Its Consequences** - The prevalence of top-down approaches and centralised decision-making power has created significant gaps between policy formulation and ground realities. This centralisation often overlooks local knowledge systems, traditional management practices, and community needs. In water governance, this manifests as disconnected policies that fail to account for local water use patterns, traditional water management systems, and community-level adaptation strategies.

- Missed Opportunities and Emerging Conflicts - Perhaps most critically, current governance frameworks fail to recognise the complementarities, potentialities, and contestations inherent in peri-urban spaces. The inability to identify and leverage potential synergies between different stakeholders and management approaches represents a significant missed opportunity. Similarly, the failure to acknowledge and address emerging disputes over resources leads to unresolved conflicts and deteriorating resource management.
- Cascading Impacts - These governance limitations have led to a series of interconnected challenges:
 - The lack of integrated planning results in haphazard development patterns that strain existing infrastructure and resources.
 - Without coherent oversight, land use changes occur in ways that threaten both environmental sustainability and traditional livelihoods.
 - Increased pollution levels and unregulated industrial activities pose serious threats to environmental health.
 - The absence of comprehensive water management frameworks leads to unregulated water use and declining groundwater levels.
 - Overlapping and sometimes contradictory authorities create confusion and inefficiencies in resource management.

The cumulative effect of these challenges is particularly evident in water resource management, where fragmented governance approaches fail to address the interconnected nature of water systems in peri-urban areas. The lack of coordination between different governance scales and stakeholders not only hampers effective resource management but also exacerbates existing inequalities in water access and distribution.

These limitations underscore the urgent need for governance reforms that can better address the unique characteristics and challenges of peri-urban spaces. Such reforms must move beyond conventional rural-urban dichotomies to develop more integrated, flexible, and inclusive approaches to resource management. This is particularly crucial in rapidly transforming regions like Sriperumbudur, where effective water governance is essential for sustainable development and social equity.

f. Community Perceptions of Water Governance

The empirical investigation of water governance in Sriperumbudur revealed a complex tapestry of community perceptions, highlighting the intricate relationship between social structures, environmental change, and institutional dynamics. At the forefront of community concerns was the perceived deterioration in water quality, particularly notable in the collective narrative of long-term residents. This degradation was predominantly attributed to industrial activities, reflecting a growing environmental consciousness among community members. Whilst only a modest proportion of respondents explicitly articulated concerns about drinking water safety, the widespread adoption of Reverse Osmosis systems suggests a tacit acknowledgement of quality issues, manifesting as practical adaptation rather than overt complaint.

The research unveiled a multifaceted crisis in water availability, characterised by increasing competition for diminishing resources. Community members consistently identified three primary drivers: burgeoning population growth, particularly from migrant communities; escalating industrial water consumption; and shifting rainfall patterns. This confluence of factors has engendered notable tensions between various user groups, highlighting the social dimensions of resource scarcity.

A particularly salient finding emerged regarding the community's relationship with water management systems. Respondents frequently expressed a profound sense of nostalgia for traditional, community-managed water infrastructure, such as local ponds and wells. This sentiment appears to reflect more than mere romanticism for the past; rather, it represents a critique of contemporary centralised management approaches, which are widely perceived as disconnected from local needs and contexts. The juxtaposition between traditional and modern management paradigms reveals deeper questions about the role of community agency in resource governance.

The social stratification of water access emerged as a critical theme, with clear socioeconomic disparities evident in both access and distribution patterns. Economically marginalised communities reported systematic disadvantages in water allocation, whilst the financial burden of water access presented a significant challenge for lower-income households. These findings underscore the way in which water governance intersects with broader patterns of social inequality and economic disadvantage.

Environmental degradation emerged as a significant concern, with communities demonstrating sophisticated understanding of ecological interconnections. Respondents articulated clear links between the deterioration of local water bodies and broader environmental impacts, including biodiversity loss and threats to traditional livelihoods. This environmental awareness was particularly evident in discussions about agricultural and fishing activities, suggesting a deep-rooted understanding of the relationship between environmental and economic sustainability.

