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Editorial

India houses 18 percent of the world's population but only 4 percent share in water resources of the earth. On an average out of total precipitation that is 4000 billion cubic metres (BCM) about 1900 BCM water remains available as natural runoff. However, due to geological and other factors, the utilisable water availability is limited only to 1137 BCM. Most of the rain falling on the surface runs off rapidly, leaving very little for the recharge of groundwater. This has become starker with erratic monsoons owing to climate change.

According to NITI Ayog, a large number of Indians face high to extreme water stress. So, water has become a commodity as precious as gold in summers for people in India. While the Government of India is consistently working towards improving access to water, participation of local people and institutions is also the need of the hour. Considering the stern need of awareness regarding water resource management, the theme of this special issue of *Kurukshetra* is *Water Resources*.

Since India is an agrarian economy, a large fraction of our water is consumed in irrigation. Our lead article *Equitable Water Resource Management* states that around 91 percent of our water is used in agriculture sector for irrigation. More than 60 percent of this agricultural demand is met from groundwater, leading to a severe decline in groundwater levels. Therefore, water management in agriculture is very important. The article *Water Management in Agriculture* tells us about the importance of water management at source and participatory Irrigation Management for avoiding over-consumption of water, increasing productivity of crops and for sustainable employment of local people.

There is a huge pressure on us to conserve our water resources and this can be done by making use of all the wonderful water conservation knowledge employed by our forefathers since millennia. India has a rich tradition of water harvesting systems, details of many such systems belonging to different regions of the country are given in the article *Traditional Knowledge in Water Conservation*.

The worst sufferer of this water-crisis is women. Fetching water in rural areas from long distances is considered as women's duty from centuries. Realising this, the article *Role of Women in Water Conservation* tags Jal Jeevan Mission as a blessing for women, as the objective of this mission is to provide Functional Household Tap Connections (FHTCs) to every rural household. Along with this the Jal Jeevan Mission has placed an emphasis on including women as decision-makers on water management, a role traditionally that has been denied to them.

Lastly, apart from creating new sources of water, keeping the existing water bodies clean and not polluting them is equally essential. For this it is necessary that we understand that nature-based solutions and pro-environmental behaviour along with necessary technological interventions and innovations are required to save our precious water resources.

We would like to inform our readers that from this issue we are introducing a new logo of the journal reflecting the growth in rural development. The logo was selected through a competition on MyGov and we congratulate the winner for designing it.

We wish our readers a happy reading. Stay safe.

Equitable Water Resources Management

Avinash Mishra
Arunlal K.

Though India has about 1999 Billion Cubic Meters (BCM) of annual water availability, its distribution is grossly unequal across the river basins and thus leads to water-stress in many regions in the country. Given the limited storage capacity and complexities of inter-basin transfers, it becomes imperative to improve the efficiency in conveyance and use of water to ensure equitable access to everyone. Technological infusion in the water sector needs to be improved to address the rising stress due to population growth, rapid urbanisation and climate change impacts. Community driven model of water management with people-centric approach is the need of the hour to compliment the efforts of the Government in reducing the wastage and improving productivity of water in all sectors.

United Nations (UN) General Assembly resolution adopted in July 2010, explicitly recognises the human right to water and sanitation and also calls upon international co-operation to help countries, particularly developing countries, to provide safe, clean, accessible, and affordable drinking water and sanitation for all. According to World Health Organisation (WHO), a person requires a minimum of 50 litres of water per day to meet the most basic needs and the water source has to be within 1 km of the home with collection time not exceeding 30 minutes. It is estimated that globally, 2.3 billion people live in water-stressed countries and about 2.0 billion people lack access to safe drinking water[1]. In India, analysis done by Central Ground Water Board on groundwater availability and utilisation reveals that annual extraction in 16 percent of the total assessed area is more than the annual recharge quantity, and that in 4 percent of assessed area is 90 – 100 percent of annual recharge. Blessed by nature, every year on an average, India receives nearly 4000 billion cubic metres (BCM) of water through rainfall of which about 1999 BCM form available water in rivers, lakes, reservoir, groundwater and glaciers. However the distribution of this quantity is not uniform across the country, whereas some river basins are acutely drought prone, some other basins are frequently devastated by flood.

[1]The Sustainable Development Goal Report 2021, United Nations

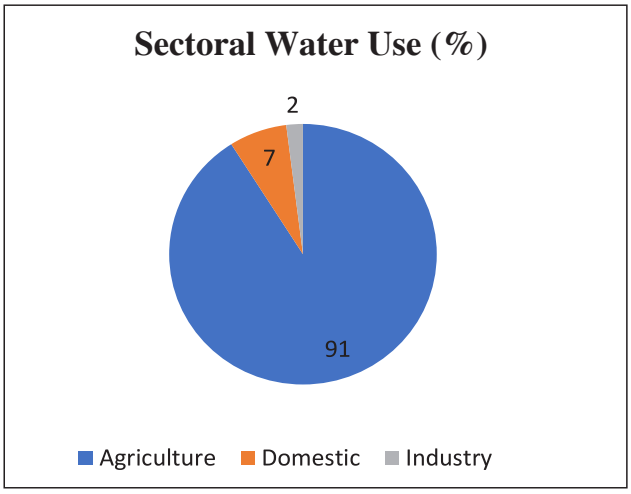
For example, Brahmaputra and Barak basins, the most flood prone basins, which have annual average water availability of 614 BCM drains its major share into Bay of Bengal. At the same time, basins like Cauvery and East Flowing Rivers (EFR) between Pennar and Kanyakumari are facing water deficiency.

To address these spatial and temporal disparities, the available water should either be stored in reservoirs or be transferred from surplus basins to deficit ones. However, both these options aren't easily implementable owing to certain inherent limitations. As of now, our surface water storage is just below 260 BCM and may go up to 300 BCM when the ongoing projects are completed[2]. Taking up new and large storage projects often take long gestation period due to the time required to manage environmental aspects, resettlement and rehabilitation processes, investigation processes, and other issues arising in the implementation stages. Moreover, a significant quantity of the reservoir storage capacity is lost through siltation which reduces the effective potential of the projects. The concept of inter-basin transfer was formalised in the year of 1980 under National Perspective Plan (NPP). This was deliberated at various platforms, detailed investigations and negotiations on inter-state aspects were carried out, and eventually the first inter-linking project of Ken-Betwa has all set to begin, after 40 years since NPP was presented. Considering the complexities of inter-basin transfers involving multiple stakeholders and the extent of research and investigation required, the time lag is justifiable. So, the most viable and practical option is to manage and utilise the available water resources efficiently and judiciously. Demand on water resources is pre-dominantly divided among irrigation, domestic and industrial uses. Among these sectors about 91 percent of the water is consumed for irrigation purpose in India, while the figure is in between 30 - 70 percent in many other countries.

Agriculture Sector

Consequent to partition of the country in 1947 food problem for India worsened as large parts of the highly developed canal irrigated areas were included in Western Pakistan. Thus, it became inevitable for India to utilise its water resources to the fullest extent practicable and the five-year plans gave prominence to irrigation sector. Significant numbers of major and medium irrigation projects have been setup across the country as a result of the due importance given in the five-year plans. The annual outlay in Major and Medium Irrigation (MMI) sector grew to Rs 1,65,000 crores in Eleventh plan (2007-12) from Rs 376 crores in the first plan (1951-56). While there were only about 380 large dams by 1950, the 50 year period between 1950 and 2000 witnessed completion of 3,900 large dams in the country.

In spite of the large thrust given and consumption of 91 percent of total available water for irrigation, only 68 million hectares out of the net sown area of about 140 million



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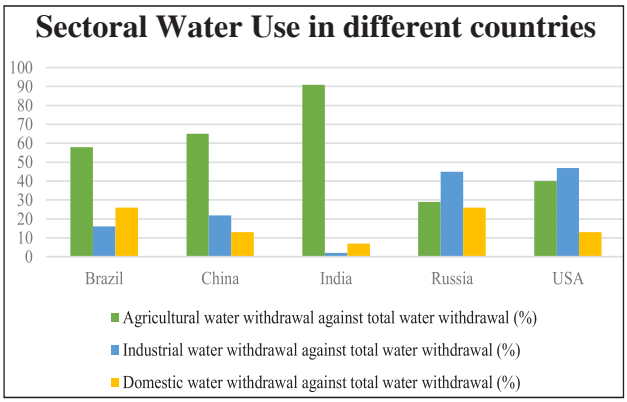

Source: FAO Aquastat

[2]Water Resources at a glance 2021, Central Water Commission, Govt. of India

hectares are covered under irrigation and the rest is rainfed. Out of the total irrigated area of 68 million hectares, 31 million hectares is under rice and sugar cane, the top two water consuming crops, and 28 million hectares under wheat[3]. Over consumption of water in agriculture sector is mainly due to the conveyance loss during distribution through canals, flood irrigation of farm fields, cultivation of crops without regard to the agro-climatic conditions (For example, dominance of high-water consumption crops even in arid zones), misconception among farmers that more water brings more yield, unplanned and untimed irrigation schedule, and poor quality of irrigation water. Further, although the conjunctive use of surface water and groundwater was strongly advocated by the government since the inception of irrigation schemes in the country, it has not been practiced judiciously even in the water scarce areas. This is where the need of adopting and promoting efficient irrigation methods like micro-irrigation becomes vital. A study conducted by the Department of Agriculture Cooperation and Farmers Welfare to assess the impact of micro-irrigation revealed that irrigation cost gets reduced by 20-50 percent with average of 32.3 percent, energy consumption reduced by 31 percent, average productivity of fruits and vegetables increased by at least 40 percent, saving of fertilizers is increased by 7- 42 percent and average rise in farmers' income by 48.5 percent.

As on today, only 14.5 million hectares are covered under micro-irrigation of which 6.7 million hectares were added in the last 7 years as a result of the huge push offered under PMKSY-Per Drop More Crop scheme of Government of India since 2015. Along with the efforts of improving micro-irrigation coverage, India needs a paradigm shift from its cultivation from rice and sugarcane to millets which are nutritious and water-efficient. UN General Assembly has adopted the idea proposed by Government of India to declare 2023 as International Year of Millets, and the idea was also endorsed by members of Governing Bodies—Food and Agricultural Organisation (FAO). Promotion of millets is expected to save at least 20 percent water in agriculture sector, in addition to its contribution for food security and nutrition.

Table: Year-wise Addition of Micro-Irrigation Since 2015

Year	Area under micro-irrigation (in lakh ha)	Cumulative (in lakh ha)
As on 31.03.2015	-	77.75
2015-16	5.51	83.26
2016-17	8.40	91.66
2017-18	10.49	102.15
2018-19	11.58	113.73
2019-20	11.74	125.47
2020-21	9.37	134.84
2021-22	10.15	144.99

Source: Agriculture Statistics-2015 and Agricoop-Dashboard (agrionline.nic.in)

Drinking Water and Sanitation

The Sustainable Development Goal (SDG) target 6.1 aims universal and equitable access to safe and affordable drinking water for all by 2030. It is estimated that India's domestic water sector consumes about 7 percent of total water consumed annually. As per the Central Public Health and Environmental Engineering Organisation (CPHEEO) standards, 135 litres of water is considered sufficient to meet the needs for a person in a day in town areas and this may go up to 200 litres per person per day in Metropolitan cities. Given these facts, less than 70 BCM of water must have been more than enough to cater the domestic needs of all 1.35 billion people of the country. But in reality, there are many areas in the country where safe drinking water is not available in enough amount. So, it is evident that the resource is over used by a few, lost by leakages and theft, and distributed in a grossly inequitable manner.

Impact of Climate Change

Water cycle is undergoing drastic changes due to climate change and is driving more intense rainfall and flooding in certain areas, whereas certain other areas, generally further away from coasts, are facing intense droughts. India Meteorological Department's analysis of rainfall

[3]Agriculture Statistics 2020, Dept. of Agriculture, Cooperation and Farmers Welfare.

data for the period 1971-2020 shows that the long period average (LPA) of south west monsoon declined by 1 cm and that of annual rainfall 1.7 cm, as compared to the 1961-2010 average. Shortage of 1 cm rainfall across the country means reduction of about 25 BCM to 30 BCM from the annually expected water availability which is equal to the quantum of water required to meet annual domestic water demand of 600 million people with 135 litres per day.

Groundwater

Groundwater led irrigation was instrumental in the success of the Green Revolution in India from the 1960s. However, it has become apparent that gains in irrigated agricultural production have progressively led to a significant decline in groundwater levels in parts of the country, particularly in north-western and peninsular southern India. More than 60 percent of the agricultural water demand is met from groundwater with 2.6 million deep tube wells, 9.1 million shallow tube wells and 8.8 million dug wells. The increased ground water extraction may even lead to salt water intrusion in coastal aquifer which is a permanent damage to the water quality. Further, as the depth of groundwater falls more energy is consumed to pump water resulting in higher cost of irrigation and a raised cost of cultivation.

