IWMI
International Water Management Institute

Country Strategic Roadmap India

2024–2030

Driving Action • Propelling Change

Credits:

Photography
Front cover: Yatin Kumar, a farmer and individual irrigation service provider at Chakhaji in Samastipur district installed his solar irrigation pump in 2016, as part of AKRSP-I and IWMI Tata Water Policy Program's pilot, and identified the solar irrigation system a game changer, to address the irrigation probelm in the state. (Tanmoy Bhaduri/IWMI)
Page v: A farmer using a light-duty tube well (minor irrigation scheme) in Kayetpur village, state of West Bengal, India (Tanmoy Bhaduri/IWMI)
Page 4: Women self-help group members during an exposure visit to Muzaffarpur, Bihar, to learn about off-grid Solar Irrigation Pump (SIP) technology and its potential for improving irrigation access and rural livelihoods. (C. de Bode/CGIAR)

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Contents

Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AI	Artificial Intelligence
CGWB	Central Ground Water Board
CSO	Central Statistics Office
CWC	Central Water Commission
FPO	Farmer Producer Organization
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German International Cooperation Society)
ICAR	Indian Council of Agricultural Research
IPCC	Intergovernmental Panel on Climate Change
IUWM	Integrated Urban Water Management
IWMI	International Water Management Institute
MAR	Managed Aquifer Recharge
Mha	million hectares
MNRE	Ministry of New and Renewable Energy
MoA&FW	Ministry of Agriculture & Farmers' Welfare
MoJS	Ministry of Jal Shakti
MoRD	Ministry of Rural Development
Mt	metric ton
NbS	Nature-based Solutions
NDMA	National Disaster Management Authority
NMCG	National Mission for Clean Ganga
NRAA	National Rainfed Area Authority
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan
PRADAN	Professional Assistance for Development Action
SADMS	South Asia Drought Monitoring System
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SPaRC	Solar Power as Remunerative Crop
TFWS	Transformative Futures for Water Security
UTFI	Underground Transfer of Floods for Irrigation
WEF	Water-Energy-Food
WIZ	Water Influence Zone

Foreword by the Country Representative

It gives me great pleasure to present the International Water Management Institute's (IWMI) Country Strategic Roadmap for India 2024–2030, which outlines our vision, priorities, and approach for advancing sustainable water management and resilient agricultural systems in India over the next five years.

Water is at the heart of India's development challenges and opportunities. Rapid urbanization, climate change, and evolving agricultural demands place immense pressure on our water resources, making integrated, evidence-based management more critical than ever. IWMI is committed to generating actionable knowledge, fostering innovation, and supporting policies that ensure water security while promoting inclusive and sustainable development in India.

> **Water is at the heart of India's development challenges and opportunities. Rapid urbanization, climate change, and evolving agricultural demands place immense pressure on our water resources**

This strategic roadmap provides a clear framework for the future. By identifying priority research areas, partnerships, and capacity-building initiatives, it enables us to anticipate emerging challenges and respond with agility and relevance. It will guide our work in designing innovative solutions, influencing policy, and scaling impact on the ground, ensuring that our efforts lead to tangible improvements in water management, food security, and climate resilience.

Moreover, this document reinforces our commitment to collaboration, gender inclusion, and community engagement, which are essential for translating scientific insights into lasting societal benefits. By aligning our work with national priorities and global sustainability goals, this roadmap positions IWMI to play a leading role in shaping the country's water and agricultural future.

I am confident that, guided by this strategy, IWMI will continue to deliver impactful research, innovative solutions, and evidence-based policy support, contributing to a sustainable, equitable, and climate-resilient future for India.

Dr. Alok Sikka
Country Representative – India

> A 3.5-fold increase in population during the last six decades has made India one of the most water-scarce countries globally.

1. Context

India is the largest democracy in the world and supports 16% and 17% of the world's human and livestock population, respectively, with just 4.25% and 2% of the world's freshwater and land resources, respectively. Although India has become one of the fastest-growing economies in the world, there is a growing concern that water scarcity will become a binding constraint on its development. A 3.5-fold increase in population during the last six decades has made India one of the most water-scarce countries globally. Water availability is down from 5300 m^3 in 1951 to about 1400 m^3/capita/year at present, barely sufficient to sustain economic growth and support human well-being. Water availability is projected to decline to 1340 m^3 by 2025 and further still to 1140 m^3 by 2050. In 2013, the World Resources Institute declared India among the world's 50 most water-stressed countries (Luck et al. 2015). The increased water needs for drinking, domestic use, energy, and industrial sectors due to economic development and urbanization are contributing to this decline. However, the main use of freshwater in India is for irrigation, accounting for approximately 80% of the total (Figures 1 and 2). It is expected to further increase to meet the demands of a growing population, as assessed by the National Commission on Integrated Water Resources Development. Tackling the issue of water security in India will entail tackling the following key challenges for the country.

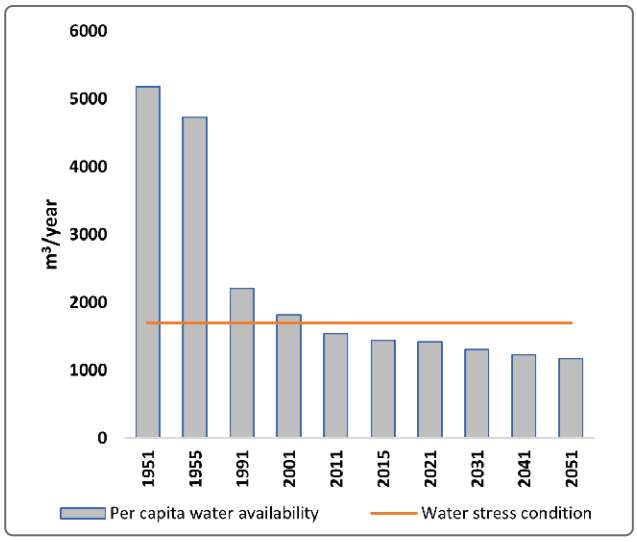

Figure 1. Per capita water availability (*Source:* Central Statistics Office [CSO] 2018)

