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ALTERNATIVES DEVELOPMENT

Returning swans at our rejuvenated pond

Water for Planet, People, Prosperity, Peace, and Partnership

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The Need for Novel Forms of Learning to Plan for Resilient Water Systems in Human Settlements[1]

The resilience of any social-ecological -technological system (SETS) in the Anthropocene is defined as the capability to navigate uncertainties and manage changes. At the same time, approaches to building resilience must also influence the direction of change towards greener, more inclusive, and just pathways of development to achieve the goals of sustainable development. Resilient systems, therefore, need flexible internal structures that can adapt or transform to deliver desired outcomes in response to changing circumstances. In addition, they have the capability and agency to redirect the course of socio-economic development interventions by inducing strategic shifts in policies and programmes. This requires capacities for adaptive management and adaptive governance, and mechanisms that enable continued societal and institutional learning critical to ensure such adaptive capacities.

Local and regional water commons within human settlements are SETS with all the characteristics of complexity, interdependence, connectivity, self-organisation, and adaptive learning potential. They are subject to dynamic pressures from external (such as climate change) and internal (such as population and pollution) sources. These pressures can drive the water system to change its form, availability, accessibility, and ability to deliver ecosystem services; gradually losing resilience and suddenly tipping over into a degraded state and becoming incapable of responding to the requirements of human settlements.

Learning mechanisms within governance and management systems capture information and feedback from the socio-economic and ecological spheres, including potential political and technological disruptions. This helps in informing policy design, planning, and implementation in a regular, timely, and systematic manner. Such mechanisms are conspicuously missing in the local governance of water systems in India. Most Monitoring and Evaluation (M&E) systems used by

Community in discussion

municipalities and panchayats in India are merely trackers designed to track the inputs and achievement of defined outputs. Very few conduct the analysis to evaluate drivers and barriers to achieve the desired sustainability outcomes, and rarely do M&E systems bridge with 'Learning (L)' to support planning and plan implementation, course correction, and, importantly, system transformation in real-time and in an inclusive manner. Through readings, case studies, and conversations with experts working on local and sub-national governance issues in the area of water systems resilience, some areas of consideration emerge:

1. In the context of human settlements, three interconnected and nested levels of resilience of SETS are recognised: (a) socio-economic dealt at the local level through local engineering and infrastructure solutions, (b) the sub-regional, intermediate hazard resilience where uncertainty and extreme events are in focus, and (c) the regional socio-ecological where trajectories of change are slow but often irreversible. M&E systems need to draw upon the impact of this interconnectedness to enable learning. This means data from different spatial scales is required to build a comprehensive understanding.

2. Feedback loops and time lags in the feedback across the relationships between elements of SETS, influence the outcome behaviours of the system. M&E systems, therefore, need to track trends dynamically and draw attention to potential future shifts based on what has already transpired. This points to a robust longitudinal data framework for system analysis.
3. To understand and respond to the resilience of local and regional water commons comprehensively, M, E and L mechanisms will need to take in diverse forms of knowledge captured from different sources from a wide range of stakeholders. Both quantitative and qualitative data regarding ecological, social, and economic indicators will need to be juxtaposed. Data will come in different forms and sources, such as from monitoring equipment that tracks water quality and quantity, human health data from local medical establishments, spatial, heat, and water data from satellite and meteorological sources, observed seasonal shifts in ecological patterns by citizen scientists, and social behaviours through surveys or memes on social media expressing societal concerns or children's art, etc.
4. 'Early warning signals can sometimes indicate that a system is losing resilience' (global tipping points report, December 2023)[2]. It is important that signals regarding ecological distress or social indifference are captured and taken into cognisance early on for course correction. Smart systems can pick up indicators such as clogged drains needing de-siltation and technical breakdowns in wastewater treatment systems. Other indicators, such as visible waste dumping and foul smells, encroachment, and barricading of waterbodies, are easily picked up by vigilant citizens. Citizen scientists such as school students can be additionally equipped to capture water quality, water quantity, local biodiversity, and pollution data locally. They can also conduct ground verification of satellite data regarding the typology of green cover, the extent of water body degradation, groundwater levels, micro heat islands, etc. These possibilities point to expanding the domain of data collection and innovative ways of bringing data from different sources, in different formats and from different knowledge systems to be juxtaposed for analysis in a rapid response approach.
5. To act on sustainability challenges of the Anthropocene, M&E mechanisms must influence external drivers of change, that is, influence policy and market shifts, consumption behaviours, and value basis. Therefore, besides having a strong factual footing based on credible evidence and a capacity for scenario building, an adaptive local and regional water commons system also needs to have the ability to track and grab potential policy, technology, and societal windows of opportunity. This includes an ability to communicate and share lessons and an ability to envision and create imageries of possible sustainable futures.