Socio-economic Disparities

As the resource depletes, affordability and accessibility will be extremely challenging and this will widen the inequity existing in water sector. Accessibility to water predominantly comprises of physical accessibility and economic accessibility, and the poor and marginalised get affected the most when the pressure on the resource soars. In most of the households due to not having water supply on the premises, women and girl children are often burdened with the responsibility of fetching water from far or collecting water from tankers. The time spent and the associated hassles leave them with no time for quality education, independent income generation and other social engagements. This eventually leads to the widening of already existing inequalities in all other sectors including health and education. Lives of low-income population will be impacted with a rise in lack of access to basic hygiene, migration for water and exposure to water-borne diseases.

Government of India, through its two flagship schemes, Swachh Bharat Mission (SBM) and Jal Jeevan Mission (JJM) tackled this disparity to a great extent and could bring in equitable access of water and sanitation. Successful implementation of SBM ensured access to sanitation facilities to all. The Jal Jeevan Mission (JJM) which aims to ensure Functional Household Tap Connections (FHTC) to all rural households by 2024, has at present achieved about 51 percent coverage[4].

Need of Technology Infusion

Technology penetration in water sector is low as compared to other social sectors such as health and education. Stress on water resources keeps on increasing as population increases, rate of urbanisation soars, and climate change causes extreme weather events, and thus it becomes imperative to augment the human efforts with the aid of technology. This could be in the form of automation of canal operation, real-time assessment of irrigation requirement with the help of Artificial Intelligence (AI), modern and water saving irrigation methods, automated leak detection in drinking water pipelines, cost-effective wastewater treatment, on-the-spot water quality testing, and zero-liquid discharge power plants. Operation of most of the major and medium irrigation projects involves significant amount of human interventions and manual calculations based on static data, which often causes losses which are avoidable. For example, water distribution schedule of irrigation projects is governed by historical rainfall data, records of soil data, and cropping patterns followed in last few years. A dynamic irrigation schedule that takes into account actual rainfall, soil moisture, and seasonal change in cropping pattern is nearly impossible with manual calculation and operation, but can be easily achieved by an AI system. Saving of 10 percent water in agriculture sector through technological intervention means creation of additional availability of about 60 BCM to 70 BCM for direct use in domestic sector.

[4]Jal Jeevan Mission Dashboard, https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx

As far as the drinking water sector is concerned, capital expenditure on treatment infrastructure, cost of water treatment, operation and maintenance expenditure of distribution pipelines adds value to the drinking water much more than the raw water used for irrigation. It is also important to note that the drinking water is considered as wastewater/used-water immediately after it leaks out from tap or distribution pipeline. This means, though the total quantity of drinking water is only about one tenth of irrigation water, the economic loss of leakage and theft from drinking water supply line is much more than that from irrigation canals.

Government Initiatives

Government of India have adopted various measures to improve water use efficiency in agricultural sector in the country. Per Drop More Crop (PDMC) component under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) mainly focuses on improving water use efficiency at farm level through micro-irrigation and better on-farm water management practices to optimise the use of available water resources. State governments have also launched initiatives aimed at optimising water demand for agriculture. Examples are, ban on early sowing of paddy by Haryana and Punjab; 'Jal Hi Jeevan Hai' Scheme by Haryana to incentivise growing of less water intensive crops; and mandatory use of drip irrigation for sugarcane cultivation by Maharashtra Government. In addition to this, the Government also conducts mass awareness and public outreach programmes. Best practices for water conservation and enhancing water use efficiency are rewarded through institution of 'National Water Awards'[5]. Further, the National Water Mission, Ministry of Jal Shakti has launched 'Sahi Fasal' campaign in November 2019 to nudge farmers in the water-stressed areas to grow crops which are not water intensive, but use water very efficiently; and are economically remunerative; are healthy and nutritious; suited to the agro-climatic-hydro characteristics of the area; and are environmentally friendly[6].

Fifteenth Finance Commission has categorically stated in its report that States need to develop long-term drought mitigation plans and these plans need to include measures for improvements in surface and groundwater management and promotion of efficiency of water use. The Commission also recommended incentive-based grants to States that maintain and augment groundwater stock and put a check on any fall in the water table based on the fact that net effect of measures of rationalisation of water use can be captured from changes in the groundwater table. As per the criterion, performance incentive for sustainable water use for the State will be reduced by the percentage equal to *the share of wells which showed decline in water table in pre-monsoon compared to mean level of previous decade.*

Way Forward

As we go forward, the society as a whole, not just limited to the Government or other major stakeholders, should be more conscious towards productivity of water. There should be a pro-active introspection from farmers and civil society organisations on how the subsidised power and less priced water leads to inefficient use of the precious and scarce natural resource. The price recovery should be such that it makes the system self-sufficient to meet its regular operation and maintenance expenses. Civic sense should prevail among citizens that the water we waste, misuse or overuse make the under-privileged and their children to lead a water-stressed life. The water use principles should uphold the spirit of inclusiveness and ensure that *"No one is left behind"* as envisaged in the Sustainable Development Goals (SDGs). Water is best managed at community level and hence the people-centric model of water management, which reflects the Hon'ble Prime Minister's vision of Collective Efforts, Inclusive Growth *(Sabka Saath, Sabka Vikas)*, should be the future for India's water management.

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[5]Report of Parliamentary Standing Committee 2019-20, 7thLokSabha, First Report, December 2019
[6]Report of Parliamentary Standing Committee 2020-21, 7thLokSabha, Sixth Report, February 2021

Jal Shakti Abhiyan : Catch the Rain

A National Call to Action on Water Conservation and Recharge

Suneel Kumar Arora

Jal Shakti Abhiyan: Catch the Rain (JSA:CTR) campaign with the theme "Catch the Rain, where it falls, when it falls" was launched by Hon'ble Prime Minister Shri Narendra Modi on 22 March 2021, the World Water Day. This was a time-bound, mission mode water conservation campaign. Beyond the numbers, the campaign created a strong environment for bringing together all stakeholders working on water recharge and management. Many States did more than that was originally planned. Some states extended the campaign to all their districts, going beyond the water stressed districts that were selected initially.

Creating water secure communities is at the heart of Government of India's efforts in the water sector. We have great challenges; India is home to 18 percent of the world's population but we have just 4 percent of the fresh water resources of the world. This availability is also variable and dependant on the rains. Climate change, which is manifesting itself through changes in the water cycle, also threatens our water security.

Jal Shakti Abhiyan 2019

To address this problem, the Government of India, inspired by the Hon'ble Prime Minister's impetus on water conservation, launched the Jal Shakti Abhiyan (JSA) in 2019. This was a time-bound, mission mode water conservation campaign, implemented in the July - November 2019 period in 1,592 blocks of 256 water-stressed districts of the country. These blocks fell under the critical or over-exploited groundwater category, where groundwater was being extracted faster than it could be replenished.

JSA was a collaborative effort of various ministries of the Government of India and state governments, coordinated by the Department of Drinking Water and Sanitation, Ministry of Jal Shakti. During the campaign, officers, groundwater experts and scientists from the Government of India worked together with the States and district officials in India's most water-stressed districts for water conservation and water resource management by focusing on accelerated implementation of five targeted interventions. The JSA aimed at making water conservation a *jan andolan* through extensive communication and involvement of communities.

JSA focused on five aspects: *water conservation and rainwater harvesting, renovation of traditional and other water bodies, reuse of water and recharging of structures, watershed development, and intensive afforestation*. Besides, the special interventions included development of Block and District Water Conservation Plans, Krishi Vigyan Kendra Melas, Urban Waste Water Reuse, Scientists and IITs, and 3D Contour Mapping of all villages.

The combined efforts of all stakeholders achieved the creation of 2.73 lakh water conservation and rainwater harvesting structures, renovation of 45,000 water bodies/ tanks, creation of 1.43 lakh reuse and recharge structures, 1.59 lakh watershed development related works, 12.36 crore trees planted and preparation of 1372 block water conservation plans. Beyond these numbers, the campaign created a strong environment for bringing together all stakeholders working on water recharge and management. Many States did more than that was originally planned. Some states extended the campaign to all their districts, going beyond the water-stressed districts that were selected initially.

Jal Shakti Abhiyan: Catch the Rain 2021

Encouraged by this, the "Jal Shakti Abhiyan: Catch The Rain" (JSA:CTR) campaign with the theme ***"Catch the Rain, where it falls, when it falls"*** was launched by Hon'ble Prime Minister, Shri Narendra Modi on 22 March 2021, World Water Day.

Jal Shakti Abhiyan : Catch The Rain campaign, taken up in all 734 districts (7213 rural blocks and all urban areas) of the country during the pre-monsoon and monsoon period, i.e from March 2021 to 30 November 2021, was to *"nudge the states and stakeholders to create and maintain appropriate Rain Water Conservation Structures, suitable to the soil strata and climatic conditions of the area, with people's participation, before the onset of monsoons so that they are ready to catch the rain, where it falls, when it falls''.*

This unique campaign – by converging funds for all water conservation related schemes (MGNREGS, AMRUT, CAMPA Funds, etc) of central and state governments, funds mobilised locally and from corporate sectors – aimed to create and maintain RWHS with total participation of people. The campaign implemented by National Water Mission (NWM), had the following five focused interventions.

(a) Rainwater harvesting and water conservation

(b) Enumerating, geo-tagging and making inventory of all water bodies; preparation of scientific plans for water conservation

(c) Setting up Jal Shakti Kendras in all districts

(d) Intensive afforestation and

(e) Awareness generation

a. Water conservation and rainwater harvesting included renovation of traditional and other water bodies/ tanks; recharge using old bore wells; watershed development. Activities taken up under this included roof-top RWHS on all buildings- with priority for government buildings, water harvesting pits in all compounds, maintenance of old/ building of new check dams/ponds, removal of encroachments of tanks/lakes, de-silting of tanks to increase their storage capacity, removal of obstructions in their channels, repairs to traditional step-wells and other RWHS, use defunct bores/unused wells to recharge aquifers, rejuvenation of small rivers and rivulets, revival of wetlands and protection of flood-banks. These works are taken up in rural areas from funds under MGNREGS or Finance Commission grants or locally mobilised; in urban areas from AMRUT and its own funds and in forest areas with CAMPA funds.

b. Every district was to enumerate all existing water-bodies/Water Harvesting Structures (WHS) based on old revenue records and using remote sensing images from National Remote Sensing Agency (NRSA) and GIS mapping technology and using the data to plan scientifically new WHS. NWM had prepared guidelines for preparation of GIS based water conservation plans and inventory of water bodies of districts and forwarded it to all the districts for its implementation.

c. State Governments were to set up 'Jal Shakti Kendras' (JSKs) in all district HQs. These JSKs are to act as resource or 'knowledge centers' for disseminating information related to water, techniques for water conservation and water saving and also provide technical guidance to local people as well as to the district administration.

d. Afforestation drive taken up to plant saplings to increase green cover.

e. Awareness generation to be taken-up to make *Jal Andolan* a *Jan Adolan*.

Development of portal

National Water Mission, with the help of NIC, developed a portal (http://jsactr.mowr.gov.in/) for monitoring the progress of the campaign. The portal showcases the campaign's progress in interventions: a) water conservation and rainwater harvesting; b) renovation of traditional and other water bodies/ tanks; c) reuse/recharge structures; d) watershed development e) intensive afforestation; f) enumeration of water bodies and scientific planning

Capacity and Awareness Building: It is a major part the campaign. Nehru Yuva Kendra Sangathan (NYKS) and its youth clubs have engaged over 2.90 crore people in the campaign through their activities like rallies, *Jal Choupals*, quizzes, debates, slogan writing competitions, wall writings etc. NWM has conducted 150+ webinars on the subject to build awareness and capacities of various stakeholders and NGOs/ INGOs. It has engaged with many universities and premier education institutions like IIM, IITs, etc. to focus on the urban areas, a meeting with all State Principal Secretaries (Urban Development), Mission Directors of Smart City projects and Municipal Commissioners of all cities with 5 lakh+ populations was held.

IEC Materials: NWM got information, education and communication (IEC) materials developed in regional languages on water harvesting and conservation by professional agencies and uploaded in the official website of NWM for the use of stakeholders. These included slogans for wall writings, social media posting, e-posters, scripts for *Nukkad Nataks,* topics for debates and essay writings, quiz questions, etc. The link was also shared in webinars/meetings to maximise its outreach.

Collaboration with Nehru Yuva Kendra Sangathan (NYKS): NWM has collaborated with NYKS, Department of Youth Affairs to spread awareness on JSA:CTR campaign. NYKS helped in generating awareness on JSA:CTR campaign in 623 districts of the country.

