Water challenges in India: seeking solutions with an integrated approach

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Rapidly expanding population and extensive urbanization have led to the demand for water growing swiftly from agriculture, energy, industry and domestic sectors. Other reasons such as, depletion of water sources, water pollution, inefficient usage, poor management of water supply systems and multiple institutional arrangements make the situation more complicated. System losses due to poor operation and maintenance, inaccurate metering, unbilled consumption, illegal tapping, etc. further add to unaccountable losses. Therefore, water resources need to be managed at numerous levels, with the involvement of numerous stakeholders and professionals from diverse disciplines.

Access to safe and clean drinking water is one of greatest challenges that India is facing. According to the Falkenmark water stress index, out of the 22 major river basins in India, 4 are water-stressed, 11 are water-scarce and 4 others face absolute water scarcity. Among the 5,842 administrative units assessed for groundwater availability in India, 802 units are over-exploited, 169 critical and 523 semi-critical[1]. Around 60% of all districts have issues related to either availability and/or quality of ground water[2].

Water is defined as safe, if it is free from biological contamination and within permissible limits of chemical contamination as per IS-10500 standard of BIS, 2012. According to the Central Ground Water Board[1], several states are inflicted with groundwater contamination mainly due to arsenic, fluoride, nitrate and iron. According to the 2011 census, only 49% of households have piped water supply within their premises, the urban–rural distribution being 70.6% and 30.8% respectively. Disparity is also evident among communities, based on their vulnerability in the society. Twenty per cent of dalits do not have access to safe drinking water and 48.4% of dalit villages are denied access to a water source[3]. Moreover, there is lack of a comprehensive database due to multiple institutions addressing different aspects of water independently. The lack of coordination among various institutions, leads to inefficient data management and ineffective policy formulation. This calls for the need to conduct inter/multidisciplinary research with inter-institutional and multi-stakeholder approaches, in order to arrive at sustainable solutions.

India has a diverse population, varied conditions with multiple priorities and needs which make the task of finding solutions to challenges in the water sector difficult. Therefore, the regional dimension of water-related issues is important in the Indian context, as they are extremely heterogeneous in terms of their water usage and requirements, as well as the policy, governance and institutional structures that govern them.

Drinking water is the basic right of every individual. An evident disparity in the level of public awareness, socio-economic status, occupation, education, social practices and rituals add to the complexity of meeting the need of safe and adequate drinking water for all.

The water-sector has seen increasing interventions by state and non-state actors because of growing perceptions surrounding water scarcity. Some of the characteristics of an ideal technological intervention are practicability, cost effectiveness, sustainability and up-scalability of technology. But often these interventions and their wider social ramifications are not studied adequately. Water-related interventions and studies of their impacts often come with specific disciplinary orientations, whereas water being a fluid social resource needs the integration of perspectives and methodologies of the social sciences and the sciences on the one hand and the integration of the technical with civil society approaches on the other.

The public agencies responsible for taking water-related decisions tend to take these on their own without consulting stakeholders, often leading to poor and unreliable service characterized by inequities of various kinds[4]. Innovation and transfer of technologies are often insufficient to solve community-related problems. It is therefore imperative that people's perspectives are engaged in all processes to develop appropriate solutions. Multi/interdisciplinary and multi-stakeholder approaches therefore ensure that the solutions are appropriate, acceptable, viable and sustainable.

Planning, development and management of water resources should be governed by a common integrated perspective taking into consideration local, regional, state and national context, being environmentally sound, and keeping in view the human, social and economic needs[4]. The policy should be managed in a decentralized way and in partnership between communities and the state governments concerned. Thus each state requires its own state-specific water policy[5].

Decentralization has been an important factor in enhancing the effectiveness of any region-specific intervention. Local specific issues are tackled best through these partnerships, as professionals and stakeholders representing the zone have a greater understanding of geographical constraints, socio-economic, political and cultural situation as well as public opinion. It is in this regard, that zonal water partnerships (ZWPs) have been established by the NIAS water programme in six different zones of the country: the North, South, East, West, Jammu and Kashmir and the Northeast.

In the same context a pan-India DST supported research project on 'Social and technological solutions for major water challenges facing India' was initiated. The study adopts a multi/interdisciplinary and multi-stakeholder perspectives integrating science and technology, social sciences and the civil society approaches for various prioritized issues identified at zonal levels.

The objectives of the project are: Carry out field based research on existing technical and social interventions and suggest solutions based on in-depth assessments; Develop innovative research methodologies with a multi/interdisciplinary perspective; Organize multi-stakeholder consultations to facilitate informed debate for policy.

Local specific issues related to drinking water were addressed in a decentralized

manner with the help of partners drawn from the respective ZWPs. Thus an integrated approach to water resource management through the development of ZWPs across the country would enrich the coherent water resource development and management plans.

Striving for inclusiveness, transparency, accountability and gender sensitivity are the core values of zonal partners. The ZWPs bring about meaningful dialogue among people with different interests and are therefore likely to change the perspective of dealing with water-related issues.