All of the above indicate that M&E systems must be designed for Learning – 'L' at the individual, societal, and institutional levels. While individual learning is driven largely by the education system and self-motivation, societal and institutional learning must be driven through deliberately designed mechanisms in local governance. These mechanisms include mandated spaces and opportunities for multi-stakeholder interactions, citizen participation in data collection and assessments of their local water commons, integration of diverse knowledge systems and ways of knowing, and finally, communication and sharing of socio-ecological and economic learning regarding the local and regional water commons to all concerned stakeholders. ❐

Notes

1 This editorial is built upon learning from (i) ongoing research on the reciprocal relationship between social and institutional learning systems and nature-based solutions to enhance the resilience of urban water systems in India and (ii) the current body of work on water body rejuvenation led by Development Alternatives.

2 Details available at https://global-tipping-points.org/section1/1-earth-system-tipping-points

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Water for Peace and Development

Water is an indispensable resource that is at the core of all human activities. It is required for drinking, growing food, sanitation, generating power, transportation, recreational activities, and even rituals. Water flow is an essential part of sustainable development and is crucial for ecosystem services as well.

Climate change is more of a water-related crisis, with floods, droughts, and unpredictable precipitation (rains and cloud bursts) affecting food security and the livelihoods of people across geographies. Water plays a crucial role in adapting to climate change and acts as the crucial link between the climate system, human society, and the environment. Without proper water governance, competition for water between sectors will increase and various kinds of water crises will escalate, triggering emergencies in a range of water-dependent sectors. Women, children, and the differently-abled persons in the community are the most affected by water crises. Women, as natural custodians, collect and allocate water for domestic needs, but they tend to receive the least amount for hygiene and sanitation. This is further aggravated as the access and availability to water is further constrained.

When there is a shortage of clean water or it has been polluted, or when people do not have equal access to it, it can lead to conflicts and tensions between communities and even countries. The existing water-sharing treaties and arrangement with neighbours is complex, given that along with India, its neighbours also share the common problems of population rise, urbanisation, and water stress due to climate events. Hence, sustainable measures to prevent conflicts and tackle water scarcity is a big challenge for policy makers across the borders.

The increasing impacts of climate change demand urgent action to protect and conserve our water sources. This requires cooperation within and between countries, including a framework to assess availability and needs, building resilience to extreme weather events and help populations to adapt to a changing climate. Furthermore it is important to acknowledge that with growing population and urbanisation, the demands on water will substantially increase, and has the potential to trigger environment degradation. Health and wellbeing, food and energy systems, ecosystem functions, and integrity are all dependent on access to water, making a well-functioning and equitably managed system crucial. By putting water at the centre of action, policy makers can create an enabling system to enable communities to adapt to climate change by building resilience and reducing carbon emissions from water. A well-designed innovative finance mechanism for water resource management has the potential to attract investment, create jobs, and support governments in fulfilling their water and climate goals.

AI generated

According to the UN World Water Development Report 2023, Partnerships and Cooperation for Water[1], 'safeguarding water, food, and energy security through

India, once known as land of rivers, attaches great significance to water and the interlinkages to ecological sustainability, economic growth, human well-being, yet is one of the most water-stressed countries in the world.