Major outcomes of JSA:CTR campaign - 2021

Since the launch on 22 March 2021, till 28 March 2022, both urban and rural areas put together, 46,76,852 water related works are completed/on-going (10,69,649 water conservation and rainwater harvesting structures have been completed while 5,58,028 works are on-going thus totaling to 16,27,677 WHS; 1,79,950 traditional water bodies have been renovated while 1,17,716 works are on-going; 8,32,596 reuse and recharge structures were created/ getting made; 19,18,913 watershed development activities have been undertaken/going-on); in addition to 36,76,60,580 afforestation activities carried out under the campaign. The expenditure under MNREGS alone is Rs 65,666 crores. As per information on the portal, 374 Jal Shakti Kendras were set up in various States/UTs.

As reported by the Ministry of Rural Development, more than 2.03 lakh GPs out of the 2.69 lakh GPs have prepared water conservation plans. 15.32 lakh water bodies have been enumerated with its details like its latitude and longitude, ownership, state of health, photos, etc under the campaign. Over 16.67 lakh photos on the activities undertaken/works done under the campaign have been uploaded on the portal.

Reduction in water run-off and rise in water table across the country due to successful implementation of the "Catch the Rain" campaign is acknowledged by those who monitor it for their cause.

Jal Shakti Abhiyan: Catch the Rain 2022

Building on the success of the Jal Shakti Abhiyans of 2019 and 2021 in generating awareness amongst the citizens of the country, this year 'Jal Shakti Abhiyan: Catch The Rain-2022' (JSA:CTR-2022) campaign was launched by Hon'ble President of India on 29.03.2022. JSA:CTR-2022 is being taken up in all districts (rural as well as urban areas) of the country with the main theme *Catch the Rain, where it falls, when it falls*. The campaign is being implemented from 29 March 2022 to 30 November, 2022 - the pre-monsoon and monsoon period in the country. Under this campaign activities are also undertaken under the following new interventions in the campaign in addition to the activities considered under interventions of JSA: CTR-2021:

(a) Spring Shed Development and Management

(b) Wetland Development and Management

(c) Catchment area protection and development

Amrit Sarovars

India is celebrating the Azadi ka Amrit Mahotsav, marking 75 years of Independence. It has been decided that, in order to commemorate this momentous occasion, 75 water bodies will be created or rejuvenated in every district. These will be called Amrit Sarovars. The creation/rejuvenation of the Amrit Sarovars will be a special effort under JSA-CTR 2022.

As a part of this exercise, district authorities have been requested to –

(i) Identify possible sites for the creation of new water bodies. This may be done by using contour maps of the District, identifying available lands that are already in the possession of the Government. The exercise may also include afforestation/ tree planting around water bodies and its catchment area.

(ii) In case of rejuvenation of existing water bodies, there are detailed guidelines that have been issued by the National Water Mission. Rejuvenation may include cleaning/ de-silting, removal of encroachments, ensuring that the channels for water flow are clear and treatment of the catchment area, if required. It may also include actions to improve water quality, if required. This exercise has to be completed within this Financial Year.

Resources for this activity will be available both from MGNREGA and PMKSY funding and these resources may be accessed. In addition, the broad guidelines issued under the Jal Shakti Abhiyan will apply.

Visit of Central Team to the Districts

This year it is proposed to send a Central Team consisting of one Central Nodal Officer (CNO) and one Technical Officer for one field visit to the districts during the campaign for interaction with district authorities on Jal Shakti Abhiyan.

They will observe the progress of ongoing and completed works in the districts on water conservation related structures, spring shed development (wherever applicable), Intensive afforestation, reuse and recharge structures, renovation of traditional bodies, rejuvenation of rivers/ rivulets and wet-land protection (wherever applicable) and other interventions of JSA: CTR-2022. CNOs will monitor the progress on 'Amrit Sarovar' also in the districts assigned to them. **Together we can make this a *Jan Andolan* from *Jal Andolan*!!**

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Traditional Knowledge in Water Conservation

Yugal Joshi

There is huge pressure to conserve the water, keeping it clean, and to protect, harness, improvise and sustain all that wonderful water conservation knowledge employed by our forefathers since millennia. An integrated approach taking into account the long-term sustainability, starting from the planning stage where looking at every water-body along with its catchment, is required. Unless, we don't involve the local people, the revival of traditional water conservation systems and bodies will be unsuccessful. All traditional systems survived because of people's active participation.

Global consumption of water is doubling every 20 years. This consumption growth is more than twice the rate of human population growth. Mismanagement and unsustainable use of water and a blind eye on used water (that we so naively call wastewater) is making the whole situation environmentally uncomfortable for India and the world. Most of the rain falling on the surface runs off rapidly, leaving very little for the recharge of groundwater. This has become starker with erratic monsoons owing to climate change.

Nature has gifted India with extraordinarily rich endowment of diverse and distinctive water bodies. Our ancestors had designed and developed hundreds of water harvesting systems in different parts of the country. They may have different names like *johads*, *ahars, bawdis, talabs, vavs, eris,* and others. But their underlying theme has remained same "save water with public participation". These traditional water-harvesting systems had played an important role in maintaining and restoring the ecological balance. Till this day these bodies act as a source of drinking water, an instrument for recharging groundwater, a reliable system to control floods, a resource supporting biodiversity, and a contributor of livelihood opportunities to many people.

Water is a simple chemical molecule made of Hydrogen and Oxygen atoms, but its interaction with living earthlings is complex; because of diversified geological formations, complexity in tectonic framework, climatic variations and changing hydro-chemical environments. Burgeoning human population and its greed to exploit water by infinite means have made this interaction precarious.

Natural replenishment of groundwater reservoir takes place slowly. At present it is unable to keep pace with excessive, unmindful and continued exploitation of groundwater resources. As a result, in various parts of the country groundwater levels have slipped down rapidly and groundwater resources have depleted.

Overuse of water for agriculture and the inability of urban/ rural areas to increase efficient treatment of their used water have further limited repletion of groundwater resources. Falling groundwater levels, deteriorating groundwater quality and pollution of surface water bodies –these three have combined together to further aggravate an already alarming situation. Ever growing industrial requirements for quantity and quality of water and at the same time, their poor record in treating the effluent and recharging the aquifers, have made policymakers restless. The source sustainability has become the most important thing to be ensured.

In view of above, there is huge pressure to conserve the water, keeping it clean and to protect, harness, improvise and sustain all that wonderful water conservation knowledge employed by our forefathers since millennia.

India's Rich Tradition of Water Harvesting Systems

Water harvesting may be defined as a deliberate collection and storage of water that runs off on natural or manmade catchment areas. Catchment may include rooftops, compounds, rocky surface or hill slopes or artificially prepared impervious/semi-pervious land surface. The amount of water harvested depends on the frequency and intensity of the rainfall, catchment characteristics, water demands and how much runoff occurs and how quickly or how easy it is for the water to infiltrate through the subsoil and percolate down to recharge the aquifers. The most attractive attribute of traditional rainwater harvesting systems is their simple, cheap, replicable, efficient, sustainable and adaptable technique.

Due to water scarcity, water-harvesting techniques were developed in a big way in semi-arid regions. As water for irrigation was not available regularly and rainfall was meagre, for the people of these regions, water harvesting was not a technique but a part of their culture and was embedded in the socio-cultural framework. It became like a part of their *dharma* as is so brightly evident in *vavs* of Gujarat and *baolies* of Rajasthan.

The practice of harvesting rainwater dates back to Vedic times when the need to create water sources that would remain both clean and provide plentifully was recognised. But even before that the Indus valley cities had excellent systems of water harvesting and drainage. Dholavira in Kutch, Gujarat was laid out on a slope between two storm water channels –it is an example of sophisticated water engineering. Sage Narada, in Mahabharata advises Yudhishthira to excavate large lakes to store water and make cultivation independent of rainwater.

Dams built of stone rubble were found in Baluchistan and Kutch dating back to 2000 BC. We have evidences of dams, lakes and irrigation systems in the time of the Mauryas. Kautilya's *Arthashastra* mentions irrigation using water harvesting systems.

A refined water harvesting system of first century BC was found at Sringaverapura near Prayagraj. It contained floodwaters of River Ganga in a fully brick lined tank that is 800 feet long, 60 feet wide and 12 feet deep.

In South India, great Karikala Chola built a Grand *Anicut* or *kallanai* across the river Cauvery to divert water for irrigation in second century AD. This system is still functional. South India has a long tradition of such *anicuts*. In Central India, King Bhoja of Bhopal built one of the largest artificial lake, measuring approximately 65,000 acres fed by streams and springs in 11th century. In North India, poet and historian Kalhana in his 12th century chronicle *Rajatarangini* describes a well-maintained irrigation system in Kashmir.

Technology of Water Harvesting

In India, rainwater, runoff and the floodwaters from rivers, all three were harvested. Most of the water harvesting systems were located in the open to capture rainwater. The first benefit of water harvesting was the water recharge and it was a huge public good. When standing water percolated into the ground it recharged the water table. Thus, wells in the surrounding areas got plenty of good water, green cover increased in the surrounding areas, soil erosion reduced, river silting reduced, floods and runoff got controlled. The water for drinking, agriculture and other purposes, obviously, was then guaranteed.

Naturally, the local people decided the design and structure of each system based on the terrain and rainfall pattern of the region. Hence, each eco-zone of India had developed its unique techniques for harvesting water.

For example, in hills and mountainous regions where there were plenty of streams, simple engineering structures were used to divert the water into channels that fed the fields. In high rainfall areas people devised methods to literally catch the rainwater wherever it fell. The structures became more sophisticated and much bigger when the streams turned to rivers, as we see in planes of Assam and North India. In arid and semi-arid regions, streams were more seasonal, and therefore the diversion channels first led the water to a storage structure like a tank. At some places storage systems to collect just runoff from the watershed were also built. In flood plains, several unique systems to control and harness the floodwaters were devised. In the coastal areas, where possibility of river water turning saline is high, several ingenious ways were devised to regulate the flow of saline water.

In the regions where good groundwater aquifers were available, wells were dug with innovative methods to lift the water. Deep wells were dug in the beds of tanks and rivers, both to serve as a source of good water when the water receded and also to recharge the groundwater when they were fully submerged.

Almost following above described regional pattern, we would here mention few water harvesting techniques employed in various parts of India.

North East India

Bamboo Pipes

In this simple method, water is transported through bamboo pipes for irrigation. Bamboo pipes are used to divert water of springs on the hilltops to the lower regions by gravity. Bamboos of varying diameters are used for laying the channels. In Meghalaya they do it for black pepper cultivation. In Ri Bhoi district of Meghalaya, few villages collect flowing stream water through bamboo pads for domestic use.

Apatani

The water harvesting system is called *Apatani* because the Apatani tribes of the lower Subansiri district of Arunachal Pradesh practice it. *Apatani* is a wet rice cultivation cum fish farming system practiced in elevated hilly regions and gentle sloping valleys of Northeast India. *Apatani* can tap the water of small streams and springs in these high rainfall hilly regions through their temporary walls. These walls act as barriers and can divert the flow of water towards terraced and valley lands. In old days when most of the waste in villages was biodegradable organic waste, such harvested water from the hilltops used to get mixed with such domestic waste as it passed through the village through small channels. The mix formed as a result was considered good for paddy cultivation.

Zabo

The Zabo literally means 'impounding run-off'. It is an ingenious method of catching rainwater from running off the mountains. This system is practiced in Nagaland. Like other traditional water harvesting methods in hills, *Zabo* also combines water conservation with forestry, agriculture and animal care and promotes soil management, environmental protection and sustainable water management.

Cheo-ozihi

Angami tribe of Nagaland practices this system. In this system, a long channel carries the river water. From this channel many branches take off, and water is often diverted to the terraces through bamboo pipes. The channel is called Cheo-oziihi. Oziihi means water and Cheo was the person responsible for the laying of this 8-10 km long channel with its numerous branches. The channels are maintained and cleared each year by the local community.

Dongs or Ponds

Dongs are ponds constructed by the Bodo tribes of Assam in Brahmaputra valley to harvest water for irrigation. Water was lifted from the ponds and distributed into the fields by an instrument called *lahoni*. The ponds were individually owned and there was no community involvement for digging and maintenance.

Garh and Dara

These are also rainwater-harvesting techniques practiced in Assam from the ancient time. A *Garh* is built to channelise river water to the agricultural field. A *Garh* is like a big *nala*, where both sides of the *nala* have big and long embankment and the middle side is left open to water flow. In the paddy field, the whole area is divided into small pieces in square size, creating small embankments, called *Dara*, where rain water is stored for cultivation.

Indo-Gangetic Plains

Indo-Gangetic plain is full of rivers and their floodwaters. It stretches from Haryana-Punjab in west to West Bengal in the east. Few important water harvesting systems in this region are mentioned below:

Ahar-pyne

It is a traditional floodwater harvesting system prevalent in Bihar. Ideal terrain for *Ahar-pyne* should have an evident slope, sandy soil, low groundwater level and flood during monsoon. The slope is an average of one meter per km from south to north. In combination, these factors make floodwater harvesting a best-suited option.

The *Ahar-pyne* system received a deathblow under the nineteenth-century British colonial regime.