The study revealed a profound crisis of confidence in institutional governance. Community members expressed widespread scepticism regarding the efficacy of government agencies in managing water resources, accompanied by strong demands for enhanced transparency in decision-making processes. A smaller, but significant, subset of respondents highlighted the influence of corruption and vested interests in water management, suggesting the presence of informal power structures that shape resource allocation. These findings point to a significant disconnect between formal governance structures and community expectations, with implications for the legitimacy and effectiveness of current management approaches.

These findings collectively paint a picture of a community grappling with multiple, interconnected challenges in water governance. The results suggest that effective solutions will require attention not only to technical and environmental aspects but also to social equity, institutional trust, and community participation in governance processes.

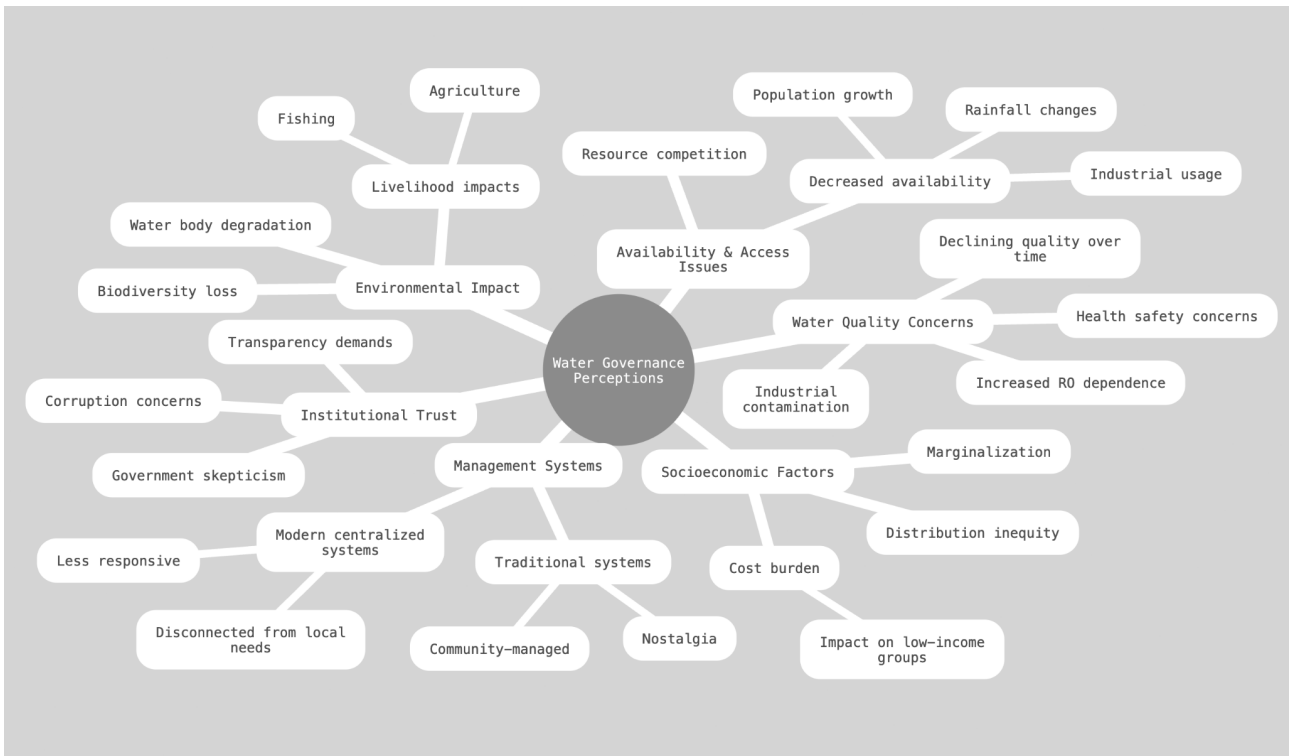


Diagram depicting community perceptions around water

IV. Discussion

a. Strengthening Water Governance: Pathways for Change

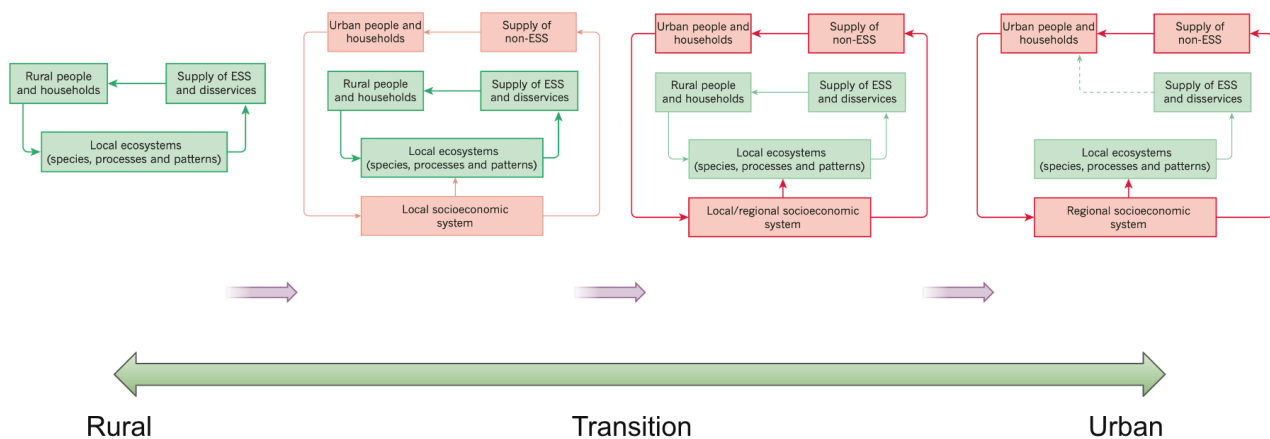
Effective water governance ensures equitable distribution, sustainable use, and long-term resilience of water resources. Local communities and citizen bodies play a vital role in fostering transparency, accountability, and participatory decision-making. Below are key citizen groups who, through their contribution, can enhance water governance:

- **Water User Associations (WUAs)** - They act as intermediaries between local communities and water management systems. They represent community interests in decision-making, mediate among various water users (agriculture, domestic, industrial), and ensure transparency by monitoring water usage. WUAs hold water users accountable, preventing over-extraction, which is crucial in water-scarce regions. They also promote sustainability by encouraging conservation practices like responsible water consumption and source protection. Through these efforts, WUAs create a framework for equitable, transparent, and sustainable water management at the local level.