With an 18% of the world's population holding only around 4% of the world's water resources, there is a competition to the water resources given rapid urbanisation and industrialisation, leading to a higher demand for water in the agricultural, energy, and industrial sectors.

The Composite Water Management Index (CWMI) 2019, NITI Aayog, clearly states that the water challenge is not only because of the limited availability of water resources but also its mismanagement.

Water scarcity not only affects gross domestic product directly in the form of loss of productivity to the agriculture, industrial and service sectors (including infrastructure) but also decreases the ability of the population to adapt to alternate production systems leading to water-stress migration.

sustainable water management, providing water supply and sanitation services to all, supporting human health and livelihoods, mitigating the impacts of climate change and extreme events, sustaining and restoring ecosystems and the valuable services they provide, are all pieces of a great and complex puzzle. Only through partnerships and cooperation can the pieces come together. And everyone has a role to play.'[2]

The Sustainable Development Goal 6 (SDG 6) aims to ensure the availability and sustainable management of water and sanitation for all by 2030. Unfortunately, progress towards the goal is off-track and in some areas, there needs to be a significant increase in the rate of implementation. Perhaps through a coordinated approach and cooperation, water can be the catalyst for sustainable development and address many of the ecological and developmental challenges of today. ❐

Notes

1 United Nations. 2023. *UN World Water Development Report 2023.* Details available at https://www.unwater.org/publications/un-world-water-development-report-2023

2 UNESCO. 2023. Main findings of the United Nations World Water Development Report 2023 – Partnership and cooperation for water. Details available at https://www.unesco.org/en/articles/main-findings-united-nations-world-water-development-report-2023-partnership-and-cooperation-water#:~:text=Safeguarding%20water%2C%20food%20and%20energy,the%20valuable%20services%20they%20provide%2C

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The Groundwater Gamble: Can India Manage Its Hidden Water Resource Sustainably?

Well water being pumped for irrigation

Problem

Groundwater resource accounts for nearly 60% of India's total irrigation needs, feeding a population of over 1.4 billion people. But this hidden resource faces a dangerous gamble: can India manage its groundwater sustainably before it runs dry? Statistics paint a worrying picture. The Central Groundwater Board reports that 18 states/union territories in the country are facing 'critical' groundwater depletion. A 2023 United Nations report warns that by 2025, the entire northwestern region, vital for India's agricultural output, is expected to experience critically low groundwater levels. This region, comprising states like Punjab and Haryana, is crucial for the nation's food supply as it produces significant portions of its rice and wheat. However, unsustainable groundwater usage has led to 78% of wells in Punjab being overexploited. In central Punjab, groundwater extraction has already reached depths of 150-200 metres. If the current rate of depletion persists, Punjab's groundwater levels are projected to decline below 300 metres by 2039, according to the Central Ground Water Board.

Additionally, projections published in the journal *Science Advances* suggest that India's groundwater depletion could further accelerate due to climate change. The research indicates that while increased summer rainfall may aid in refilling aquifers, it will not suffice to counteract the effects of higher evaporation rates and heightened irrigation demands during drier winters. The research also highlights that although the most severe overuse has been observed in Punjab and Haryana, similar issues could emerge in southwestern India by 2050, particularly in areas with hard rock aquifers that hold less water.

This unsustainable extraction stems from several factors. Agriculture, the backbone of the Indian economy, accounts for over 80% of groundwater use. Inefficient irrigation practices, like flood irrigation, lead to significant water loss. Also, subsidised electricity for pumping incentivises excessive extraction. Compounding the challenge is a fragmented policy landscape. Groundwater management lies primarily with individual states, which are often lacking robust monitoring and regulation mechanisms. Additionally, limited data availability and inadequate infrastructure further hinder effective management.