The post-independent state was hardly better. In 1949, a Flood Advisory Committee investigating continuous floods in Bihar's Gaya district came to the conclusion that "the fundamental reason for recurrence of floods was the destruction of the old irrigational system in the district."[1]

Bengal's Inundation Channel

In old times, inundation canals were a popular and efficient irrigation system in Bengal. Floodwater entered the fields through the inundation canals, carrying not only rich silt but also fish, which swam through these canals into the lakes and tanks to feed on the larva of mosquitoes. This helped to check malaria in this region. This ancient system of overflow irrigation had lasted for thousands of years. Unfortunately, during the Afghan-Maratha war in the 18th century and the subsequent British conquest of India, this irrigation system was neglected, and was never revived[2]. Many experts suggest restoration of this traditional method to tackle modern agricultural issues and recommend for its revival from the public health point of view.

Jampois or *Dungs*

Dungs or *Jampois* are small irrigation channels linking rice fields to streams in the Jalpaiguri district of West Bengal.

Rajasthan, Gujarat and the Western Deserts

This geographical region is full of deserts, ravines and valleys. Irrigation by wells and tanks was very common in western India. The natural undulations provide for creation of wells and lakes. Both Jodhpur and Udaipur in Rajasthan are dotted with innumerable lakes. There are small (*talai*), medium (*talab*) and large (*sagar*) lakes. Pichola, Fatehsagar and Udaisagar are Udaipur's main lakes. Every effort was made to catch every drop of rainwater by building tanks, lakes, ponds, wells and drainage canals.

The Chandela kings (between 9th to 13th centuries) in central India established a network of several hundred *tankas* that ensured a satisfactory level of groundwater. *Tankas* were constructed by stopping the flow of a *nullah* or a rivulet running between two hills with a massive earthen embankment. The quartz reefs running under the hills confined the water between them.

The Bundela kings who came later used lime and mortar masonry. Steps, pavilions and royal gardens bordered their reservoirs. Breaching of embankments and cultivation on the tank bed has destroyed many tanks. But the wells in the command area of these tanks continue to yield well and also serve to recharge the groundwater.

Great Thar Desert receives very little rainfall. Traditionally, the rainwater was captured and stored in ponds and underground tanks. For example, *tarais* (reservoirs) were built in the valley between sand dunes by constructing bunds at the two ends. When it rained, the rainwater was collected in the reservoir. The *tarais* dried up in a few months owing to the highly porous soil. But the region around it remained wet and moist. Wells were usually dug close to a *tarai*.

Tankas/Tanks

Tankas are underground small tanks and are popular in Bikaner. *Tanka* is a round or rectangular underground room in a house that functions as a water tank. Rainwater from the roof or terrace is directed towards an opening in the floor that leads to the *Tanka.* Rainwater is collected in these circular holes, lined with fine polished lime, made in the ground. *Tankas* are often beautifully decorated with tiles. These tiles help to keep the water cool. The water was used only for drinking purpose. In water scarce arid regions, *tankas* save families from the everyday drudgery of fetching water from distant sources.

In contrast, tanks (*sagar/jheel*) are generally constructed with large walls on four sides and an almost impermeable floor, with enormous water holding capacity. These are the oldest source of water for irrigation. Most of them are small reservoirs with earthen walls, used for storing water diverted from a stream or run off. The tanks are provided with a large catchment area and a system of canals.

Kunds or *Kundis*

In western arid areas of Rajasthan, *kunds* are water-harvesting structures. *Kunds* have a saucer-shaped catchment area that gently slopes towards

[1]Parampara, HYPERLINK "https://www.paramparaproject.org/traditions.html"Traditions & Practices>Ahar-pyne, Ministry of Culture, "http://www.paramparaproject.org/traditions_ahar_pyane.html"

[2] For more on Bengal Canals and Willcocks, please refer to: Willcocks, William, Sir, Ancient System of Irrigation in Bengal and Its Application to Modern Problems, 1984, B.R. Publishing Corporation, Delhi.

the centre where the well is situated. A wire mesh across water-inlets prevents debris from falling into the well pit. The sides of the well-pit are generally covered with lime and ash. Most pits have a dome-shaped cover or a lid to protect the water. *Kunds* are constructed where the groundwater availability is limited and salinity is moderate to high.

Locally available material like pond silt, charcoal ash and small gravels are used to make catchment areas of the *Kunds*. The depth and diameter of *Kunds* usually depend on consumption patterns. It is an ideal system for desert areas where rainfall is scant.

Kuis or *Beris*

Dug mostly in western Rajasthan, the *Kuis* are 10-12 metre deep pits in the vicinity of *tankas* to collect leaking or oozing water. When 6 to 10 *Kuis* are constructed together, the entire system is then called Paar system. Rainwater harvested through such system is called *Patali Paani***.**

Kuis can also be used to harvest rainwater in areas with scant rainfall. The mouth of the pit is usually made very narrow which reduces the evaporation of the stored water. The pit gets wider as it gets deeper, so that water can seep into a large surface area. The openings of these earthen structures are generally covered with planks of wood, thus remain mostly *kuchcha*. This water is used sparingly, as a last resource in crisis situations.

Khadins

The *Khadin* system is a runoff agricultural system, in which, the runoff water from the high catchment area is stored with the help of a *Khadin* bund where it is impounded during the monsoon season. This water is then used for irrigation. The *Khadin* soil remain moist for a long period because of water storage and chemical weathering, decomposition along with the activities of the microbes, which eventually raise the organic matter and other nutrient content of the soil.

Khadin have functioned efficiently for centuries maintaining the soil fertility. The Paliwal Brahmins of Jaisalmer are said to be the pioneers of this technique in the 15th century. The king gave lands to the Paliwals and asked them to develop *Khadins* on the land. The ownership of the land would remain with the King. The Paliwals used to get a share in the harvest. This system has great similarity with the irrigation methods of the people of Mesopotamia around 4500 BC.[3]

Nadis

A *nadi* is the local name of a village pond used for storing rainwater from the adjoining natural catchment areas. These were very common in Jodhpur. Based on available natural catchments and its water yielding potential, site for a *nadi* was selected. The location of the *nadi* had a strong bearing on its storage capacity due to the related catchment and runoff characteristics. Unfortunately, because of poor maintenance and negligence, destruction of catchment areas and unplanned urbanisation, most of the *nadis* have been severely polluted.

Talabs

A *talab* is a water harvesting structure constructed in valleys and natural depressions. They are used as reservoirs. Some *talabs* have wells in their beds. Such well-decked *talabs* are called *beris*. The existing oldest *talab* in Rajasthan is Ranisar. It was constructed in 1490 AD.

Virda

Virdas are shallow holes, which are made in the sands of dry riverbeds and lakes for collecting drinking water. They are found all over the *Banni* grasslands, a part of the great Rann of Kutch in Gujarat. First a depression or *Jheel* is excavated up to depth of 2 to 5 meter depending on the type of soil and level of salinity. This helps in removing the salinity embedded in the topsoil and non-permeable clay. Such a dug area looks like a small pond. Such depressed structure helps in storing more amount and longer retention of monsoon runoff, leading to enhanced infiltration to shallow aquifers.

The most important structure in this whole water system is *Virda* or dug well. Within a *jheel*, 10 to 20 wells of approximately 1 to 1.5 meter of diameter and 3 to 5 meter of depth are dug. These dug wells are framed from inside in square form with wooden trunks to support them. Further on the inner side of these trunks, the locally available

[3]Bhalge, P. and Bhavsar, C. 2007. Water management in arid and semi arid zone: Traditional wisdom. International History Seminar on Irrigation and Drainage, Tehran-Iran, pp. 423-428.

grasses mixed with local soil are filled very thickly and they work as a filter as well as fill the macro pores. The upper portion of these dug wells is plastered with the clay.

In *Virdas*, the sweet freshwater remains in the upper layer from which the water is collected, and the saline water remains below the freshwater zone because of its higher density. The harvesting system depends on the grass cover of the adjacent areas that is essential for free infiltration of groundwater. The Maldharis (local nomadic people) first established these unique structures in the Rann of Kutch.

Naada / Bandha

Naada/bandhas are found in the Mewar region of Rajasthan. It is a stone check dam that is constructed across a stream to capture monsoon runoff on a stretch of land. Because of submergence in water, the land becomes fertile as silt deposits on it and the soil retains substantial amount of nutrients.

Johads

Johads are small earthen check dams that store rainwater. They constitute high elevation in three sides; a storage pit, and excavated soil on fourth side. Some *johads* are interconnected through deep channels, with a single outlet in a river or stream to prevent structural damage. This cost-efficient and simple structure requires annual maintenance of de-silting and cleaning the storage area of weed growth. A *johad* prevents rainwater from running off, allowing it to percolate into the ground, recharging water aquifers and improve the water balance of the earth.

In past few decades, due to the efforts of some voluntary organisations *johads* have seen a revival in Rajasthan, especially in Alwar district. It is estimated that for per capita investment of Rs 100 on a *johad*, results in Rs 400 annual profit by increasing crop production. A significant social impact has been the increase in women's role in decision-making.[4]

Stepwells or *Baoli*

Stepwells are India's most unique contribution to the water architecture. They are called *vav* or *vavadi* in Gujarat, and *baolis* or *bawdis* in northern India. The stepwells of Gujarat consist of a vertical shaft in the middle from which water is drawn. This shaft is surrounded by corridors, chambers and steps that provide access to the well. Important stepwells are profusely carved and designed in such a way to serve as a cool resting place in summer. Thus many of them are constructed on old trade routes to give comfort to the people.

Eleventh century made Mata Bhavani's *vav*at in Ahmedabad is said to be one of the earliest stepwells. *Rani ki vav* (Queen's well) at Patan was built few decades after that is the grandest among all *vavs*. Some other fine examples of stepwells in Gujarat are Dada Harir's *vav* in Ahmedabad, and the octagonal *vav* at Adalaj, Gandhinagar.

Stepwells are open for all. Anyone can draw water from them. One can admire their beautiful arches, carved motifs and stepwells, as well as the rooms on their sides. Their grandness is befitting to any grand temple of ancient India. Their grandness is a testimony of the value attached to water by Indians.

The location of a *baoli* revealed its usage. *Baolis* within villages were mainly used for utilitarian purposes and social gatherings. *Baolis* on trade routes were often frequented as resting places. Stepwells used exclusively for agriculture had drainage systems that channelled water into the fields.

Bawaris

Bawaris were unique stepwells used for water storage in the cities of Rajasthan in medieval times. Scant rain received would be diverted to these man-made tanks through canals built on the hilly outskirts of cities. These, like all traditional water harvesting systems, helped in recharging a deep and intricate network of aquifers. To minimise water loss through evaporation, a series of layered steps were built around the reservoirs to narrow and deepen the wells.

Jhalara

Jhalara is also a local name given to manmade stepwells used for community water needs and for religious rites purposes. Often rectangular in design, *jhalaras* have steps on three or four sides. These stepwells collect the subterranean seepage of an upstream reservoir or a lake. The oldest

[4]Das, S. 2010. Johads of Alwar.Journal of Geological Society India, 75(2): 446–447.

Jhalara in Jodhpur is *Mahamandir Jhalara*, which dates back to 1660 AD.

Chauka System

In Jaipur, Rajasthan, degraded pastures have been dyked to form *Chaukas* to harvest rain. The *Chaukas* are rectangular plots arranged in a zigzag pattern and lie along a small gradient. Dykes with height of 1.5m are built along the three sides that lie towards the lower part of the gradient.

Trees are also planted on the dykes to withstand rain. When it rains, water gets collected in the dyked lower half of the *Chauka*. As the water level rises in one *Chauka*, it spills into the next and so on. Thus, the entire pasture receives water. The *Chaukas* do not get flooded. The excess water from the last *Chauka* flows into a drain. The *Chauka* system also promotes recharge of groundwater.

South India

When we talk about water conservation practices in South India first picture comes to mind is of temple tanks. The temple tanks are known as *Kovil Kulam* in Tamil Nadu, *Kulam* in Kerala, *Kalyani* in Karnataka and *Cheruvu* or *Pushkarini* in Andhra Pradesh/Telangana. The temple tank is the focal point of several religious activities like the *Theppam* or float festival. Banks of the tank are also used for meditation and other rituals.

It has been mentioned that Chennai city alone once had over 50 temple tanks constructed to harvest rainwater and prevent flooding. In addition to it there were several hundred *Yeris* (artificial tanks) to hold rainwater. It is also said that the founder of modern Bangalore, Kempegowda built several tanks in and around the city.

Tanks are of two types: system and non-system tanks. System tanks get their water from the overflow of a reservoir, nearby stream and the runoff from around their catchment. These tanks, being water sufficient, help farmers to grow more than one crop a year. On the other hand, non-system tanks depend entirely on rainfall and therefore can support only one crop. The tanks are connected through a system of canals to control and transport the water. In watershed areas, many tanks may be built and linked by canals. The surplus of water in the higher tank, thus, flows into the lower one; following the natural slope of the land.