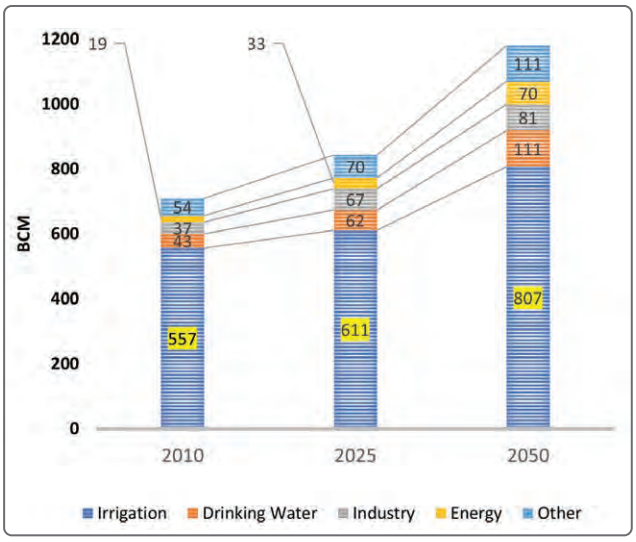

Figure 2. Projected water demand by different sectors in India (*Source:* CSO 2018)

1.1 Climate change-induced threats to water security

Climate change is intensifying India's already complex water security challenge. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (IPCC 2022) warns of more frequent extreme heatwaves and disruptions to the hydrological cycle, where even small changes in annual water yield can alter streamflow timing and create regional imbalances - wet regions becoming wetter and dry regions drier. The Indian Network for Climate Change Assessment projects a 5–20% increase in water yield in the Himalayan region by the 2030s, but declines in the North-Eastern, Western Ghats, and Coastal regions. Under a 2°C warming scenario, heatwave frequency in India could rise thirty-fold (halved under 1.5°C), exacerbating evapotranspiration, soil moisture stress, and meteorological drought (Mujumdar et al. 2017), while increasing crop water demand and groundwater abstraction. At the same time, intense rainfall events and fewer rainy days are likely to reduce groundwater recharge, and glacier retreat in the Himalayas will further affect river flows. Together, these impacts threaten per capita water availability, agriculture, and economic development, intensifying competition for water and disproportionately affecting small and marginal farmers;

if current demand trends continue, nearly half of India's water demand may remain unmet by 2030 (Shah 2016), underscoring the need to reimagine water management to meet development and Sustainable Development Goals (SDGs). These trends highlight the need for climate-resilient and adaptive water management approaches in India.

1.2 Water use efficiency challenges in Indian agriculture

Although agriculture now contributes only about 14% to India's Gross Domestic Product, it continues to support nearly 60% of the population dependent on farming and allied livelihoods. Indian agriculture remains highly monsoon-dependent, with around 50% of the net sown area (140 million hectares) rainfed and therefore vulnerable to climate variability and change (MoA&FW 2023). Irrigation accounts for about 80% of total water use in India, though this share is projected to decline to 72% by 2025 and 65–68% by 2050 due to rising competing demands (ADB 2013), making water-use efficiency critical for future food and water security. However, irrigation efficiency remains low—around 30% in surface water schemes and 55% in groundwater schemes, with an overall efficiency of ~40%; Central Water Commission (CWC) estimates an average efficiency of only 38% across major and medium irrigation projects (Sikka et al. 2022). With water supply increasingly constrained and uncertain, improving irrigation efficiency is urgent, and the government has set targets of a 20% overall efficiency increase, prioritising large surface irrigation systems (CSO 2018).

1.3 Groundwater sustainability challenges

Groundwater underpins India's food security and drinking water supply, meeting about 63% of irrigation demand, 85% of rural water needs, and over 50% of urban water requirements, with nearly 90% of annual groundwater withdrawals used for irrigation (CGWB 2025). This reliance has led to a groundwater sustainability crisis, with around 27% of districts affected by over-extraction and/or water quality problems (salinization), driven by private tubewells, active groundwater markets, and free or subsidized energy for pumping. Of 6,762 assessment units nationwide, 11% are classified as over-exploited and 14% as semi-critical critical, with northwestern India's "grain bowl" being a hotspot of groundwater depletion. Groundwater irrigation in India is also highly energy intensive, as pumping water from increasing depths requires substantial electricity and diesel use. This makes groundwater pumping a significant source of greenhouse gas emissions, estimated at 14.38 Mt CO_2 annually from electric and diesel pumps combined (Reddy et al. 2015). As groundwater levels decline, energy requirements and associated emissions rise further, reinforcing the strong link between groundwater depletion, energy use, and climate impacts. Addressing this challenge requires integrated groundwater management combining supply-side recharge, Water-Energy-Food nexus, and storage with demand-side measures such as climate-smart agriculture, appropriate energy pricing, and context-specific strategies that account for physical water scarcity in western and southern India and economic water scarcity in the eastern states (Mukherji et al. 2013).

> "As groundwater levels decline, energy requirements and associated emissions rise further, reinforcing the strong link between groundwater depletion, energy use, and climate impacts.

1.4 Urban water-sanitation-health

India is experiencing rapid urbanization, with its urban population projected to reach 607 million by 2030 (UN-Habitat 2024), while the total population projection for India is 1,510 million by 2030 (UN 2024). This estimates that more than 40% of the total population would be living in urban centers, thus accelerating the concerns around urban water security. Yet existing governance and institutional capacities remain inadequate to meet growing water and sanitation demands. Safe management of wastewater and fecal sludge in cities, peri-urban areas, and rural settlements is a major challenge for achieving the Swachh Bharat Mission (SBM) and SDGs, as conventional treatment facilities are limited and much untreated sewage pollutes rivers, lakes, and aquifers, while being informally reused in peri-urban agriculture with serious health risks. With a low sewerage treatment rate of 28% through centralized systems (NMCG 2014) and about 47% of urban households relying on on-site sanitation systems, there is a strong need for environmentally safe fecal sludge management and resource recovery and reuse through integrated, innovative solutions supported by technical agencies, partnerships, community participation, and targeted investments until universal access to sanitation is achieved.