- **Farmers' Groups** - These groups play a key role in water management, especially in regions where agriculture is the largest water consumer. They promote efficient irrigation methods, such as drip irrigation and rainwater harvesting, and educate farmers on water conservation. Their practical insights into local conditions, seasonal variations, and challenges provide valuable data that inform water governance policies. By advancing sustainable irrigation practices and participating in policy discussions, farmers' groups help align agricultural needs with environmental sustainability, making them crucial stakeholders in water governance.
- **Women's Groups** - They ensure inclusivity in water governance, advocating for the needs of marginalised communities, particularly women, children, and the elderly. They promote water conservation at the household and community levels through initiatives like rainwater harvesting and safe water practices. By pushing for the inclusion of marginalised voices in decision-making, these groups ensure that water governance policies address diverse needs, making water management more equitable and responsive.
- **Citizen Science Groups** - They empower communities to actively contribute to water governance by documenting environmental changes, monitoring water quality, and collecting data on water usage. These groups track alterations in water bodies, test for pollutants, and develop databases on consumption patterns, providing critical data for evidence-based decision-making. By bridging the gap between scientific research and community action, they support informed, adaptive water management practices.
- **District-Level Engagement with Governing Agencies** - These bodies facilitate communication between local communities and government authorities, ensuring that community voices are integrated into water governance decisions. These bodies advocate for the inclusion of local needs in district policies and monitor the implementation of water management programs. By strengthening accountability and ensuring policies align with local realities, district-level

engagement plays a pivotal role in bridging grassroots efforts with broader governance frameworks.