Eri and Kulams

The southern state of Tamil Nadu in India has a rich water resource heritage. Tamil Nadu has no perennial river that can cover the whole state. This inspired people to use monsoon rains for irrigation and filling the ponds for consumption and other purposes. It has been mentioned that approximately one-third of the irrigated area of Tamil Nadu is watered by the *Eris* (tanks).[5]

Without the *Eri,* the development of rice cultivation, which is the staple diet of the people, would not have been possible. A large number of irrigation tanks were built between 6th and 10th century A.D. during Pallava rule. From the beginning of the 16th century, rivers were partially diverted to fill these tanks quickly, which in turn, ensured food production.[6]

Before the East India Company's rule, local communities maintained these Eris. For the maintenance about 4.5 percent of the gross produce of each village was allocated for the maintenance of the *Eris* and other irrigation structures.

If *Eri* is the broad irrigation tank, *Kulam* was the small pond close to a temple. *Kulams* were constructed by the local masons. A *Kulam* was built with bricks (and occasionally by granite) and was attached to a temple, giving it the name *Kovil Kulam* or temple tank.

Other Water Bodies

Lakes or *Yeris* and ponds or *Kuttais* were two other important water conservation structures in Tamil Nadu. A *Yeri* was a large earthenware tank dug out of the ground with the dugout mud making the side walls or bunds. A *Kuttai* was a small pond.

Anicuts (check dams) were small or medium dams built across rivers to divert water into irrigation channels. The Grand *Anicut* or *Kallanai* was built by Karikala Chola in the second century A.D. It was made of stone and situated on the river Cauvery where the River Kollidam branches off. The

[5]Agarwal A., Narain S. (ed.) 1997. Dying wisdom: Rise, fall and potential of India's traditional water harvesting systems. (State of India's Environment – A Citizens' report, No. 4). Centre for Science & Environment (CSE), New Delhi, pp. 11-12.

[6]Bhattacharya S., Traditional water harvesting structures and sustainable water management in India: A socio-hydrological review, International Letters of Natural Sciences, Vol. 37 (2015)

Anicuts in Kanyakumari district were built many hundreds years ago.

Surangam (tunnel) is a horizontal cave excavated in the mountains with super-condensed soil or rocks. The excavation itself is a tedious endeavour. This is a special water harvesting structure popular in Kasaragod district in northern Kerala. Water drips out from the rock crevice and runs through the horizontal cave/ tunnel (*Surangam*) and is collected in an open pit.

Kudimaramathu is one of the old traditional practices of stakeholders participating in the maintenance and management of irrigation systems. In this, citizens of a village participate in maintaining the water bodies of their village by deepening and widening the lakes and ponds and restoring them back to their original form. The silt, rich in nutrients, collected in the process is used by the farmers themselves in their field. A sense of collective ownership ensured the continued survival of the water bodies.

The Islands

Jackwells

Nicobar's physiography, topography, type of rocks and variation in rainfall, has encouraged the local tribes to develop different water harvesting structures. In lower parts of the undulating terrain, they make bunds using logs of hard bullet wood. Split bamboos are extensively used. A full length of bamboo is cut longitudinally and placed along a gentle slope with the lower end leading into a shallow pit. These split bamboos serve as channels for rainwater that is collected drop by drop in pits called Jackwells.

Deccan and Maharashtra

In Maharashtra and Deccan, the elevation ranges from 1,000m in the south to 500m in the north. The rainfall is low to moderate. Many kinds of irrigation systems were in vogue in the region such as the wells, embankments across rivers and streams, reservoirs, tanks, etc.

Kohli Tanks

Kohli Tanks are called so because of the name of group of cultivators who built these tanks three centuries back. A network of channels to practically carry water to every house was in existence in the Bhandara district of Maharashtra. The tanks were built on the slopes of the Gaikhuri range. The larger tanks were on the higher slopes, while the smaller ones were placed in the foothills. These tanks constituted the backbone of irrigation in the area until the government took them over in the 1950s. These are considered crucial for sugar and rice irrigation even today.

Bandharas

These are a traditional system of check dams or diversion weirs built across rivers. These check dams also impound water and form a large reservoir called *Bandhara*. They raise the water level of the rivers so that the water flows into the channels. The water supply would usually last for a few months after the rains.

Phad

This traditional water harvesting system is more than four centuries old. Managed by the community, this irrigation system is prevalent in north-western Maharashtra. The system operated on three rivers in the Tapi basin - Panjhra, Mosam and Aram - in Dhule and Nasik districts. At few places it is still used.

Kere

Tanks, called *Kere* in Kannada, were the predominant traditional method of irrigation in the central Karnataka plateau, and were fed either by channels branching off from *Anicuts* (check dams) built across streams, or by streams in valleys. The outflow of one tank supplied the next all the way down the course of the stream; the tanks were built in a series, usually situated a few kilometres apart. This series of tanks avoided the wastage of water through overflow and also ensured that the seepage of a tank higher up in the series would be collected in the next lower one.

Ramtek model

The *Ramtek* model has been named after water harvesting structures in the town of Ramtek, Maharashtra. Impressive at sight with its pillars, columns and compartments enclosing artificial water pond, Ramtek model is an intricate network of groundwater and surface water bodies. These water bodies are intrinsically connected through surface and underground canals. This model harvests runoff through tanks, supported by high yielding wells and structures like *Bawries*,

Kundis, and waterholes. An engineering marvel, this old system is intelligently designed to utilise every raindrop falling in the watershed area. However, like many ancient wisdoms, Ramtek Model is fast falling prey to negligence and ignorance.

Tanks in Ramtek model form a chain, extending from the foothills to the plains, conserving about 60-70 percent of the total runoff. Once tanks located in the upper reaches close to the hills were filled to capacity, the water flowed down to fill successive tanks, generally through interconnecting channels. This sequential arrangement or series of tanks generally ended in a small waterhole to store whatever water remained unstored.

Higher Himalayas

Zings

Zings are water-harvesting structures popular in Ladakh. These are small tanks, in which melted glacier water is stored. The essential component of this storage is the network of guiding channels that brings the water from the glacier to these tanks. As glaciers melt during the day, the channels fill up with a trickle, that in the afternoon turns into flowing water. The water is collected by the evening, and is used the next day. A local water official called the *Churpun* ensures that water is equitably distributed.

Ghul

In the high altitude of Himalayan region, water is tapped from hill slops known as *Ghuls*. *Ghuls* may be as long as 15 km. A *Ghul* normally carries a discharge of 15 to 100 litres of water per second. In the entire region of Western Himalaya comprising Jammu, Himachal Pradesh and Northern Uttarakhand, *Ghul* is a standard harvesting technique. While constructing a Ghul, a cut is made in the stream, which is further extended by stone embankment, generally made of a pile of stones.

Revival of Water Bodies

Everybody wants revival of water bodies. But in enthusiasm to achieve the goal of revival of water bodies, we need to understand that one solution may not fit all. Depending on the purpose, ecological services, livelihood and socio-cultural practices, the approach, process and solution may vary from one water body to another.

However the issues with regard to lack of data and action plans, encroachments, interrupted water flow from the catchment, siltation, violations of laws, solid waste deposit and polluted water, involvement of too many agencies, etc. have to be taken into consideration; but above all it will be political leadership and people's awareness that would be critical to complete the task.

Important actions and consideration that need to be undertaken are as follows.

1. Focus should be on sustainability. Therefore emphasis should be on long-term goals, operation and maintenance, adequate budget, and ownership and responsibility to the people.
2. Economic, environmental and social impact of the project should be studied in detail before hand and reviewed in between for the course correction, if needed. Local communities need to be involved in all these planning and reviews.
3. Encouraging local people to collaborate with other stakeholders to successfully utilise resources should be done to ensure the protection and conservation of water bodies.

An integrated approach taking into account the long-term sustainability, starting from the planning stage where looking at every water-body along with its catchment, is required.

Unless, we don't involve the local people, the revival of traditional water conservation systems and bodies will be unsuccessful. All traditional systems survived because of people's active participation. Water needs to be seen as a responsibility of both the government and the citizens, as well as a collective communal responsibility.

To take water conservation at the grassroots level through people's participation and urge stakeholders to create rainwater harvesting structures suitable to the climatic conditions and subsoil strata, to ensure proper storage of rainwater, Hon'ble Prime Minister launched transformative, successful and highly inspiring *jan-andolan* for water conservation namely, Jal Shakti Abhiyan: Catch the Rain.

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Nature Based Solutions for Urban Water Management

Aakanksha Sharma Juneja and Dr. Namrata Singh Panwar

The solutions from nature for water management are a long-lost science of India rephrased and reproduced by modern science to solve the present urban water management concerns. India boasts a rich and precious knowledge of various water harvesting structures specific to geography and topography. The Vedas and other ancient Indian scriptures make references to wells, canals, tanks, and dams. The traditional knowledge aligned with nature always played an important role in maintaining and restoring ecological balance, acting as a source of drinking water, groundwater recharge, flood control, while ensuring livelihood opportunities to people.

In 21st century, emerging changes in climate are not new to the world. Besides, scientists, environmentalists and local people have also started experiencing the wrath of climate change. Erratic rainfall patterns, extensive droughts, extreme heatwaves, and intense storms are some of the instances of changing climate that have its impact on economic, social, and environmental fabric of the world. In the last decade, weather related disasters affected around 4.1 billion people, leaving them homeless and in a vulnerable condition[1].

The gruesome impact of climate change seems to be intensified as the power of resilience of the natural resources has weakened gradually. Rising population and the subsequent concentration of people into cities are some of the reasons for distorting the resilience system of natural resources. Deforestation, conversion of agricultural lands, creating infrastructure beyond the carrying capacity, loss of wetlands, distortion of watershed are some of the activities taken up

[1]https://tourism.gov.in/sites/default/files/2020-05/Brief%20Note%20FTA%20March%20

to support the rising population in cities.

Jane Jacobs, the renowned urbanist and activist, claimed that cities will be the future which will drive the economic development of the countries. Today, India, the world's sixth-largest economy, is a home to more than 4,400 cities and towns out of which 53 cities have a million-plus population. Moreover, it is predicted that about 60 percent of world population will be living in urban areas by 2025[2] wherein India will nearly add about 416 million urban dwellers to cities by 2050[3].

Increasing urbanisation and changing climatic trends with a limited resource base has created an undue pressure on the natural resources making the cities vulnerable to climate changes. The Global Climate Risk Index 2021 ranks India as the 7th most-affected country from climate-related extreme weather events such as storms, floods, heatwaves, etc. Summer of 2022 has undoubtedly substantiated the findings of the report.

While there are several environmental issues persisted in the cities such as air pollution, waste contamination, water pollution and more, challenges associated with the urban water sources are more imperative to be put on table for discourse.

Water scarcity can hamper economic growth as half of the world's workforce i.e., about 1.5 billion people are dependent and employed in one of the eight water and natural resources dependent industries. Besides this, as per the World Bank report 'High and Dry: Climate Change, Water and the Economy', water scarcity, aggravated by climate change, could cost some regions up to 6 percent of their GDP. The Fifth Assessment Report of Intergovernmental Panel on Climate Change (IPCC)[4] while assessing hydrological impacts of climate change also projected that global warming can have huge implications on water resources.

Climate change can have varied implications on urban cities, increasing water in some regions while reducing expected water availability in another region. These changing patterns of precipitation have become more prominent in number of Indian cities. Widespread drought in July 2019 followed by devastating floods in August 2019 in Chennai can be seen as a perfect example of extreme events due to changing climatic trends. Furthermore, flash floods of Uttarakhand (2013) and Wayand (2018), extreme and frequent cyclones of eastern coast are also the instances probing for proper understanding and planning for such unusual events.

Disappearance of surface water sources and depletion of groundwater sources is another prevalent scenario of Indian urban cities. As per World Resource Institute's Aqueduct Water Risk Atlas, India is ranked thirteenth among all 'water-stressed' countries in the world. As per the assessment by NITI Aayog, over 21 major Indian cities including Delhi, Bengaluru, Hyderabad, and Chennai, would run out of groundwater very soon, affecting nearly 100 million people. Besides this, infringement and intrusion of urban water lakes and ponds has made cities more vulnerable to flooding and more susceptible to climate change.

Reiterating the fact that the urban flooding has become a new norm of Indian urban cities, the idea is to attain the attention of administrators and policymakers to become more proactive in making cities resilient to changing climatic trends amid rising urbanisation. According to a report of National Institute of Urban affairs, intensive monsoon rainfall will exacerbate the probability of flash flooding in about 78 Indian cities[5]. Moreover, about 77 coastal urban cities are also prone to frequent cyclones and storms.

Geographically, with Himalayas at crown and Indian ocean at nadir, India is home to several perennial and seasonal rivers where all prominent towns and cities were grown on the banks of rivers since ancient times such as Delhi, Lucknow, Varanasi, Indore, Kolkata. However, the unprecedented growth of urban cities has polluted these lifelines of cities making water unfit for drinking and other purposes.