The water issues in each zone were prioritized through multi-stakeholder consultations and research carried out by interdisciplinary teams comprising of scientists/technologists, social scientists and civil society representatives. Intensive field work was undertaken to collect data regarding the effectiveness of existing technologies and the social mechanisms for water-issues. The region-specific issues are – North: Drinking water security in arid and semi-arid areas of Rajasthan; South: Disappearing water bodies of Hyderabad city: social and technological options for drinking water supply; East: Community-based technological solutions for providing safe drinking water to arsenic exposed population of Ganga–Meghna–Bramhaputra plains; West: Quenching the thirst of tribal communities in the Central Indian forest heartlands; Northeast: Socio-technological study on safe drinking water in hill and valley areas of Manipur and Assam; Jammu and Kashmir: Drinking water supply in sub-zero temperature.

The projects at various zones which have approached conclusion were aimed at achieving goals of utmost importance to the respective zones.

The north zone provided a critical review of policies and programmes concerned with rural drinking water supply in the arid and semi-arid areas of Rajasthan. The existing traditional best practices were documented by amalgamating the traditional and modern technologies and practices and a well knit community-based integrated water management system was evolved.

The south aimed at designing of policies, programmes and action plans to stop the destruction of water bodies in Hyderabad and identifying strategies for rehabilitation of urban water bodies. It identified technical and institutional mechanisms for rejuvenation of water bodies and propagated the same through advocacy and public action.

The contamination of ground water with arsenic is the prime focus in the east zone. It aimed at monitoring the removal of arsenic from water with the help of phytoremediation and microbial remediation within constructed wetland. Design manuals were developed for the removal of arsenic by vermi-filtration technology processes. These methods were tested for their efficiency and piloted as a community-based technological solution for arsenic contamination.

The west zone focused mainly on the preparation of a framework for integrated drinking water supply plan through a participatory approach in the districts of Maharashtra, Madhya Pradesh and Andhra Pradesh. An assessment of traditional and new technological options has helped identify the best available technique through scientific validation.

The northeast facilitated the invention/adoption of innovative technologies by participation of local communities in Manipur in order to solve their water-related issues. In Assam, the primary objective was to identify, evaluate and assess community-based low cost technological solutions for providing clean and safe drinking water for the populations exposed to arsenic contamination.

Jammu and Kashmir aimed at identification of problems of frozen pipes that affect the supply of drinking water during sub-zero temperatures. An assessment of conventional/traditional systems and usage of latest technologies, for their viability, acceptability and sustainability was also carried out.

The research project provides possible real life social and technological solutions based on in-depth assessments of interventions in the water sector already made in terms of their impact, sustainability and

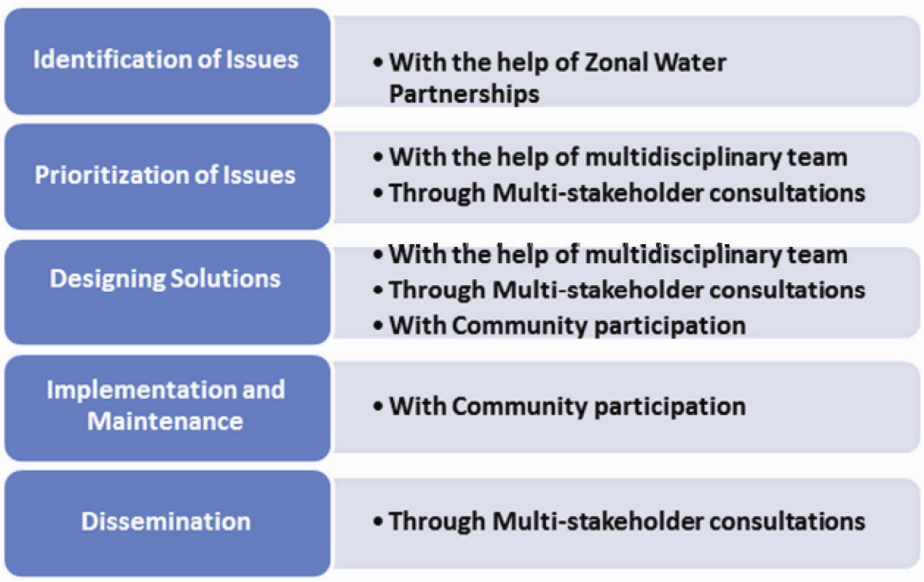

Figure 1. Diagram illustrating the stages of methodology adopted.

scalability. The research has specifically addressed solutions that are technologically feasible, socially acceptable, economically viable and up-scalable. In order to achieve the above mentioned objectives, a comprehensive, multidisciplinary and interdisciplinary research methodology was evolved. A schematic illustration of the methodology adopted has been provided as Figure 1.

The major highlights of the methodology adopted for the socio-technological solutions addressed in the study are: (i) identification of issue/s of specific concern which were prioritized in consultation with the stakeholders; (ii) assessment of the impact of already existing interventions; (iii) understanding the factors that lead to the success or failure of interventions; (iv) learning the role of such factors in replacing obsolete technologies; (v) recommending sustainable technological and social solution options to challenges in the water sector, and (vi) water management in a decentralized manner.

The ZWPs were established in six zones to address the diverse water challenges in the country with the help of a methodology that integrates various disciplines and stakeholders through a process of decentralization and consultation.

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5. National Water Mission, State Specific Action Plan, Ministry of Water Resources, River Development and Ganga Rejuvenation, GoI; http://www.nationalwatermission.gov.in/?q=node/76 (accessed on 13 March 2017).

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