Policy

Within the national framework, the Model Groundwater (Sustainable Management) Bill, 2017 is a proposal that aims to establish water regulatory bodies to oversee groundwater extraction. However, it is yet to be enacted. The Central Ground Water Board, operating under the Ministry of Jal Shakti, plays a crucial role in monitoring groundwater levels nationwide and providing technical guidance. To support this effort, the *Atal Bhujal Yojana* was launched in December 2019. This initiative aims to involve community participation and line departments in seven states of India (i.e. Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh) to arrest the decline in groundwater levels and improve groundwater management. At the state level, policies vary widely. Some states, such as Gujarat and Andhra Pradesh, have implemented comprehensive groundwater laws, while others lack robust regulatory frameworks. Many states also employ common elements such as permit systems, meter installation, and restrictions in over-exploited areas to regulate groundwater extraction. Nevertheless, challenges remain, including limited enforcement capacity, inadequate data availability, and a lack of coordination between upstream and downstream states, which collectively impede the effectiveness of groundwater management efforts.

State responses to water challenges vary across India, showcasing a wide range of approaches and initiatives. Tamil Nadu, for instance, mandates rainwater harvesting for new constructions and promotes micro-irrigation techniques. Maharashtra has implemented the Water Resources Regulatory Authority Act (2005) to determine the distribution of entitlements for various categories of use and the equitable distribution of entitlements of water within each category of use. Karnataka's Krishi Bhagya Jala Samriddhi Yojana focuses on constructing farm ponds to recharge groundwater. However, in states grappling with severe water crises, challenges persist. Punjab continues to over-exploit groundwater despite stricter regulations, largely due to subsidised electricity and water-intensive agricultural practices. Rajasthan struggles with inadequate infrastructure and limited enforcement capacity, hindering effective water management efforts. Similarly, in Haryana, the lack of agricultural diversification contributes to heightened pressure on groundwater resources. These examples underscore the complexities and varied dynamics of water management across different regions of India.

Proposition

A multifaceted approach is needed to address the pressing challenges of groundwater depletion in India. Strengthening the national framework by enacting the Model Water Bill and endowing the Central Ground Water Board with robust enforcement powers is critical. Additionally, to enhance data collection and monitoring mechanisms, necessitating the utilisation of advanced technologies such as remote sensing and investment in comprehensive hydrogeological studies must be invested in. Moreover, community-based management approaches should be promoted to empower local stakeholders to take charge of their water resources through participatory decision-making processes.

Furthermore, a shift towards managing water demand is imperative, entailing the incentivisation of water-efficient practices such as micro-irrigation, crop diversification, and precision agriculture. On the supply side, interventions such as promoting rainwater harvesting and recharge structures can help alleviate pressure on groundwater reserves. Interstate cooperation is also essential, requiring concerted efforts to facilitate collaborative river basin management and resolve water disputes across state boundaries. Through these concerted efforts, India can move towards sustainable groundwater management, reducing the risks associated with the 'Groundwater Gamble', and ensuring both food security and water justice. ❐