1.5 Water governance, gender, equity, and migration

India has made substantial investments in water infrastructure, creating a strong foundation for improving agricultural productivity and water security. This progress presents an important opportunity to further strengthen governance systems by enhancing management capacity, improving operation and maintenance, and introducing robust performance monitoring and benchmarking mechanisms. Many projects have suffered negligible user charges, inadequate revenues for operation and maintenance, and a large backlog of deferred maintenance - often described as a “build – neglect – rebuild” cycle. Greater attention to last-mile connectivity, participatory irrigation management, and the effective functioning of Water User Associations can significantly improve system efficiency and sustainability. Water scarcity and water-related disasters also drive distress migration, disproportionately affecting small and marginal, women-led, and tenant farmers; when men migrate, women and the elderly bear increased farming and water-management burdens, highlighting the need for stronger institutional support, gender-responsive policies, and targeted investments to ensure sustainable access to water.

2. Achievements: Our Story of Impact

The International Water Management Institute (IWMI) has played a significant role in advancing water security, climate resilience, and evidence-based decision-making through policy-relevant research, pilot interventions, and sustained engagement with national and state governments in India. Its work has contributed to the design and implementation of flagship programs, strengthened institutional capacity, and demonstrated scalable solutions at the water–energy–agriculture nexus.

2.1 Improving water productivity

IWMI has worked extensively on mapping and suggesting pathways for improving water productivity in India. A study by IWMI has shown that a significant gap exists between the actual and maximum water productivity, popularly known as More Crop, Per Drop, and reducing this gap alone could substantially reduce additional need for irrigation water (Sharma et al. 2010). IWMI research showed great scope for improving water productivity. Building on their existing work, IWMI released national-scale Water Productivity Atlas (now hosted by the India water platform Water Resources Information System [WRIS] by the Ministry of Jal Shakti [MoJS]) providing a one-stop hub for water productivity and water footprints indicators for India.

IWMI played a key role in introducing concepts, innovative technologies, and convergence-based approaches to improve farm water use efficiency and enable scaling of effective interventions through multiple programs and projects. This includes piloting, capacity building, and policy research around efficient interventions. For example, IWMI, in partnership

with the Indian Council of Agricultural Research (ICAR)-Indian Institute Of Water Management (IIWM) and Mahatma Phule Krishi Vidyapeeth (MPKV), demonstrated the Water Influence Zone (WIZ) concept in the Sina medium irrigation canal system, highlighting direct canal irrigation and indirect return-flow-based conjunctive use beyond the designed command area. The project introduced a WIZ performance assessment framework combining water accounting, benchmarking indicators, and water cost curves to inform decision support for enhancing economic water productivity (INR/m³ of Consumptive Water Use). The analysis generated key policy insights on shifting assessment from command area to WIZ, strengthening conjunctive irrigation in *rabi* through return-flow-recharged groundwater, and promoting cropping patterns that increase EW. Similarly, IWMI in partnership with partners and governments in Odisha, Haryana, and Karnataka led research for promoting and identifying barriers to adoption of efficient interventions (micro-irrigation, direct seeded rice) to improve water use efficiency and crop productivity. In addition, IWMI's Country Representative for India chaired the Task Force on the Bureau of Water Use Efficiency, contributing to national discussions on water efficiency standards and institutional mechanisms.

2.2 Contributions to the Prime Minister's Krishi Sinchayee Yojana (PMKSY)

The Prime Minister's Krishi Sinchaayee Yojana (PMKSY) is a flagship national program aimed at providing water to every farm *(Har Khet Ko Paani)*. IWMI contributed to PMKSY by providing analytical inputs for district prioritization and supporting the preparation of District Irrigation Plans. IWMI analyzed the program's design and implementation and shared findings through high-level policy consultations in Delhi. IWMI research prioritized 112 irrigation-deprived districts—characterized by less than 30% irrigated holdings and groundwater development below 70% (Shah et al. 2016). Several IWMI recommendations were subsequently taken up by the Government of India, contributing to the development of a PMKSY scheme focused on expanding small-scale irrigation through groundwater in convergence with water conservation measures.

> **IWMI research has helped in improving groundwater access for smallholder farmers to make groundwater use profitable**

2.3 Managing groundwater

Groundwater has now become the backbone of India's food security as it supports about 63% of the country's irrigation demand, besides catering to 85% of rural water needs and more than 50% of urban water consumption. While this has helped increase agricultural productivity and farmer income, it has also led to the over-exploitation of aquifers. IWMI has been the pioneer in the field of water-energy-food (WEF) nexus and has recently developed the first of its kind composite WEF index. It would be near-impossible to sustainably manage any one of them without supportive policies and actions in the other two sectors. IWMI argued against the insistence on universal metering and recommended a practical, second-best strategy of "rational flat tariff coupled with intelligent rationing" (Shah et al. 2004). In 2005-06, the Government of Gujarat implemented the Jyotirgram Yojana (JGY) to completely re-wire the state by separating agricultural feeders from domestic and industrial ones. Not only did this facilitate the "intelligent rationing of farm power" but also led to substantial improvements in the quality of rural life and positive impact on farm economy (Verma and Shah 2008). In West Bengal, IWMI research has helped improve groundwater access for smallholder farmers to make its use profitable through an amendment of the groundwater pumping act. IWMI also pioneered, piloted and supported scaling the innovative managed aquifer recharge (MAR) approach—Underground Transfer of Floods for Irrigation (UTFI)—in the Ganges basin which helps co-manage floods and droughts at the river basin/sub-basin scale. UTFI involves targeted recharge of aquifers using seasonal excess surface water flows that potentially pose a flood risk, with the aim of mitigating downstream flooding and increasing groundwater storage.