[2]Water Supply for Urban Poor in India, Water Aid, 2017
[3]World Urbanization Prospects- The 2018 Revision
[4]file:///C:/Users/Admin/Downloads/UN-Water_Water-and-Climate-Policy-Brief_unedited.pdf
[5]https://niua.org/c-cube/blog/content/impacts-changing-climate-water-resources-%E2%80%93-consequences-indian-cities

Since the last decade, urbanisation and its associated challenges have been discussed at several forums. Various urban planners, environmentalists, administrators, and other knowledge experts had also devised solutions to manage the concerned issue of rising population in urban centres. However, those solutions were found to be unsustainable, costly, and environmentally insensitive.

Looking back at the roots, scientists and environmentalists realised the potential of nature in solving all the modern-day concerns. The world understood the power of nature wherein ecosystems support all life on Earth. The healthier our ecosystems are, the healthier the planet - and its people. Considering Ecosystem Restoration significant, the United Nations has also called for 'UN Decade on Ecosystem Restoration 2021-2030'.

Prominently, water management has always been seen as a tradition in India. India boasts a rich and precious knowledge of various water harvesting structures specific to geography and topography. The Vedas and other ancient Indian scriptures make references to wells, canals, tanks, and dams. The traditional knowledge aligned with nature always played an important role in maintaining and restoring ecological balance, acting as a source of drinking water, groundwater recharge, flood control, while ensuring livelihood opportunities to people. India can demonstrate an ingenious system of Bamboo drip irrigation system in rainfall rich region of Meghalaya where about 18-20 litres of water can be collected by tapping stream and spring water by using bamboo pipes.

Hence, it can easily be stated that the solutions from nature for water management are a long-lost science of India rephrased and reproduced by modern science to solve the present urban water management concerns.

As stated by International Union for Conservation of Nature (IUCN), nature-based solutions are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity

benefits"[6]. A nature-based solution uses tools that are provided by nature only. These solutions enhance existing and man-made infrastructure offering economic, social, and environmental benefits. These solutions not only deliver short term benefits but also extend the long-term benefits to present and future stakeholders.

In China, restoration of degraded Loess Plateau benefited over 2.5 million people with the introduction of sustainable farming practices. In greater Manchester, over £150 million/year were saved for healthcare costs with an access to green spaces and tree planting activities[7]. Globally, it is also estimated that the mangrove forests can save about USD 80 billion per year by avoiding losses from coastal flooding and protecting up to 18 million people[8]. In all, natural infrastructure has the potential to not only restoring the provisioning and regulating services of ecosystems but also enhancing the cultural ecosystem services, unlike grey infrastructure. Nature-based solutions also generate economic gains through immediate job creation, increased business productivity and tourism.

Considering the benefits of nature-based solutions, still less than 1.5 percent of all public international climate finance has gone to invest in nature-based solutions in developing countries[9] and even less than 1 percent of water sector investments go towards nature-based solutions[10]. Notably, nature-based solutions do not necessarily require additional financing sources but usually involve redirecting and making more effective use of existing financing sources.

The nature-based solutions can be explored to look at water management through a different lens. Nature-based solutions (NBS) for water resources management involve the planned and deliberate use of ecosystem services to improve water quantity and quality and to increase resilience to climate change[11]. NBS for water have high potential to contribute to the achievement of SDGs and targets of the 2030 Agenda for sustainable development.

Nature-based solutions to manage water sector involves enhancing and delivering natural ecosystem services such as mangroves protecting shorelines from storms, peatlands sequestering carbon, wetlands filtering contaminated water, lakes storing large water supplies, and floodplains absorbing excess water runoff[12]. In urban set up, the idea is to integrate grey build up infrastructure to support and complement natural infrastructure such as promoting green roofs, open and green buildings, planting trees and terrace gardens, recycling and reusing water and much more.

When every drop of water counts, the idea is to recollect the oldest and most effective method of tapping rainwater at source. The urban households can plan and design houses to store rainwater for at least non-potable uses. As an estimate, a plot size of 30x40 can save up to 70,000 litres of rainwater annually which may be used for 140 days with an average consumption of a family, reducing dependence on municipal water or groundwater.

Tapping rainwater is also required to rejuvenate urban lakes and ponds. These local ponds and lakes act as a sponge and thermos-regulators, helping areas to accumulate rainwater, enhance groundwater and regulate micro-climate. The revival of local water bodies can also support cities to be less dependent on far away water sources for meeting water demands. For instance, the city of Indore in the state of Madhya Pradesh gets its water from Narmada River, whereas the city of Bengaluru in Karnataka gets its water from Cauvery River located about 100 km from the city. This not only comes with huge economic costs but also make a city dependent on unsustainable source of water. Therefore, cities exploring nature-based solutions to rejuvenate and revive the urban

[6]https://digital.iucn.org/water/nature-based-solutions-for-water/
[7]https://www.iucn.org/theme/nature-based-solutions/about
[8]https://www.weforum.org/agenda/2021/03/nature-based-solutions-adaptation-climate-change-solutions
[9]https://www.weforum.org/agenda/2021/03/nature-based-solutions-adaptation-climate-change-solutions
[10]https://www.nature.org/en-us/what-we-do/our-insights/perspectives/resilient-watersheds-nature-based-solutions/
[11]https://wedocs.unep.org/bitstream/handle/20.500.11822/32058/NBSW.pdf?sequence=1&isAllowed=y
[12]https://digital.iucn.org/water/nature-based-solutions-for-water/

local ponds should be appreciated and promoted.

Besides this, watershed management also offers a wide range of potential benefits for these growing urban settlements. The learning from the case of New York City watershed treatment has also proved that managing watershed at different levels can also offer clean and safe drinking water supply saving millions of dollars of construction and maintenance cost of water filtration plant.

Endorsing blue-green infrastructure in the cities, creation and maintenance of urban green spaces is also recommended. Creating urban green spaces is a holistic and a comprehensive approach to convert concrete jungle into a liveable natural space with blue water bodies and green tree plantations. Nowadays, many metropolitan cities are investing in urban green spaces. For instance, under the Mozambique Cities and Climate Change Project, the World Bank is creating urban parks in the city of Beira. The project activities include rehabilitation of the riverbed, the construction of an outlet, the dredging of the fishing port, and the planting of 2,200 mangrove trees with active flood mitigation function. This solution will include the creation of a large park along the river, public spaces, cycling paths, and overall green landscape planning[13] .

By integrating grey and green infrastructure, cities are also investing in sustainable drainage systems[14]; reducing hardened and impervious surfaces allowing water to infiltrate into the ground. Surface permeability in urban areas can be also be increased by using permeable paving where appropriate (e.g., footpaths, car-parking areas, access roads), thus reducing surface run-off and increasing groundwater recharge[15].

Significance of green landscapes should also not be undermined as the parks and recreational spaces can help in absorbing the free flow storm water avoiding cities to get water logged. One of the practices to avoid storm water being practiced in China is 'Sponge Cities'. The concept features to absorb excessive rainfall through soil infiltration while retaining it in underground tunnels and storage tanks, only discharging it into the river once water levels are low enough[16].

Learning from the past, nature-based solutions are the future to strengthen the power of resilience of cities, towns, and people against changing climatic trends. As soon as we understand that there is a need to adapt for nature and not to mould against the nature, humanity will find a way to fight against climate change and its related impacts.

With the rising global challenges of climate change, urbanisation, biodiversity loss, as well as the current global health and economic crisis, the investment in nature-based solutions should be well promoted. Many of developing countries possess traditional wisdom to live in harmony with nature. Policymakers should acknowledge and promote these gems of wisdom while devising policies to integrate blue-green infrastructure solutions with grey infrastructure.

Launching of 'LiFE Movement' by Prime Minister Shri Narendra Modi, on 5th June 2022, can be recorded as one of the initiatives to set the path for nature-based solutions to modern-day concerns. The movement is to promote an environmentally conscious lifestyle that focuses on 'mindful and deliberate utilisation' instead of 'mindless and destructive consumption'. LiFE envisions making individual behaviour change the centre of the climate action narrative in the world and making sustainable lifestyles a global mass movement. Undoubtedly, this kind of movement will encourage the common people to contribute to the battle against climate change.

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[13]https://documents1.worldbank.org/curated/en/739421509427698706/pdf/Implementing-nature-based-flood-protection-principles-and-implementation-guidance.pdf
[14]https://wedocs.unep.org/bitstream/handle/20.500.11822/32058/NBSW.pdf?sequence=1&isAllowed=y
[15]https://climate-adapt.eea.europa.eu/metadata/adaptation-options/water-sensitive-urban-and-building-design
[16](Yang & Zhu, 2017)

Water Management for Sustainable Rural Livelihood

Dr H L Sharma

The Government of India is committed towards the rational and efficient water management in the country. To this effect many schemes and programmes have been launched to ensure adequate water facilities in every nook and corner of the country. Water needs to be used and managed judiciously by maintaining a proper balance between availability and utilisation for its long-term sustainability. In this direction proper water resource management through rainwater harvesting, natural farming and crop diversification with the active participation of local communities and NGOs is imperative. Public awareness regarding the judicious and rational use of water also needs to be promoted through education, information and communication.

Water is crucial for the existence of life on earth. It is an essential component to achieve inclusive and sustainable growth in an economy. It is vital to ensure food security, health and hygiene in rural areas. In fact, easy access to adequate water is both, a direct component of economic well-being as well as an input for enhancing productive capabilities. Judicious use of water resources assumes utmost importance, particularly when changing environment, increasing population, urbanisation, and related developmental activities create additional pressure on available water resources. Sustainable water management along with adequate water infrastructure are the key factors in maintaining a healthy and productive workforce, expanding agriculture and allied activities, creating gainful employment opportunities, and improving rural livelihood.

Water Resources of India

The average annual water availability of a country/region is largely dependent upon the hydro-meteorological and geological factors which generally remain constant. India accounts for nearly 4 percent of fresh water resources of the World as against 17.7 percent of total population and 2.4 percent of the land area. The main water resources of India consist of the precipitation on its territory which is estimated to be around 4000 Billion Cubic Meters (BCM) per annum and trans-boundary flows received in its rivers and aquifers from the upper riparian countries (Table 1). On an average out of total precipitation,1869 BCM (46.7 percent) water remains available as natural runoff. However, due to geological and other factors, the utilisable water availability is limited only to 1137 BCM (28 percent of total precipitation) per annum; comprising of 690 BCM of surface and 447 BCM of replenishable groundwater.

Table 1: Water Resources of India

S. No.	Source	Water (km3)
1	Annual precipitation	4000
2	Run-off received from upper riparian countries	500
3	Estimated utilisable water	1869
4	Average annual natural flow in rivers and aquifers	1137
	(i) Surface	690
	(ii) Ground	447
5	Water demand	634
	(i) Agriculture	541
	(ii) Domestic	42
	(iii) Industry, Energy & Others	51

Sources: *(i) National Water Mission under National Action Plan on Climate Change, 2008, GOI.*

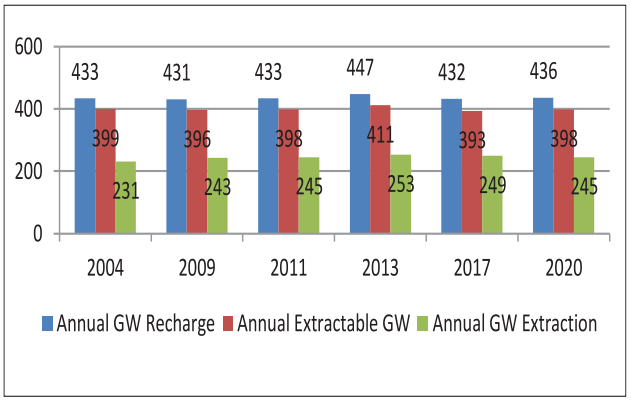
(ii) Dynamic Groundwater Resources of India, 2020, Ministry of Jal Shakti, GOI

The surface water account for nearly 61.44 percent of total usable water sources in the country. The major sources of surface water are; rivers, lakes, ponds and tanks. Most of the surface water resources in India are also getting polluted with industrial, agricultural and domestic effluents, which in turn limits the availability of usable water resources.

Owing to its universal availability, easy access, and low cost of extraction, groundwater has become the most preferred source of fresh water for various uses in India. It acts as a buffer stock during the times of drought and a resilient resource for mitigating the adverse effects of climate change on agriculture. The main source of groundwater recharge is rainfall, which contributes nearly 64 percent of the total annual recharge. Variability in the onset, withdrawal and quantum of rainfall during the monsoon season has profound impacts on water resources, power generation, agriculture, economics, and ecosystems in the country.

The total annual groundwater recharge in the country hovered between 431 to 447 BCM during 2004 to 2020 (Fig. 1). The annual extractable groundwater resources have been 91 to 92 percent of total recharge during the period under context. The annual groundwater extraction for irrigation, domestic and industrial use was 231 BCM in 2004, but it up surged to 245 BCM in 2020. The overall annual groundwater extraction has been in the range of 58-63 percent of extractable water during the period under context.