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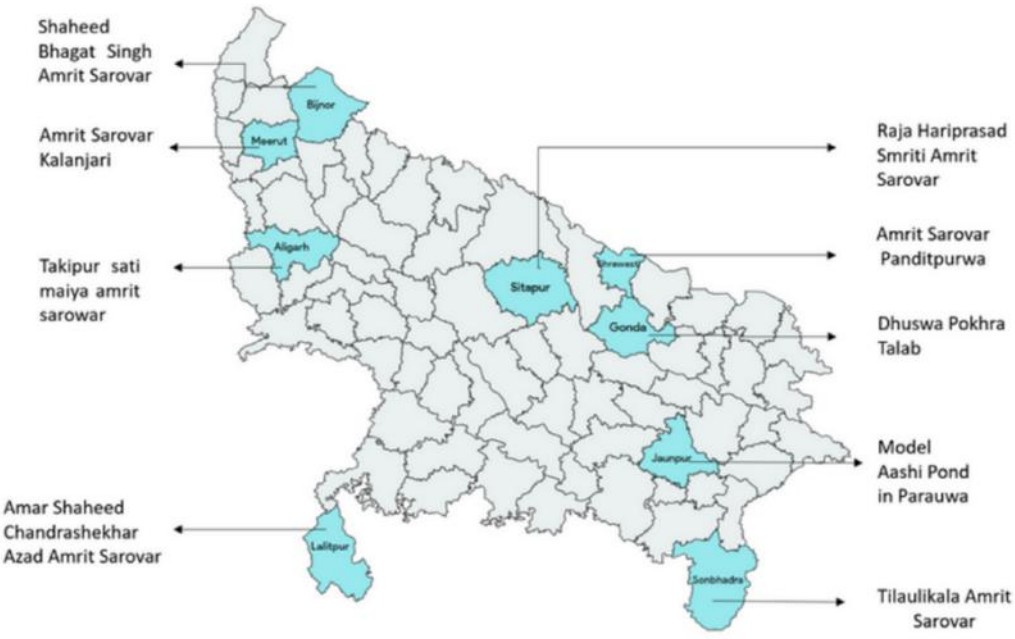
Pilot Assessment of Amrit Sarovars from Nine Agro-Climatic Zones of Uttar Pradesh

In Uttar Pradesh, a total of 245,088 water bodies have been counted, with 98% (240,140) being located in rural areas and the remaining 2% (4,948) in urban areas. This information comes from the first census of water bodies conducted by the Union Ministry of Jal Shakti (water resources) in 2023. The Uttar Pradesh government has reported that 14,245 ponds have been built in the state as part of the mission. Therefore, it is crucial to assess the impact of the pond ecosystem on various components of human and environmental well-being, as the components of the ecosystem have far-reaching implications.

A framework for monitoring, evaluation and learning (MEL) was co-developed by Development Alternatives and the Government of Uttar Pradesh (including the Directorate of Environment, Government of Uttar Pradesh and Economic Advisor to CM, Government of Uttar Pradesh) as a draft, followed by the development of its allied questionnaire and assessment matrix. The assessment matrix is used to grade the ponds based on the services rendered by these water bodies.

Amrit Sarovar at Gram Panchayat Tilauli-Kalan, Bindhya zone of Uttar Pradesh

For the analysis, nine case studies featuring the pond ecosystem were identified and analysed using the impact assessment framework. A list of ponds was compiled from each of the agro-climatic zones of Uttar Pradesh, from which one pond was selected based on desk research supported by the Rural Development Department,



Location of Amrit Sarovars in Nine-Agro climatic zones of Uttar Pradesh

Agro- Climatic Zone	District	Block	GP	Sarovar ID	Sarovar Name	Survey Team
Bhawar and plain, tarai plain	Shrawasti	Sirsiya	Panditpurwa	107879	Amrit Sarovar Panditpurwa	Gorakhpur Environment Action Group
Western Plain Zone	Meerut	Janikhurd	Kalanjari	18013	Amrit Sarovar Kalanjari	Neer Foundation
Mid western plain zone	Bijnore	Haldaur	Amheda	19760	Shaheed Bhagat Singh Amrit Sarovar	Neer Foundation
Western sub tropical zone	Aligarh	Tappal	Taquipur	120102	Takipur sati maiya amrit sarowar	DFO,Aligarh
Mid plain zone	Sitapur	Mishrikh	Bermi	68593	Raja Hariprasad smriti Amrit Sarovar	Vasudha Foundation
Bundelkhand Zone	Lalitpur	Talbehat	Gevragundera	96827	Amar Shaheed Chandrashekhar Azad Amrit Sarovar	Development Alternatives
North Eastern Plain Zone	Gonda	Itiyathok	Sanjhawal	44403	Dhuswa Pokhra Talab	Turtle Survival Alliance
Eastern Plain Zone	Jaunpur	Muftiganj	Parauwa	131849	Model Aashi Pond in Parauwa	Development Alternatives
Bindhya Zone	Sonbhadra	Ghorawal	Tilauli Kala	128874	Tilaulikala Amrit Sarovar	Development Alternatives

The representation of Amrit Sarovars in various Agro-climatic zones and respective survey teams

Uttar Pradesh. To collect suitable data for assessment, six field teams were oriented on the process.