2.4 Solar irrigation

India hosts more than 92% of the world's off-grid solar capacity deployed for agriculture and serves as a global leader in solar irrigation. IWMI has played an important knowledge-partner role in this space, supporting the International Solar Alliance (ISA) and working with partners such as Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Swiss Agency for Development and Cooperation (SDC), the World Bank, the Asian Development Bank (ADB), and the Global Green Growth Institute. Through a partnership with CGIAR research programs Climate Change, Agriculture and Food Security, and Water, Land and Ecosystems (WLE), IWMI conceptualized and field-tested an alternate model of solar irrigation promotion—one that also incentivizes efficient energy and water use. The approach is called SPaRC (Solar Power as Remunerative Crop) and involves promotion of grid-connected solar pumps with the option for pump owners to sell any surplus power to the grid at attractive tariffs. In 2015—16, IWMI field-piloted this approach with nine smallholder farmers in the Dhundi village (Shah et al. 2017). IWMI argued that the SPaRC approach can: [a] transform farmers from consumers of subsidised grid power to energy "prosumers"; [b] reduce the deadweight of farm power subsidies and improve financial viability of distribution companies; [c] incentivize efficient energy and water use; [d] offer farmers an additional, reliable source of income; [e] reduce the carbon footprint of India's groundwater economy; and [f] contribute to meeting India's renewable energy targets. IWMI's SPaRC pilot in Dhundi attracted a lot of media and policy attention and inspired the Government of Gujarat's Suryashakti Kisan Yojana (SKY). The model is also part of the Government of India's ambitious Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM-KUSUM) scheme (PIB 2018).

Recently, IWMI was also invited by the Ministry of New and Renewable Energy (MNRE) to serve on the expert group reviewing PM-KUSUM and contributed technical inputs to the design of PM-KUSUM 2.0. IWMI partnered with ICAR Research Complex for Eastern Region and Borlaug Institute for South Asia to develop the Solar Irrigation Pump (SIP) Sizing Tool for MNRE.

2.5 Managing climate-induced water risks

IWMI has played a pioneering role in strengthening climate risk management in agriculture. IWMI developed the South Asia Drought Management System (SADMS), a regional early warning and decision-support platform that enables timely drought preparedness and response. The system has demonstrated significant benefits for farmers and strengthened engagement with national and state disaster management agencies. SADMS received the Geospatial World Excellence Award in 2020. Further, IWMI has developed and integrated SukhaRakshak AI—a drought contingency chatbot with SADMS that supports 22 Indian languages (using India's indigenous AI4Bharat).

IWMI further advanced integrated agricultural risk management approaches that address both floods and droughts, supporting more resilient farming systems under climate extremes. IWMI also pioneered the concept of (UTFI), which uses excess wet season flows for aquifer recharge. UTFI reduces downstream flood risks while providing reliable dry-season irrigation, acting as a buffer against increasing climate variability. The approach was successfully piloted and scaled in the Ramganga basin in partnership with ICAR and state agencies, demonstrating strong potential for wider adoption in flood-prone regions.

3. Strategic Priorities

IWMI has developed and adopted its Strategy for 2024–2030, with three strategic focus areas and four strategic levers (Figure 3). This strategy should build towards achieving IWMI's vision of a water-secure world. In addition to the context of challenges and enabling environment in India, the country plan is also developed in close alignment with the framework presented by the Transformative Futures for Water Security (TFWS) missions. The identification of key gaps and strategic opportunities in the country was carried out through a method of stakeholder partnerships and consultations. Through the TFWS program, a country-level multistakeholder consultation was conducted through partnerships with four major national and international water institutions in India forming a local steering committee with IWMI. In addition, several thematic consultations aligned with projects and initiatives have been organized to understand gaps and strategic opportunities and their relevance for the TFWS missions, ensuring alignment with the IWMI Strategy 2024–2030.

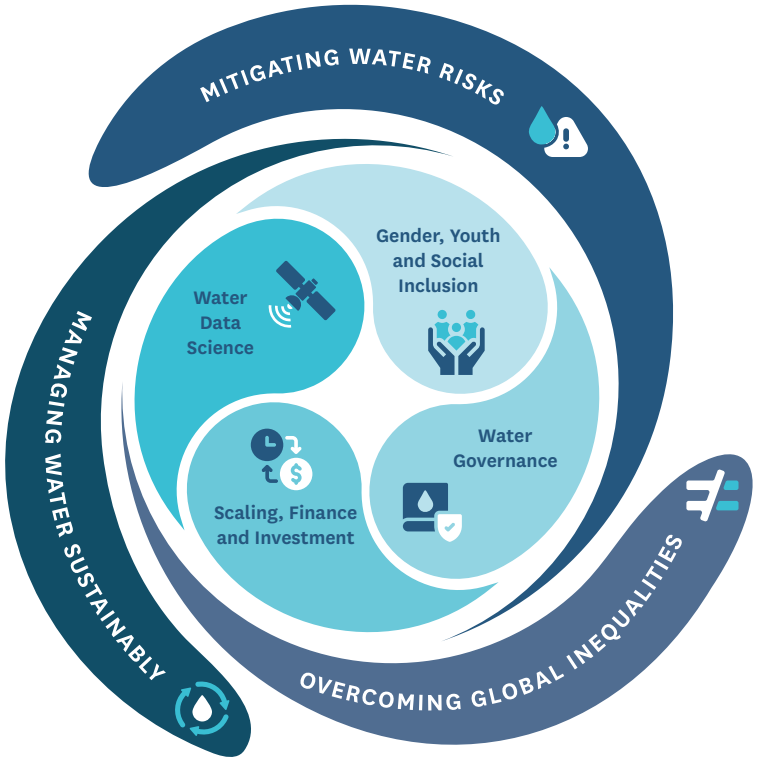

Figure 3. IWMI's 2024–2030 Strategy: Strategic focus areas and levers (IWMI 2024)

3.1 Strategic Priorities for 2024–2030

3.1.1 Agriculture water management and water productivity

Water is the entry point and most critical input to food production systems—crops, livestock, and fisheries and livelihood. In India, over 90% of fresh water is used in growing food but with a very low water use efficiency and water productivity. IWMI's research in this domain will focus on improving smallholder livelihoods through enhanced water access, control, and use in agriculture; integrated watershed and river basin management; facilitating the shift toward high-value agriculture; and promotion of water-centric livelihood options in agriculture and allied sectors. Building storages in the form of in-situ water conservation, rainwater harvesting, surface water and groundwater storages, together with demand-side water management, forms the key to improved resilience and climate change adaptation. Key sub-themes under this strategic priority area are:

Revitalization and sustainable and equitable expansion of irrigation: IWMI will generate evidence and solutions to expand irrigation equitably in irrigation-deprived regions by improving conjunctive water use, system performance, and governance of public irrigation through technological, institutional, and policy research.

Improving water productivity: IWMI will benchmark and map water productivity across scales using remote sensing and field research and develop tools and innovations to close the "more crop per drop" gap and enhance smallholder viability.