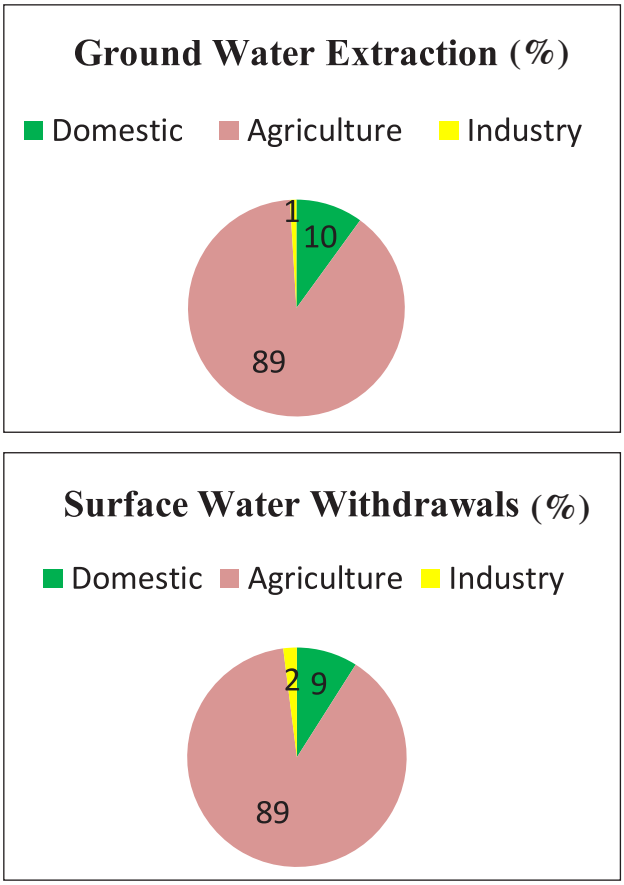
Figure 1: Ground Water Resource Assessments of India (BCM)



Source: *Dynamic Groundwater Resources of India, 2020, Ministry of Jal Shakti, GOI.*

The largest user of ground and surface water in the country is irrigation sector which accounted for about 89 percent of total ground as well as surface water extraction in 2020. (Fig.2).

Figure 2: Ground and Surface Water Extraction for Different Uses in India (2020)



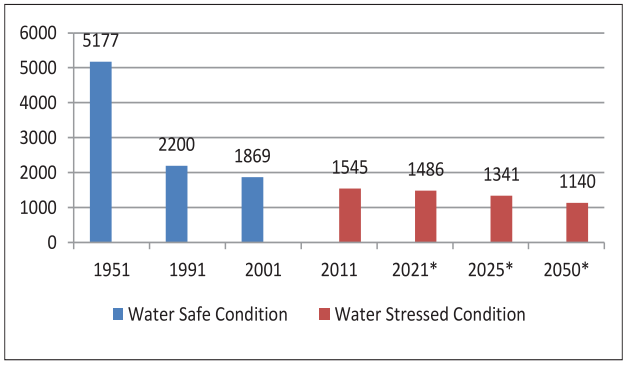
Source: *Dynamic Groundwater Resources of India, 2020, Ministry of Jal Shakti, GOI.*

Per Capita Availability of Water

Per capita availability of water in the country has been falling progressively due to rapid population growth and environmental factors. The average annual per capita water availability in India was as high as 5,177 cubic meters in the year 1951 (Fig. 3). It sharply slid down to 1,869 cubic meters in the year 2001 and to 1,545 cubic meters in 2011. As per the report released by the Ministry of Jal Shakti on dated 25 March 2021, per capita annual availability of water in the country is estimated to be at 1,486 cubic meters in the year 2021. It is expected to fall to 1,341 cubic meters in 2025 and further to 1,140 cubic meters by the years 2050. The per capita

annual water availability of less than 1,700 cubic meters is considered as water-stressed condition, whereas below 1,000 cubic meters it is considered as water scarcity condition. Due to wide temporal and spatial variations of precipitation, the water availability of many regions in the country is much below the national average and can be considered as water stressed/ scarce state.

Figure 3: Per Capita Availability of Water in India (Cubic Meters)



Sources: *(1) Master Plan for Artificial Recharge to Groundwater in India (2020), Ministry of Jal Shakti, GOI.*

(2) Per Capita Availability of Water, Press release by Ministry of Jal Shakti, GOI on March 25, 2021.

Water for Rural Livelihood

Water is a core component to ensure sustainable rural livelihood. It is an essential input to achieve growth with equity along with health and hygiene of rural masses. All the agricultural and allied activities like livestock, horticulture, floriculture, fisheries, etc. cannot grow and sustain without the adequate supply of water. Many other job oriented activities in rural areas like food processing also require a considerable amount of water. In order to improve rural livelihood, expand local economies, create decent jobs, and maintain a healthy and productive workforce in rural areas, it is essential to provide improved access to irrigation and drinking water through efficient water management.

Challenges in Water Management

India is facing a number of challenges in water management such as high inter-temporal and spatial variations in the availability of water resources due to varied hydro-meteorological conditions, declining per-capita water availability due to ever increasing population, inadequate water storage for meeting future demands, over-exploitation of groundwater resources, poor quality of water, low water use efficiency, and so on.

Over-Exploitation of Water Resources

The blatant, indiscriminate and irrational use of groundwater has led to its extraction in excess of annual replenishment in several parts of the country, particularly in the river basins lying in north-western region and parts of south India. The overall stage of groundwater extraction (ratio of annual withdrawal to annual availability) in the country was at nearly 62 percent in 2020. This ratio stood very high (more than 100 percent) in the states of Punjab, Haryana, Rajasthan and Delhi. Over extraction of groundwater has resulted in adverse environmental impacts including declining groundwater levels and deterioration in quality. The climate change also poses challenges to water security as more extreme rates of rainfall and evapotranspiration intensify the impacts of floods and droughts. The groundwater needs to be used and managed judiciously by maintaining a proper balance between availability and utilisation for its long-term sustainability. In this context, rainwater harvesting is one of the most important initiatives which can help in a long way in sustaining the water supply in rural areas.

Stressed Water Demand

Water use has been increasing worldwide by about 1 percent per year since the 1980s due to population growth, socio-economic development, and changing consumption patterns. Unfortunately, India is not an exception to this trend, as it has emerged as the largest consumer of groundwater in the world. India is placed at 13th rank among the world's seventeen extremely water-stressed countries. As per the report submitted by the Committee on Restructuring the Central Water Commission (CWC) and the Central Ground Water Board (CGWB) 2016, if the current pattern of demand continues, nearly half of the demand for water will remain unmet by 2030, which can cause social upheaval and disruptions.

Government Initiatives

Steps for conservation, augmentation and

efficient management of water resources are primarily taken by the State Governments, as water is a State subject. In order to support and supplement the efforts of the State Governments, Central Government provides technical and financial assistance to the States through various schemes and programmes. At the central level, the Ministry of Jal Shakti is the nodal agency responsible for policy formulation, planning, funding and coordination of programmes for sustainable water management.

Government of India is committed towards the rational and efficient water management to ensure sustainable rural livelihood in the country. To this effect, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched on 1 July 2015 with the motto of *Har Khet Ko Paani*. The scheme is being implemented to expand cultivated area with assured irrigation, reduce wastage of water and improve water use efficiency. The scheme also focuses on creating protective irrigation by harnessing rainwater at micro level through *Jal Sanchay and Jal Sinchan.* Micro-irrigation is also incentivised through subsidy to ensure water use efficiency in the agriculture sector by promoting appropriate technological interventions like drip and sprinkler irrigation technologies and encourage the farmers to use water saving and conservation practices. Focusing on water conservation, capacity building and minimising wastages, the National Water Mission (NWM) was launched in the year 2009. It also aims at ensuring equitable distribution of water both within and across States through integrated water resource development and management.

The Government of India has accorded high priority not only to improve irrigation facilities in rural areas but also on providing clean and safe drinking water to every rural household. As a part of this endeavour, Prime Minister announced Jal Jeevan Mission-*Har Ghar Jal* (JJM) on 15 August 2019. The JJM aims to provide adequate and safe drinking water to every rural household through a functional tap connection by the year 2024. For the implementation of this pan India movement on water, there is provision of an outlay of Rs 3.60 lakh crore in partnership with States. With the objective to improve water availability conditions in the country, a campaign for water security and conservation under *Jal Shakti Abhiyan* (JSA) was launched in the year 2019 in 256 water-stressed districts. Realising the utmost importance of rainwater conservation and recharge, a campaign under Jal Shakti Abhiyan,"Catch The Rain 2022" was launched by Hon'ble President of India Shri Ram Nath Kovind on March 29, 2022. The Ministry of Jal Shakti has proposed the implementation of this campaign with the theme *catch the rain where it falls, when it falls* from April to November 2022. The recommendations for the implementation of the campaign are (i) water conservation and rain water harvesting (ii) renovation of traditional and other water bodies (iii) re-use of bore well recharge structures and (iv) watershed development. Central Government has formulated a National Perspective Plan (NPP) for Water Resources Development which envisages transfer of water from water surplus basins to water deficit basins through inter-linking of rivers. Under the NPP, the National Water Development Agency has identified 30 links (16 Peninsular and 14 under Himalayan Component) to be pursued in a consultative way.

It has been observed that the regions where the crops like paddy, wheat and sugarcane are grown have higher groundwater stress levels. In view of this, Crops Diversification Programme (CDP) is being implemented in the original green revolution states viz. Punjab, Haryana and Western UP since 2013-14, to shift towards less water requiring crops such as oilseeds, pulses, coarse cereals, nutri cereals, cotton, etc. An amount of Rs 120 crore as Central share was earmarked for implementation of the programme during 2021-22. The crop diversification in the country has also been promoted through the MSP policy. In recognition of river Ganga's significant economic, environmental, cultural and religious value, the Government of India has declared river Ganga as the national river in 2008. Further, the Government of India launched the Namami Gange Mission in 2014 as an integrated and multi-sectoral mission for conservation of Ganga and its tributaries. The Mission aims to protect, conserve and rejuvenate the basin of river Ganga.

Future Initiatives

The total population of India is estimated to be around 1,388 million in 2021. Due to

stagnant water resources on the one hand and ever increasing population on the other hand, per capita annual water availability in the country has come down sharply during the last 70 years. It is estimated to decline to 1,341 cubic meters by 2025. If the current trends in the demand and supply of water continue, then soon India is likely to become a water-scarce country. This will have serious implications for the sustainability of agriculture, food security, livelihoods, rural sanitation, and sustainable growth. For making India a water secure nation, especially the rural regions of the country, a lot of challenges are needed to be addressed from both, the demand as well as the supply side of water. From the demand side; population pressures, changing cropping pattern, high rate of urbanisation, rapid industrialisation, and issues relating to climate change need to be urgently addressed. On the supply side; proper conservation, storage, and distribution of water need to be prioritised. To meet the increasing demand of water for irrigation and drinking purposes increased public investment for the creation of water infrastructure is also the need of the hour.

Over exploitation of groundwater is also a cause of concern. Groundwater is not only the main source of irrigation for about 60 percent of the net irrigated area but also fulfills more than 85 percent demand for potable water in rural areas. The problem with the groundwater is that it is not only depleting at a rapid rate, but in some parts of the country it is highly contaminated with the presence of arsenic and fluoride. In this context, necessary technological interventions are needed for the treatment and removal of contaminants and promotion of the re-use of water. Rainwater harvesting and artificial recharge of groundwater by utilising surplus rainfall runoff is also the best supply side water management option for the sustainability of groundwater sources.

The existing cropping pattern is skewed towards cultivation of sugarcane, paddy and wheat which has led to depletion of fresh groundwater resources at an alarming rate in many parts of our country. Crop diversification can be used as a useful tool to promote sustainable agriculture. Natural farming can also be promoted to sustain agricultural production with eco-friendly processes in harmony with nature. In order to widen the access and availability of water in rural areas, there is the need to take steps to preserve and use the water judiciously with the active community participation. Emphasis should be on addressing critical gaps in the value chain through technology infusion, optimal water management to achieve 'Per Drop, More Crop'.

Proper water resource management, revival of aquifers, and traditional rainwater harvesting structures with the active participation of local communities and NGOs also need to be promoted. The groundwater resources should be managed carefully, through improving the recharge of water resources and plugging over-exploitation to prevent the critical and semi-critical assessment units from further worsening. Last but not least, public awareness regarding the rational use of water needs to be promoted through education, information and communication.

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Water User Associations

Partha Pratim Sahu

Local institutions and various types of user associations have emerged as key stakeholders in participatory natural resource management in rural landscape. A robust and well-functioned Water User Association (WUA) could play a decisive role not only in promoting inclusive and sustainable utilisation of water resources but also address the concerns of small and marginal farmers.