The team from Development Alternatives conducted assessment studies in three agro-climatic zones: Bundelkhand, Eastern Plain, and Bindhya Zone. The first step involved engaging all the stakeholders (including the gram panchayat, community members, and block-level and district-level officials) via conducting focused group discussions (FGDs) and individual interviews among them to extract as many details as possible about the ponds. The close engagement with the stakeholders enabled a thorough and in-depth understanding of each of the sites. The team developed a questionnaire based on services rendered by ponds, including cultural services, supporting services, regulating services, provisioning services, and socio-economic services. The questionnaire incorporated a range of relevant indicators against each of these service categories. The marking for each service was based on its relevance with respect to, but not limited to, the pond ecosystem. Moreover, water quality testing of all the ponds was also kept as an important component in the matrix, which was conducted with support from regional offices of the Pollution Control Board, Uttar Pradesh.

During field visits to nine agro-climatic zones, it was observed that certain indicators and measures of success for services related to ponds were not witnessed. Therefore, these parameters need to be refined or redefined. As a way forward, the framework needs to be finalised in collaboration with stakeholders from various organisations, in order to enable the state to spearhead the initiatives related to the rejuvenation of local water bodies. ❐

Field survey at Gram Panchayat, Parauwa in Eastern plain zone of Uttar Pradesh

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Drinking Water Crisis in Bundelkhand Region of India: A Case Study With Special Reference to Water Sustainability

Water has always been a major challenge of civilisation throughout history and continues to be so. It is possible that water could be the most significant problem of the 21st century. Water sustainability is a major issue that society needs to address due to the current issue of inadequate water resources and problems such as anthropogenic climate change.

The Government of India has identified Bundelkhand as a region that is 'backward' and 'human development poor'. Currently, the area is grappling with acute water scarcity, raising concerns about the potability of water in the region. To address this issue, the present study was conducted in six villages of Bundelkhand, namely Rajpura, Ladpura, Majra, Bagan, Mador East, and Chandrawan. The goal of the study was to establish a baseline dataset for groundwater availability and quality.

Groundwater samples were systematically collected and analysed for various physico-chemical characteristics, including pH, TDS, temperature, hardness, alkalinity, nitrate, turbidity, and pathogens, using the Jal-TARA water testing kit. This investigation sought to comprehend the factors affecting water quality, leading to its contamination in the region. The analysis revealed that the groundwater was contaminated, primarily due to elevated levels of turbidity, microbiological contamination, nitrate, and total dissolved solids.

Additionally, a comprehensive household survey was conducted in each of the six villages (50 households in each village), which included several aspects such as socio-economic conditions, data on water availability, education conditions, focus group discussions, knowledge aptitude practices, water handling behaviour change programmes, and water testing training sessions. This holistic approach aimed to gain insights into water-related challenges and resource availability at the grassroots level.

Water quality testing training session in a school of Bundelkhand

Focused group discussion being conducted in Bundelkhand

The study findings underscore that the water crisis in the region is multifaceted, arising from factors such as population growth, erratic rainfall, climate change, political issues, water mismanagement, and negligence of environmental concerns, including disregard for traditional water sources. Furthermore, identified issues related to water scarcity are accompanied by suggested remedial measures aimed at improving the water crisis situation.

This study's dataset is poised to be instrumental in addressing and mitigating water-related challenges, as well educating rural communities about water, sanitation, and hygiene. Moreover, the study's outcomes can serve as a baseline for implementing interventions to enhance water resilience in the six villages, potentially aligning with ongoing government schemes such as the Jal Jeevan Mission. ❐

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