Water accounting: IWMI will support basin- and sub-basin-level decision-making by applying and scaling the Water Accounting Plus framework to assess water availability, use, and performance, in collaboration with government programs.

Building farmers' resilience through climate-smart agriculture: IWMI will design and test climate-smart land and water management portfolios through integrated watershed approaches and Climate-Smart Villages, linking water management with resilient farming systems and diversified livelihoods, including animal-based protein sectors.

Frontier technologies for smart and resilient water systems: IWMI will leverage frontier technologies such as AI, Machine Learning, Internet of Things (IoT), Earth observation, and Digital Twin approaches to strengthen water management across scales, from farms and irrigation command areas to river basins. These tools will support near–real-time monitoring, scenario-based planning, and adaptive decision-making under climate variability.

3.1.2 Sustainable groundwater management

Groundwater storage has emerged as a pivotal factor in facilitating India's economic advancement and represents the primary and extensively tapped freshwater resource, catering to agricultural, domestic, and industrial demands. High dependence on groundwater, specially for agriculture, has resulted in overexploitation. The Indian government has introduced initiatives and programs aimed at augmenting groundwater storage and recharge. Key subthemes under the strategic priority area are:

Managed aquifer recharge (MAR): IWMI will support sustainable groundwater augmentation including MAR, such as the UTFI, through participatory approach.

Participatory groundwater management: IWMI will support innovative community-led groundwater governance and management for groundwater supply and demand management.

Integrated storage management: IWMI will generate evidence and tools and co-develop sustainable management solutions for coordinated surface water and groundwater storage and management, conjunctive water use, and capacity development.

3.1.3 Water-Energy-Food (WEF) nexus with a climate lens and solar irrigation

WEF nexus is a critical challenge for India where policy decisions in one sector often create unintended impacts in others. It can be summed up as an invidious nexus among water, energy, and food systems, where efforts to increase agricultural production comes at the cost of depleting groundwater resources and rising energy consumption.

Addressing these interlinkages is essential for ensuring long-term sustainability, climate resilience, and viable livelihoods. As India expands the use of solar energy for irrigation, IWMI will assess the inter-sectoral ramifications of water, food, and energy policies. Key sub-themes under the strategic priority area are:

WEF nexus trade-off and synergies: IWMI will continue its ongoing efforts and co-develop mechanisms to use composite WEF nexus index to examine trade-off and synergies for the sustainability of interdependent water-energy-food systems, particularly in the intensively groundwater-irrigated areas and basins. The WEF nexus approach will also be extended to study and inform modernization of irrigation systems.

Solar irrigation: IWMI will focus on identifying and testing solutions that reduce groundwater over-extraction while supporting climate-resilient, gender-equitable, socially inclusive outcomes. This work will inform the design of business models, sustainable solar irrigation policies, and investment decisions.

Adaptation and mitigation co-benefits of solar irrigation: IWMI will quantify the greenhouse gas reduction potential of shifting from diesel to solar while assessing enhanced energy access to farmers' adaptive capacity. This would also be linked to opportunities for climate finance and carbon markets.

3.1.4 Managing and adapting to climate and water-related risks

Water-related disasters, droughts, and floods, have significant social, environmental, and economic impacts and their frequency and severity continue to increase due to climate change. IWMI will address both managing current water risks and adapting to future climate-related risks. Key sub-themes under the strategic priority area are:

Managing water risks: IWMI will support risk management for droughts and floods through early warning systems, early action, decision-support tools, and post-disaster recovery approaches. This includes strengthening of the SADMS and SukhaRakshak AI Advisories for drought management, advancing Index-Based Flood Insurance (IBFI) and post-flood management. IWMI will continue working with ICAR and other partners in drought and flood risk management, climate action, post-flood management. The focus will be on improving timely response, reducing losses, and supporting resilient livelihoods.

Adapting to water risks: IWMI will strengthen climate adaptation by addressing water-related vulnerabilities through improved drought and flood monitoring, climate information services, and decision-support tools. IWMI will analyze adaptation–mitigation trade-offs across water, agriculture, and energy systems. A strong emphasis will be placed on equity and adaptive governance, supporting locally-led, inclusive pathways for climate-resilient water management.

Open, interoperable, and scalable digital solutions: Building on national initiatives such as the Digital Twin of the Ganga River Basin, the National Hydrology Project, and India's Digital Public Infrastructure, IWMI will support open, interoperable, and scalable digital solutions for basin planning, groundwater–surface water integration, flood and drought management, and water productivity improvement. Capacity strengthening of institutions and ethical use of digital technologies will be integral to ensuring inclusive and policy-relevant outcomes.

3.1.5 Agroecology and Nature-based Solutions for water security

Climate change and land degradation are placing increasing pressure on freshwater ecosystems and the services they provide. Under this portfolio, IWMI will promote Agroecology and Nature-based Solution (NbS) for managing water-related risks and providing water services to rural and urban communities. The focus will be on integrated landscape approaches that link land, water, ecosystems, and livelihoods to support climate resilience, water security, and sustainable development. Key sub-themes under the strategic priority area are:

Agroecological farming systems: IWMI will support the scaling of agroecological practices through the Multifunctional Landscapes approach while closely working with smallholders and food system actors. The work will focus on evidence generation, identifying a community of practice, business opportunities, financial mechanisms, and behavioral change strategy that support sustainable and climate-resilient farming systems.

Wise use of wetlands: IWMI will generate evidence on the role of wetlands in water security, ecosystem services, and climate resilience. The focus will be on community-based management of wetlands, valuation of ecosystem services, and developing a participatory framework to support wise use and protection of wetlands.

Freshwater ecosystems and reversing the drying of mountain water sources: IWMI will work on evidence-based technological, institutional and policy solutions for revival of springs and springshed management. The focus will be on understanding and analyzing hydro-ecological and hydrogeological investigations in relation to changing land use, springflows, vegetation management, and community interactions.