b. Recognising Peri Urban spaces a Socio-ecological Systems

As an interface between urban and rural landscapes, peri urban spaces represent complex and dynamic social-ecological systems that demand specific policy attention. These transitional zones, characterised by their hybrid nature, often fall through the cracks of conventional urban and rural planning frameworks. This oversight necessitates a fundamental shift in how planners, policymakers, and bureaucrats conceptualise and manage these spaces. The recognition of periurban areas as distinct social-ecological systems is crucial for developing effective governance mechanisms and ensuring sustainable development, particularly when understood through the lens of green-loop to red-loop transition theory.



The green-loop to red-loop transition. Source: Cumming, Graeme S., et al. "Implications of agricultural transitions and urbanization for ecosystem services." *Nature* 515.7525 (2014): 50-57.

The unique characteristics of peri urban spaces set them apart from both urban and rural environments, often representing a critical transition point between what scholars term 'green-loop' and 'red-loop' systems. In green-loop systems, typical of rural areas, communities maintain direct feedback relationships with their local ecosystems through subsistence agriculture and natural resource use. As peri urbanisation occurs, these areas begin transitioning toward red-loop systems, characterised by indirect feedback mechanisms where resources are acquired through markets rather than direct ecosystem interaction. This theoretical framework helps explain the complex mosaic of land uses in periurban areas, which combine traditional agricultural activities with emerging market-oriented developments, small-scale industries, and various informal economic activities.

The peri urban interface exemplifies the challenges and opportunities of social-ecological transformation. These areas serve as crucial zones for ecosystem services, providing urban areas with food, water, and other resources while simultaneously absorbing various urban outputs. The transition from green-loop to red-loop systems in these spaces creates unique feedback mechanisms between human activities and natural systems. Empirical studies across the global South have demonstrated

how this transformation often leads to the emergence of hybrid systems, where traditional ecological knowledge coexists with market-based resource management approaches, creating both vulnerabilities and opportunities for resilient development.

Traditional policy approaches have consistently failed to address the unique challenges of peri urban areas, largely because they fail to recognize the dynamic nature of green-loop to red-loop transitions. Most planning frameworks operate on a binary urban-rural classification, ignoring the complex transitional processes occurring in periurban spaces. Research from rapidly urbanising regions in Asia and Africa shows how this oversight leads to maladaptive policies that neither protect traditional resource management systems nor adequately facilitate the transition to sustainable market-based approaches.

To effectively manage peri urban spaces, policymakers must adopt systems thinking that recognizes both the theoretical implications of green-loop to red-loop transitions and their practical manifestations. Studies from peri urban regions in countries like India, Indonesia, and Kenya demonstrate how communities often maintain elements of both systems simultaneously, requiring nuanced policy approaches that can address this hybridity. Adaptive governance mechanisms must be designed to support communities through this transition while preserving valuable ecological knowledge and practices from green-loop systems.

The proper recognition of peri urban spaces as distinct social-ecological systems should draw on empirical evidence from transition studies worldwide. Research has shown that successful periurban management requires understanding the temporal dynamics of green-loop to red-loop transitions, including the critical thresholds at which traditional resource management systems begin to break down and new market-based systems emerge. This understanding can inform the development of specific policy instruments and institutional mechanisms that are better suited to managing transitional spaces.

The future of sustainable urban development largely depends on how we manage these green-loop to red-loop transitions in periurban areas. Recent studies from Latin America and Southeast Asia demonstrate that urban spaces often serve as laboratories for innovative hybrid governance systems that combine traditional ecological knowledge with modern market mechanisms. As urbanisation continues to reshape landscapes globally, the proper management of these transitions becomes increasingly critical for environmental sustainability, social equity, and economic development. Only through acknowledging the theoretical complexity of peri urban social-ecological systems and drawing on empirical evidence from transition studies can policymakers develop effective, context-specific interventions that balance development needs with ecological sustainability.

c. Evolving a Framework for Peri-Urban Water Governance

Water governance in peri-urban areas presents unique challenges and opportunities. These areas often experience rapid population growth, changing land-use patterns, and competing demands for water resources, while facing governance issues that stem from overlapping jurisdictions and institutional fragmentation. A well-structured, inclusive, and flexible governance framework is essential to address these challenges. The following framework provides a set of guiding principles and practical pathways

to navigate the complexities of peri-urban water governance, drawing from the core themes of integrity, regulatory coherence, and participatory governance.