3.1.6 Integrated urban water management

The rapid pace of urbanization in India reflects increasing incomes and growing aspirations, placing increasing pressure on urban and peri-urban water system, particularly affecting the poor and vulnerable. With about 32% of the Indian population living in cities and expected to double by 2050, with a growing economy and changing lifestyles, the pressure on already strained water resources is increasing in urban India. At the same time, in many rural areas, especially in the Indo-Gangetic Plains, over-discharge of pumped water and the loss of natural drainage are causing localized flooding and damage. This requires adoption of Integrated Urban Water Management (IUWM) that integrates often isolated sectors of water supply, sewage treatment (centralized and decentralized), circular economy, and stormwater drainage, and adopt integrated practices in the planning and implementation besides building capacity of municipal officials and other key stakeholders. Key sub-themes under this strategic priority area are:

Mainstreaming IUWM: IWMI will support the integrated planning and management of surface water, rainwater, groundwater, wastewater, and stormwater to improve urban water security. The focus will be on demand management, reduction of non-revenue water, safe reuse of wastewater, circular economy, protection of urban water bodies, strengthening urban water governance, co-management of "water" and "nutrient" exchanges between towns and their peripheries, and water quality.

Capacity building: IWMI will also support capacity building of municipal institutions and contribute evidence to urban national programs such as AMRUT 2.0, and strengthen the Jal Jeevan Mission, to promote water- and climate-smart urban and peri-urban development.

3.1.7 Water institutions, governance, and Gender Equality and Social Inclusion (GESI)

IWMI's strategic priority on water institutions and governance focuses on strengthening the capacity of national and selected state governments to design, implement, and validate effective water governance frameworks, responsive water policies, and inclusive institutions. These efforts aim to address the growing and competing demands for water across agriculture, domestic, industrial, and environmental sectors, while advancing equity, justice, and sustainability. Key sub-themes under the strategic priority area are:

Policy and institutional reforms: IWMI will support policy and institutional reforms by translating research evidence, impact assessments, and field experiences into actionable governance solutions. This includes contributing to the design and implementation of key national programs and related schemes through innovative approaches to service delivery, monitoring, and policy coherence.

Participatory governance: IWMI will actively engage communities in water research and governance processes to ensure that policies and interventions reflect local realities, values, needs, and preferences. By combining evidence-based policy support with inclusive, participatory approaches, IWMI aims to strengthen water institutions that are adaptive, equitable, and capable of delivering resilient water services in a changing climate.

Gender-responsive governance: IWMI's research will address the gender gap in water institutions, and advocate women's meaningful leadership in water management sector, including community groups.

4. Implementation Roadmap

The implementation approach commits to advancing IWMI's leadership in interdisciplinary water research, evidence-based policy engagement, and impactful research for development across diverse agroecological and socio-economic contexts. Building on lessons from the previous strategic period, IWMI will strengthen its engagement with national and state governments, policy think tanks, financing institutions, civil society organizations, and the private sector to enable scaling of water and climate innovations.

Implementation will be tracked through IWMI's Monitoring, Evaluation, Learning, and Impact Assessment system, using indicators on impacts, outputs, partnerships, and knowledge co-production and innovation, aligned with IWMI's Theory of Change, Organizational Performance Indicators (OPI), and the CGIAR results framework. An adaptive management approach—responsive to India's dynamic policy landscape, climate variability, and socio-economic diversity—will guide the implementation of this strategic roadmap.

Risk management will be a core pillar of the IWMI Country Strategic Roadmap for India, ensuring resilient and adaptive implementation across diverse socio-ecological and policy contexts. IWMI will adopt a proactive and integrated risk management approach aligned with IWMI and CGIAR policies, donor compliance frameworks, and national regulations. Through continuous engagement with central and state governments, diversification of funding sources, strong communication protocols, and adaptive management practices, IWMI will plan to mitigate risks while maintaining flexibility to respond to emerging opportunities and uncertainties in India's evolving water, agriculture, and climate landscape.

This section outlines the strategic pathways through which IWMI will operationalize its Country Stretegic Roadmap. The implementation roadmap (Table 1) presents indicative outcomes, key areas of action, and delivery approaches aligned with IWMI's Theory of Change and national priorities. Rather than a fixed workplan, the roadmap provides a flexible framework to guide partnerships, investments, and adaptive implementation across the strategy period. Specific activities and geographies will be refined over time in response to emerging needs, opportunities, and learning.

Table 1. Strategic Implementation Roadmap

Expected outcomes (i.e. intermediate outcomes as per the IWMI ToC)	Key activities	Geography	Partners (including intended beneficiary group)	Delivery method & timeline
Priority 1: Agriculture water management and water productivity				
Agricultural water productivity and farmer livelihoods are improved through scalable innovations in irrigated and rainfed agriculture.	• Co-develop and support scaling of water accounting-based planning, productivity analysis, and decision-support tools • Support adoption of water-efficient practices through capacity building and policy research	Pan-India	Indian Council of Agricultural Research (ICAR), Ministry of Jal Shakti (MoJS), Ministry of Agriculture & Farmers' Welfare (MoA&FW); Central Statistics Offices (CSOs), State departments, Farmer producer organizations (FPO), small and marginal farmers	Long term, ongoing - scaling and institutional uptake
Water allocation shifts strategically away from unsustainable agricultural practices toward economically viable, sustainable uses.	• Support policy analysis and planning for sustainable water allocation • Support efficiency-led transitions in water-intensive agricultural systems	Pan-India	MoJS, MoA&FW, State governments	Medium-term