1. Integrity and transparency - Both are foundational principles for effective water governance. In peri-urban areas, where rapid urbanisation often leads to informal settlements and irregular water access, it is critical that decision-making processes are transparent and accountable. Public authorities and water providers should foster trust through clear communication, open data sharing, and inclusive decision-making processes.

Integrity mechanisms can include anti-corruption policies, public procurement transparency, and accessible channels for citizens to report grievances. By institutionalising transparency, peri-urban water governance can mitigate the risks of elite capture or exclusionary practices, ensuring fair distribution of resources. To achieve this, governance bodies should develop codes of conduct for public officials and ensure that water management decisions are subject to public scrutiny, from allocation to distribution and tariff setting.

2. Data and Information - Accurate, timely, and accessible data is a cornerstone for informed water governance. Peri-urban areas often suffer from data gaps, especially concerning water availability, quality, and usage patterns. Reliable data collection systems, supported by technology such as remote sensing, GIS mapping, and mobile platforms, are essential for understanding the complexities of water management in these areas.

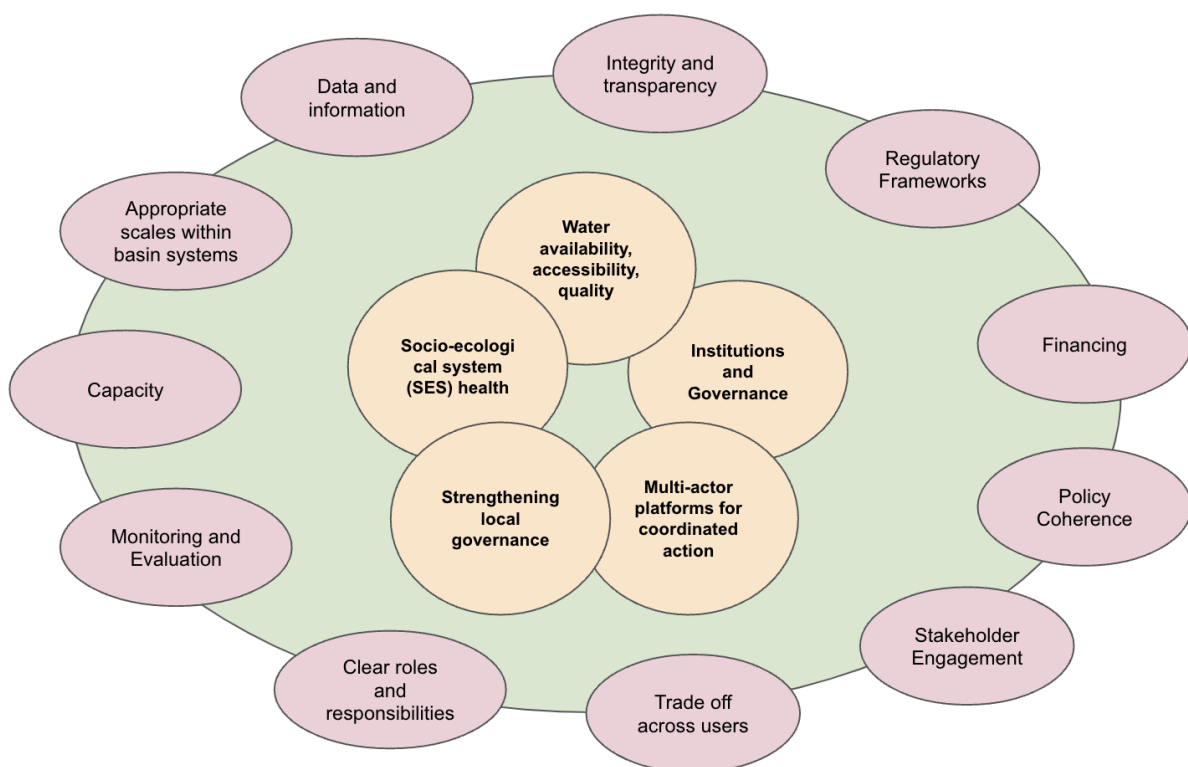
Establishing a comprehensive data architecture for peri-urban water governance is crucial. This should include hydrological data (water flows, groundwater levels, and rainfall patterns), socio-economic data (population density, usage patterns), and infrastructure data (piped networks, sanitation coverage). By making this data publicly available, authorities can ensure that water governance decisions are evidence-based, helping communities and stakeholders engage more effectively in governance processes.

3. Regulatory Frameworks - Peri-urban areas often fall under multiple, overlapping jurisdictions, leading to fragmented governance structures. To address this, a clear and coherent regulatory framework is required, harmonising laws and policies across urban, rural, and peri-urban contexts. Regulatory frameworks should address water rights, allocation, pollution control, and the enforcement of service delivery standards. Developing adaptable and context-sensitive regulations can help accommodate the dynamic nature of peri-urban areas. For instance, water allocation frameworks should be flexible enough to respond to seasonal variations in supply, while regulatory enforcement must be tailored to the local capacity for monitoring and compliance.

4. Appropriate Scales within Basin Systems - Water governance in peri-urban areas must consider the larger hydrological scale—especially river basin systems—that transcend administrative boundaries. Basin-level governance frameworks ensure that water resources are managed according to ecological boundaries rather than political ones, preventing upstream-downstream conflicts and ensuring equitable distribution. Basin-wide governance involves aligning the actions of different actors (e.g., municipalities, rural authorities, industries, and farmers) to balance water demand with ecosystem health. This requires mechanisms for cross-jurisdictional coordination, such as river basin committees

or councils, that integrate water management with land-use planning, agriculture, and environmental conservation.

5. Water Availability, Accessibility, and Quality - Peri-urban water governance must prioritise the availability, accessibility, and quality of water resources. In these areas, water supply can be unreliable, infrastructure inadequate, and water quality compromised by pollution from urban and industrial activities. Ensuring equitable access to clean water is both a technical and governance challenge. Governance frameworks should mandate the provision of basic water services to all residents, particularly those in informal or marginalised communities. This can involve innovative solutions such as decentralised water systems, community-managed water points, or the integration of water, sanitation, and hygiene (WASH) services into urban planning processes.



Suggestive Framework for Peri-urban Adaptive Governance.

Adapted from Akhmouch, Aziza, et al. "Introduction: Introducing the OECD Principles on Water Governance." *OECD Principles on Water Governance*. Routledge, 2020. 5-12.

6. Socio-Ecological System (SES) Health - Peri-urban water governance should adopt a socio-ecological system (SES) approach, recognising the interdependence of human and environmental health. Water policies must ensure the protection of ecosystems—such as wetlands, rivers, and aquifers—that provide critical services like water filtration, flood control, and biodiversity support. Maintaining the health of SES requires the inclusion of ecosystem-based management principles in water governance. For example, policies that encourage rainwater harvesting, wastewater reuse, and green infrastructure can support both ecological resilience and water security in peri-urban areas.

7. Institutions and Governance - Strong, effective institutions are essential for successful peri-urban water governance. Institutions must be capable of coordinating across different levels of government, sectors, and civil society. Governance structures should be polycentric, with decentralised decision-making that allows local authorities and communities to tailor solutions to their specific needs, while remaining integrated within a larger governance framework. Multi-actor platforms, including government agencies, non-governmental organisations, private sector actors, and local communities, should be established to facilitate coordinated action. These platforms can serve as forums for dialogue, conflict resolution, and collaborative planning.