Table 1 *(continued)*

Expected outcomes (i.e. intermediate outcomes as per the IWMI ToC)	Key activities	Geography	Partners (including intended beneficiary group)	Delivery method & timeline
Decision-making processes in water management explicitly incorporate diverse knowledge systems, cultural values, and stakeholder perspectives.	• Support establishment of participatory platforms and decision-support systems, integrating social and economic data • Support strengthened stakeholder engagement in water investments and planning	Selected states	State governments, Local institutions, CSOs	Long term-Ongoing across strategic roadmap period
Priority 2: Sustainable groundwater management				
Evidence-based assessments of multi-sector trade-offs, sustainability impacts, and groundwater recharge inform water infrastructure planning and resource allocation decisions.	• Generate evidence for sustainable managed aquifer recharge (MAR) and conjunctive use • Apply and adapt modelling tools to support investment prioritization and ex-ante assessment	Selected landscapes and basins	MoJS, State governments, Research partners	Medium-term
Priority 3: Water-Energy-Food (WEF) nexus with a climate lens and solar irrigation				
Water systems contribute to climate mitigation through adoption of low-emission, climate-adaptive technologies and practices.	• Support sustainable and context-specific scaling of solar irrigation and energy-efficient water technologies • Assess mitigation–adaptation trade-offs in water and energy interventions	Pan-India	MoA&FW, Ministry of New and Renewable Energy (MNRE), ICAR, State governments; Small and marginal farmers	Medium-term: pilots and evidence generation Longer-term: scaling
Priority 4: Managing and adapting to climate and water-related risks				
Risks and vulnerabilities to droughts and floods are significantly reduced through proactive adaptation and response strategies.	• Support and strengthen early warning systems and climate risk analytics through scientific analysis, modelling, and decision-support • Support national and state drought and flood mitigation programs through decision-support and advisory services • Support the scaling of drought and flood risk financing and insurance mechanisms	Selected states	ICAR, National Rainfed Area Authority (NRAA), National Disaster Management Authority (NDMA), MoA&FW, State governments; FPOs, Small and marginal farmers	Short-term: diagnostics and pilots Medium-term: scaling and institutional uptake

Table 1 *(continued)*

Expected outcomes (i.e. intermediate outcomes as per the IWMI ToC)	Key activities	Geography	Partners (including intended beneficiary group)	Delivery method & timeline
Future water-related risks are explicitly integrated into local national and regional climate adaptation policies and investment plans, as well as emergency preparedness and humanitarian response strategies.	• Support integration of climate risk information into water, agriculture, and disaster planning processes • Provide policy analysis and advisory support for climate-informed investments	Pan-India; pilot geographies	MoJS, NRAA, NDMA, State governments, Development partners	Ongoing across strategic roadmap period
Priority 5: Agroecology and Nature-based Solutions for water security				
Circular water management practices and innovative non-conventional water technologies are widely adopted, significantly mitigating water scarcity.	• Support evidence generation and scaling of circular and non-conventional water solutions • Co-develop and assess efficient treatment practices and management options • Support institutional capacity strengthening for adoption	Selected basins and states	MoJS, State governments, Urban local bodies	Medium-term
Nature-based Solutions (NbS) are effectively scaled, improving biodiversity, ecosystems, and environmental flows.	• Pilot and support scaling of NbS for water storage, recharge, and ecosystem restoration • Support integration of NbS into basin and landscape planning • Support integrated watershed planning for river rejuvenation and environmental flow management	Selected landscapes, sub-basins and watersheds	Ministry of Rural Development (MoRD), MoJS, State governments, CSOs	Medium-term
Priority 6: Integrated urban water management				
Water pollution is measurably reduced, enhancing human health and ecosystem integrity.	• Generate evidence and decision support for pollution reduction and wastewater management • Support integrated planning for water quality improvement in rivers, lakes, and groundwater	Pan-India	MoJS, State Pollution Control Boards, Urban local bodies	Medium-term: diagnostics and pilots

Table 1 *(continued)*

Expected outcomes (i.e. intermediate outcomes as per the IWMI ToC)	Key activities	Geography	Partners (including intended beneficiary group)	Delivery method & timeline
Priority 7: Water Institutions, Governance, and Gender Equality and Social Inclusion (GESI)				
Youth leadership capacity and meaningful participation in water governance are systematically strengthened.	• Promote youth engagement through innovation challenges, training, and digital platforms • Support youth-led solutions in water management	Pan-India; pilot geographies	CSOs, Academic institutions; Youth groups, State department	Short-term: pilots - ongoing, Medium-term: scaling
Communities affected by fragility, conflict, and migration become more resilient through conflict-sensitive and inclusive water management practices.	• Support strengthening of water-based livelihood resilience in migration-affected areas • Promote inclusive and conflict-sensitive water management approaches	Selected basins and eastern states affected by distress migration	State governments, CSOs, Local institutions; Migrant and vulnerable communities	Limited but ongoing across strategic roadmap period
Water management practices explicitly ensure equitable access and benefits for all community members.	• Promote inclusive water governance and service delivery models • Support mainstreaming of equity considerations in water programs and investments	Selected urban and rural systems	State Governments, Local institutions; Women and marginalized groups	Ongoing across strategic roadmap period
Improved understanding of inequalities in water security informs more equitable water practices.	• Generate evidence on social, gender, and spatial inequalities in water access and outcomes • Support integration of socio-economic data into water planning and decision-support tools	Selected landscapes and basins	Research partners, State governments	Short-term: diagnostics Medium-term: policy uptake
Income, livelihoods, and food security for women, youth, and marginalized groups are enhanced through inclusive water-related interventions.	• Support inclusive livelihood and circular bioeconomy models • Support capacity strengthening and awareness through education and skill-building initiatives	Selected basins	CSOs (BAIF, Professional Assistance for Development Action [PRADAN], others), State governments, Women self-help groups, Youth, Tribal communities	Medium-term-ongoing pilots and scaling

5. Partners and Funders

The International Water Management Institute works closely in India with national and subnational authorities responsible for water resources, agriculture and farmers' welfare, and new and renewable energy (MoJS, MoA&FW, MNRE, MoRD, CWC, Central Ground Water Board [CGWB], National Water Development Agency [NWDA]); global and regional cooperation platforms (International Commission on Irrigation and Drainage [ICID], Food and Agriculture Organization [FAO], South Asian Association for Regional Cooperation [SAARC], International Solar Alliance); international financial institutions: World Bank and ADB; research organizations; and development partners. Key collaborators include government agencies, ICAR and other national research systems, Indian Institutes of Technology (IITs), the Government of India's policy think tank—NITI Aayog—regional bodies, and bilateral and multilateral partners such as SDC, GIZ, ACIAR, and other development actors.

These partnerships take multiple, complementary forms, including joint analytical and diagnostic studies; co-design and implementation of investment and pilot projects; policy advisory support; capacity development and training; and the testing and scaling of innovative technologies for water and agricultural systems. IWMI also supports partners through the development of decision-support tools, evidence-based policy briefs, investment prioritization frameworks, and monitoring and evaluation systems aligned with national priorities and international standards. In addition, IWMI facilitates dialogue platforms that strengthen inter-state, regional, and transboundary cooperation on shared water challenges.