8. Financing - Sustainable water governance in peri-urban areas requires innovative financing mechanisms. Traditional public funding sources may be insufficient to meet the growing demand for water infrastructure and services, especially in fast-growing peri-urban zones. Blended financing approaches that combine public funds, private investment, and community contributions can provide a more sustainable model. Governments should explore public-private partnerships (PPPs), micro-financing schemes, and external funding sources such as international development aid to support water governance initiatives. Clear financial strategies are essential, ensuring that investments target infrastructure development, water quality monitoring, and the maintenance of equitable service delivery.

9. Capacity Building - Peri-urban water governance must focus on building the capacity of both formal institutions and local communities. Training and education programmes for government officials, utility providers, and community leaders are essential to improve understanding of water management best practices, technological solutions, and governance frameworks. Capacity-building initiatives should also empower local communities to participate actively in water governance. This can involve technical training on managing local water systems, workshops on water rights and regulations, and participatory governance processes that ensure communities are involved in decision-making.

10. Strengthening Local Governance - Strengthening the capacity of local governance bodies, such as panchayats or municipal councils, is critical for effective water governance in peri-urban areas. Local authorities must be empowered to manage water resources, enforce regulations, and ensure equitable service delivery. This involves providing them with the necessary technical, financial, and human resources to carry out their responsibilities. The grading and performance evaluation of local governance bodies can incentivise better management practices. Capacity-building efforts should also focus on improving local governance institutions' ability to address emerging challenges such as climate change, population growth, and infrastructure demands.

11. Multi-Actor Platforms for Coordinated Action - Multi-actor platforms bring together diverse stakeholders to coordinate water governance efforts across sectors and regions. These platforms enable the sharing of knowledge, resources, and best practices while fostering collaboration between government agencies, private sector entities, and civil society organisations. Such platforms can facilitate integrated water resource management (IWRM) approaches, ensuring that water governance is inclusive, transparent, and adaptive to changing conditions.

12. Policy Coherence - Water governance must be aligned with broader policy frameworks, including land-use planning, environmental protection, and socio-economic development strategies. Ensuring policy coherence requires close coordination between different sectors and levels of government, ensuring that water governance is not treated in isolation but as part of an integrated system of governance.

13. Monitoring and Evaluation - Effective governance requires robust systems for monitoring and evaluation. In peri-urban water governance, this involves tracking water quality, availability, and usage patterns, as well as the performance of governance institutions. Monitoring systems should be transparent and participatory, allowing communities to contribute to data collection and evaluation processes.

14. Stakeholder Engagement and Trade-offs - Engaging stakeholders in peri-urban water governance is critical for ensuring equitable and sustainable outcomes. Stakeholder engagement processes should be inclusive, bringing together diverse groups such as local residents, farmers, industries, and government representatives. These processes should recognise and mediate trade-offs across different water users, ensuring that no group is disproportionately disadvantaged by water allocation decisions.

15. Clear Roles and Responsibilities - Finally, a well-functioning governance framework must clearly define the roles and responsibilities of different actors. This involves delineating the responsibilities of local, regional, and national authorities, water utilities, and community-based organisations. Clear accountability mechanisms should be established to ensure that all actors fulfil their roles in delivering equitable and sustainable water services.

V. Policy Recommendations

In order to create sustainable, inclusive, and resilient urban and peri-urban environments, the following policy recommendations aim to integrate the conservation of shared land and water commons into urban planning and design processes. These recommendations prioritise the protection and equitable management of these critical resources as essential to community health and ecological balance.

1. Integrate Conservation of Land and Water Commons in Urban Planning

Urban planning frameworks must recognise land and water commons as critical resources, integrating their conservation into the core of urban design processes. The protection and management of these shared resources should not be treated as peripheral concerns but should instead be central to development plans. This requires establishing legal frameworks that prioritise the conservation of land and water resources in planning schemes, ensuring that they are safeguarded for long-term use and community well-being.

The conservation of land and water commons must include the creation of green spaces and water bodies that act as natural buffers to urban expansion. Policies should mandate the inclusion of public parks, wetlands, and water catchment areas in all new urban and peri-urban development plans. In addition, urban planners should be required to ensure that stormwater management, groundwater recharge, and ecological restoration are considered in the design of urban infrastructure.