Alongside government and research institutions, IWMI works closely with civil society organizations that have a strong on-ground presence, including the Foundation for Ecological Security (FES), Centre for Microfinance, Central India Initiative (CiNI), BAIF, and Professional Assistance for Development Action (PRADAN). These collaborations help translate research into practice and ensure community-led, inclusive, and context-specific solutions. IWMI also partners with corporate and philanthropic organizations such as Tata Trusts and ITC to support scalable, sustainable interventions that align private sector engagement with public development goals.

IWMI's comparative strength in India lies in its ability to bridge science, policy, and practice. As a globally recognized research-for-development organization, IWMI provides independent, credible, and policy-relevant evidence grounded in advanced water science and field-based research. Its long-standing presence in India enables trusted engagement with national institutions, state governments, and regional partners, while its CGIAR affiliation and global network allow the transfer of international best practices and comparative experience. Through these partnerships, IWMI acts as a neutral knowledge partner and technical integrator, supporting Indian partners in translating complex challenges—such as climate change impacts, groundwater stress, drought risk, solar irrigation, and water productivity—into actionable policies, investments, and scalable solutions.

References

ADB (Asian Development Bank). 2013. *Exploring Public–Private Partnership in the Irrigation and Drainage Sector in India: A Scoping Study.* Manila: Asian Development Bank.

CGWB (Central Ground Water Board). 2025. *National Compilation on Dynamic Ground Water Resources of India*. Ministry of Jal Shakti, Government of India.

CSO (Central Statistics Office). 2018. *EnviStats India 2018: Supplement of Environment Accounts*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

IPCC (Intergovernmental Panel on Climate Change). 2022. Climate Change 2022: Impacts, Adaptation and Vulnerability. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781009325844.

IWMI (International Water Management Institute). 2024. *IWMI Strategy 2024–2030: Research and Innovation for Water Security.* Colombo: IWMI. https://cgspace.cgiar.org/bitstreams/0768d818-3433-4960-950c-92abf5b66bc6/download.

Luck, Matt, Matt Landis, and Francis Gassert. 2015. *Aqueduct Water Stress Projections: Decadal Projections of Water Supply and Demand Using CMIP5 GCMs*. Washington, DC: World Resources Institute.

Ministry of Agriculture and Farmers Welfare. 2023. *Rainfed Farming System*. New Delhi: Government of India. Accessed April 14, 2023. http://agricoop.gov.in/en/RainfedDiv#gsc.tab=0.

Mujumdar, M., Shailza Sharma, and Pradeep Kumar. 2017. "Increasing Frequency and Spatial Extent of Concurrent Meteorological Droughts and Heatwaves in India." *Scientific Reports*. https://doi.org/10.1038/s41598-017-15896-3.

Mukherji, Aditi, Tushaar Shah, and Mark Giordano. 2013. "Water–Energy Nexus in Agriculture: Improving the Linkages between Irrigation and Power in India." IWMI–TATA Water Policy Research Highlight.

NMCG (National Mission for Clean Ganga). 2014. *Status of Sewage Treatment and Faecal Sludge Management in Urban India*. New Delhi: Ministry of Jal Shakti, Government of India.

PIB (Press Information Bureau). 2018. "KUSUM Scheme: Harnessing Solar Power for Rural India." Ministry of New and Renewable Energy, Government of India.

Reddy, K. Srinivas, Manoranjan Kumar, Vegapareddy Maruthi, Umesh Barikar, and C. V. K. Nageswar Rao. 2015. "Dynamics of Well Irrigation Systems and CO_2 Emissions in Different Agroecosystems of South Central India." *Current Science* 108: 2063–70.

Shah, Mihir. 2016. *A 21st Century Institutional Architecture for Water Reforms in India*. New Delhi: Ministry of Water Resources, Government of India.

Shah, Tushaar, Christopher Scott, Avinash Kishore, and Abhishek Sharma. 2004. "Energy–Irrigation Nexus in South Asia: Improving Groundwater Conservation and Power Sector Viability." IWMI–TATA Water Policy Research Highlight No. 3.

Shah, Tushaar, Ship Verma, Neha Durga, Abhishek Rajan, Alankrita Goswami, and Alka Palrecha. 2016. *Har Khet Ko Pani (Water to Every Farm): Rethinking Pradhan Mantri Krishi Sinchai Yojana (PMKSY)*. Gujarat, India: International Water Management Institute (IWMI).

Shah, Tushaar, Shilp Verma, and Paul Pavelic. 2017. *Solar Power as Remunerative Crop (SPaRC): A New Paradigm for Farmer-Managed Solar Irrigation*. Colombo: International Water Management Institute (IWMI).

Sharma, B. R., K. V. Rao, K. P. R. Vittal, Y. S. Ramakrishna, and Upali Amarasinghe. 2010. "Estimating the Potential of Rainfed Agriculture in India: Prospects for Water Productivity Improvements." *Agricultural Water Management* 97: 23–30. https://doi.org/10.1016/j.agwat.2009.08.012.

Sikka, Alok K., Mohammad Faiz Alam, and Vidya Mandave. 2022. "Agricultural Water Management Practices to Improve the Climate Resilience of Irrigated Agriculture in India." *Irrigation and Drainage*. https://doi.org/10.1002/ird.2696.

UN-Habitat. 2024. *World Cities Report 2024: Cities and Climate Action*. Nairobi: United Nations Human Settlements Programme. https://unhabitat.org/sites/default/files/2024/11/wcr2024_-_full_report.pdf.

United Nations (UN). 2024. *World Population Prospects 2024: Summary of Results*. New York: United Nations Department of Economic and Social Affairs, Population Division. https://digitallibrary.un.org/record/4053940?v=pdf.

Verma, Shilp, and Tushaar Shah. 2008. "Co-management of Electricity and Groundwater: An Assessment of Gujarat's Jyotigram Scheme." *Economic and Political Weekly* 43: 59–66.

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The **International Water Management Institute** (IWMI) is an international, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 17 countries and a global network of scientists operating in more than 55 countries.

Vision
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Research and innovation in partnerships for collective action that advance the transformation of water systems for sustainable, just and climate resilient development.

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