2. Ensure Equitable Access to Water Resources

Access to water is a fundamental human right, and urban policies must ensure that all community members—particularly marginalised groups—have fair access to water resources. This involves recognising traditional water rights, especially in peri-urban and rural areas, and implementing community-based management systems that allow for local participation in the governance of water commons.

Policies should establish mechanisms for water resource management that address the needs of both established communities and transient or migrant populations. This could include water access points that are shared among diverse groups and the development of low-cost water supply systems that prioritise low-income areas. The recognition of traditional water rights is essential in this process, ensuring that long-established practices of resource management are respected and integrated into formal governance structures.

To address disparities in water access, urban planning policies must also consider the development of public water-sharing schemes that prioritise areas where water scarcity is a critical issue. This includes investing in infrastructure such as water recycling systems, rainwater harvesting, and sustainable irrigation systems, all of which can reduce pressure on shared water resources while ensuring equitable access.

3. Bridge the Rural-Urban Divide in Water Resource Management

Water resources often span both rural and urban areas, making it essential to develop comprehensive strategies that bridge the rural-urban divide. Urban policies must recognise the interconnected nature of water systems and ensure that rural and urban populations are considered jointly in water management plans. This requires joint planning, shared infrastructure, and collaborative decision-making processes across rural and urban regions.

Policies should promote rural-urban partnerships that enable the sharing of knowledge, infrastructure, and resources for the sustainable management of water commons. For example, joint investments in water catchment areas, irrigation systems, and flood control infrastructure can benefit both urban and rural areas. Collaborative decision-making forums that bring together rural and urban stakeholders can ensure that planning processes take into account the needs of all communities.

4. Implement Polycentric and Flexible Governance Systems

Peri-urban areas are dynamic, with shifting populations and land-use patterns. To address these challenges, policies should implement polycentric governance systems that allow for flexible management of shared resources. Such systems enable coordination between different levels of government, sectors, and stakeholders, and provide space for local customisation within broader regional frameworks.

These governance systems should include mechanisms for regular dialogue between urban planners, rural representatives, and community-based organisations. This can be facilitated through multi-stakeholder platforms that allow for participatory decision-making in resource management. Ensuring flexibility in governance also requires clear communication channels and a transparent decision-making process that adapts to changing conditions, such as population growth or climate change.

5. Recognise Time as a Key Asset in Resource Management

Time is often overlooked as a valuable asset in resource management, particularly for women and marginalised groups. Policies must prioritise strategies that reduce the time burdens associated with managing shared resources, such as the time spent collecting water or maintaining communal spaces.

Governments should invest in infrastructure and services that reduce time burdens, such as improved access to clean water, safe transportation systems, and time-saving technologies. In addition, policies should promote the participation of women and marginalised groups in decision-making processes related to resource management, ensuring that their voices are heard and their specific needs addressed.

6. Implement Grading Systems for Local Panchayats and Build Capacity

To improve governance at the local level, a comprehensive grading system for panchayats (local governance bodies) should be implemented. This grading system will assess the performance of panchayats in key areas, such as land-use planning, water management, and climate resilience. Coupled with this, targeted capacity-building programmes must be developed to support panchayats in meeting the emerging challenges of climate change and urbanisation.

These capacity-building efforts should focus on enhancing local knowledge of sustainable land-use practices, ecosystem management, and the use of real-time data for informed decision-making. Land-use planning should emphasise the creation and protection of green spaces, ensuring that these areas provide ecological benefits and recreational spaces for the community.

7. Co-create a Rural-Urban Transition Policy

A cohesive rural-urban transition policy must be developed in partnership with a diverse set of stakeholders, including local communities, urban planners, civil society, and the private sector. This policy should focus on ensuring that the transition between rural and urban areas is managed in a way that benefits all stakeholders, at various scales.

Key areas for collaboration include food systems, waste management, and renewable energy. By fostering urban-rural partnerships in these sectors, policies can promote mutual growth and resilience while ensuring sustainable resource management.

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