Due to the growing demand for water on the one hand and depletion of water due to climate change or other reasons, efficient and sustainable use of scarce water resources is of utmost importance. Towards this goal, various efforts are being undertaken including rejuvenation of inactive water bodies, construction of water recharge pits, promotion of rainwater harvesting, treatment of wastewater, and so on. Under national flagship schemes such as Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), many activities are taken up for sustainable and efficient water resource management. However, efficient water resource management is a serious concern in many developing nations, including India. Participatory natural resource management has emerged as a new paradigm, where local institutions such as Panchayats and other village-level user groups play a crucial role. It is envisaged that it will create a sense of ownership of water resources and the irrigation system among the users, so as to promote economy in water use and preservation of the system. In rural areas, there are a large number of village-level user groups such as Water Users Associations (WUAs), Watershed Development Committees, Village Forest Committees/Forest Protection Committees,

artisans groups, farmers' cooperatives, and Self-Help Groups formed and functioning under various development programmes of the Central and state governments. However, there is a lack of updated statistics on the number of these user groups as well as very little evidence on the functional status and to what extent these groups have delivered to their mandated charter of objectives.

Current Scenario

In National Water Policy (2002), a participatory approach to water resources management was emphasised, by involving not only various governmental agencies but also the users and other stakeholders, in an effective and decisive manner in various aspects of planning, design, development, and management of the water resources schemes. Water User Associations (WUA) and local institutions such as Panchayats and urban local bodies should be involved in the operation, maintenance, and management of water infrastructures and facilities at appropriate levels progressively and with a view to eventually transfer the whole management of such facilities to the user (farmer) groups or local bodies.

Water User Associations (WUAs) are farmer groups created with the objective of improving farmers' access to irrigation water resources. In India there is diverse variety of WAUs in terms of registration, type of promoter, legal backup, and extent of powers and functions vested by the state and so on. In India, there are WUAs promoted by the State, Gram Panchayat or NGOs or groups formed by farmers themselves. WUAs provide farmers of different size category a platform to come together and work as a group with the concerned irrigation authorities so that as a group they are able to serve individual farmers' needs better. There is a long mandate of activities and functions to be undertaken by WAUs. These functions include acquisition and distribution of water; maintenance and repairs; fixation and collection of water charges; punishing defaulters within the areas of the WUA; and resolving disputes among water users in the area of operation. In many states, WUAs have been created through separate and enabling laws. These states include Andhra Pradesh, Madhya Pradesh, Assam, Rajasthan, Tamil Nadu and so on. See Box 1 for select State-wise position of enactment of new Act.

Box 1: State-wise Position of Enactment of New Act

State	Specific Act
Andhra Pradesh	'Andhra Pradesh Farmers' Management of Irrigation Systems Act, March, 1997
Assam	The Assam Irrigation Water Users Act 2004
Bihar	The Bihar Irrigation, Flood Management and Drainage Rules, 2003 under the Bihar Irrigation Act, 1997
Gujarat	Gujarat Water Users Participation Management Act, 2007
Kerala	The Kerala Irrigation and Water Conservation Act 2003
Madhya Pradesh	Madhya Pradesh Sinchai Prabandhan Me Krishkon Ki Bhagidari Adhiniyam, 1999
Maharashtra	The Maharashtra Management of Irrigation Systems by Farmers Act, 2005
Orissa	The Orissa Pani Panchayat Act, 2002
Rajasthan	Rajasthan Sinchai Pranali Ke Prabandh Me Krishkon Ki Sahabhagita Adhiniyam, 2000
Tamil Nadu	'Tamil Nadu Farmers' Management of Irrigation Systems Act, 2000".
Uttar Pradesh	Uttar Pradesh Irrigation Management Act, 2009

Source: *Government of India, 2019*

Table 1: State-wise number of Water Users' Associations (WUAs) and area covered

States	Number of WUAs Formed	Area Covered (Thousand hectare)
Orissa	20794	1757.71
Andhra Pradesh	10884	4179.25
West Bengal	10000	37.00
Haryana	8490	1616.27
Gujarat	8278	662.99
Punjab	4845	610.29
Kerala	4398	191.22
Share of above 7 states (in Per cent)	79.8	50.7
All India total	84779	17842.2

Source: *Government of India, 2019*

As per latest available statistics, there are about 84,779 number of WUAs in India, scattered

over states. About seven states account for 80 percent of total number of WUAs and half of the areas covered under these WUAs. Odisha has the highest number of WUAs (See Table 1). However, there is lack of data on the current status and functioning of these WUAs. There are studies by researchers and Government agencies on assessment and evaluation of these WUAs.

Challenges and Way Forward

Robust and efficient functioning of these WUAs is challenged by several constraints; such as, lack of legal back up, uncertainty of water availability, lack of financial viability, technical knowledge and leadership, inadequate training and capacity development, diverse nature and characteristics of members, lack of coordination between WUAs and other local institutions and stakeholders. However, the key to efficient functioning of these WUAs is active involvement of all members and work in close coordination with all other institutions, rising from self and vested interests.

In an assessment study of WUAs in Andhra Pradesh conducted in 2015, it was found that the state demonstrated strong political will and initiated various irrigation reforms through legislations and WUAs were promoted as non-political entities. However, in reality, political involvement and elite capture dominated the functioning of WUAs and importantly, devolution of powers was not effective and many crucial functions such as assessment, collection of water charges, sanctioning of works, etc, continue to remain with the irrigation departments. The success or failure of WUAs is also determined by social capital, group size, homogeneity, leadership, operational rules, etc. (Reddy and Reddy, 2005). In another study, while analysing the functioning and governance of WUAs in West Bengal, the researchers found that larger command area, dominance of small farmers, optimum membership fee, frequent general body meetings, certain documentation, and power structure improve the overall functioning and governance of these institutions (De at al, 2022).

There are many success stories of WUAs documented by NITI Aayog in a document, i.e. Compendium of Best Practices of Water Management, 2021. For instance, Tarapur Alpika Committee-WUA, Tarapur, Amethi, Uttar Pradesh started managing the irrigation of agricultural fields after enforcement of the Uttar Pradesh Participatory Irrigation Management Act, 2009. The said WUA after regular discussion with the farmers managed to reduce the malpractices such as illegal water-lifting and canal formation. In addition, in collaboration with the Uttar Pradesh groundwater department, canals were created to improve irrigation and under MGNREGA service road along canals were widened. The outcomes of the WUA are as follows.

(a) The irrigation area increased from 123 hectare in 2011 to 386 hectare in 2021

(b) The problem of tail feeding was solved through water provision

(c) Silt removal, canal cutting and cleaning resulted in improved water provision

(d) Reduction of malpractices of illicit irrigation, water-lifting and canal formation

(e) Revenue generation through sale of slit

Similarly, in Lalitpur, Bundelkhand, Uttar Pradesh one such WUA in association with the Irrigation Department of Lalitpur, Uttar Pradesh, succeeded in saving water and increasing the irrigated areas. The interventions in this case were a) distribution of water from the tail end of canals; b) training of WUA members; c) rehabilitation of minor outlets; and d) supervision of all activities by management committee. Farmers are now able to water the crops four times in a year as compared to two times in a year. Thus WUAs along with participation from local and state governments in India has adopted water conservation practices over the years, which have immensely benefitted farmers and resulted in optimal allocation of water resources. There are many such success stories which should be documented and attempts should be made to replicate and scale up in different context. Robust functioning of WUAs and convergence of schemes with active beneficiary involvement and financial contribution will ensure inclusive and sustainable utilisation of water resources and it will also address the concerns of small and marginal farmers. The problems of water scarcity can be addressed through participatory planning, involvement of such user groups, village organisations and self-help groups in the construction of small water harvesting structures

and in spreading awareness about different types of cropping systems. Small farmers may also be encouraged to explore income generating activities such as fisheries. Other interventions also need to be discussed here, such as Krishi Vigyan Kendra Melas to sensitise farmers on water conservation measures; *Jal Pe Charcha*, where training were imparted to 100 volunteers through a four hour-long session to enable them to spread awareness in their respective localities. The *Jal Sabha* campaign ran in 133 Gram Panchayats; as many as 3,165 women, men and school students participated. It raised awareness on various practices of water conservation (NITI Aayog, 2021).

Community led institutions such as WUAs could be important change agents in inclusive and sustainable utilisation of water resources. However, the success of WUAs depend on many critical factors such as active participation of members, mutual and strong co-ordination with local institutions such as Gram Panchayats as well as other stakeholders, regular training and capacity development of all stakeholders, and so on. Regular monitoring and evaluation of the performance of the WUAs is also necessary. Both the success and failure stories should be analysed and lessons should be drawn so that appropriate corrective measures can be provided for robust functioning of WUAs.

Under Localisation of Sustainable Development Goals (LSDG), 17 SDGs have been mapped in 9 themes, in which "water sufficient village" is one such theme. Along with other measures, a good number of strong WUAs will be crucial to make faster progress in this goal. In addition, WUAs also have the potential for strengthening grassroots democracy, governance and accountability. However, infusing the idea of 'responsible use of water' in the minds of all citizens must be a development priority. Possibly a nation-wide 'water literacy programme' is the need of the hour.

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Skilling Rural Workforce for Water Management

Balendu Sharma Dadhich

Spreading awareness and imparting skills for better management of water is what we need to continue as we strive to instill a sense of responsibility and accountability among the people towards the judicious use of our valuable water resources. Many stakeholders including the government and administration, the civic bodies, the educational institutions, the nonprofit world, the media and the society need to play a role in the process because this is the single most important step towards achieving the tough goal of water independence.

A country that houses 18 percent of the world's population and has just 4 percent share of global water resources will be a natural target for water scarcity. So, it's not very surprising if India faces a perennial challenge of water shortage. However, what is really surprising and shocking is the way most of us have forgotten and abandoned the centuries old customs and practices for water management and conservation which had been handed over to us by our ancestors. Many of these practices were deeply ingrained in our culture and had been helping us in averting serious water crises in the past.

India is blessed with a fascinating cultural heritage and we still enjoy a deep rooted connect with our ethos, traditions and values. Few countries in the world would have such a relationship with their centuries-old cultural heritage intact the way we have. However, as modernity makes inroads into our lives, we are losing touch with a considerable amount of traditional wisdom including the skills that generations after generations have been passing on to their successors. Our traditionally deep and strong relationship with the water resources is facing serious challenge and the results are for everyone to see. Number of regions facing water crisis is growing by the day.

Having too less a number of water resources at our command and losing touch with the traditional wisdom that provided some kind of protection against water crisis for centuries are two important aspects behind the water scarcity that we face today across the country. Regions like Rajasthan and Kutch are not the only ones to face the fury of famines and droughts anymore. Many states are facing almost similar situation including those which once had abundance of water resources, as about a third of the country's geographical area is drought-prone. A few years back, I visited Cherrapunji area in Meghalaya, which is one of the wettest places on the planet and the only place in India to receive rain throughout the year. I was surprised to see that even that area faces occasional water crisis. The irony is that our average water consumption has grown manifold over the past few decades.

Apart from the above facts, there are more reasons behind the consistent shortage of water in the country such as our ignorance of modern science and technology and lack of skills among the people to manage water in a sustainable way. While India is one of the more severely affected countries, water scarcity is a global problem. An important fact to consider, however, is that it's more prevalent in countries which exist at the distant end of development lifecycle.

Relation of Water Scarcity with Poverty

Going by the current trends, prospects for the situation to ease up don't appear very bright as

the global water resources continue to be under stress due to reduced availability and increased demand of water. Moreover, many developing countries are facing increased amount of water pollution. Oceans, rivers, canals, dams, ponds and ground water, they all are subjected to pollution. Studies have come up with interesting insights into how lack of access to water and poverty can be interconnected as what has been seen across the world is that individuals and regions which have little access to a reasonable amount of water resources are quite often seen to be poor, while the poor have mostly been lacking access to good sources of water. Even in this modern age, this correlation appears to have maintained its relevance.

The worsening situation of water scarcity as well as the looming challenge of climate change, have prompted the United Nations to paint a grim picture of the days to come which fears that by 2025, half of the countries worldwide will face water stress or outright shortages. By 2050, as many as three out of four people around the globe could be affected by water scarcity. According to the Intergovernmental Panel on Climate Change, by 2050, more than one billion people in Asia alone are projected to experience negative impacts on water resources as a result of climate change. If you link this challenge with the fact that nearly 80 percent of all cases of sicknesses and diseases are linked with unsafe water and a lack of basic sanitation, the situation becomes even more worrisome.

The following facts, shared by the UN in its report on water scarcity (www.un.org/waterforlifedecade/scarcity.shtml) are worth a serious thought.

- Around 700 million people in 43 countries suffer today from water scarcity.
- By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under water stressed conditions.
- With the existing climate change scenario, almost half the world's population will be living in areas of high water stress by 2030, including between 75 million and 250 million people in Africa. In addition, water scarcity in some arid and semi-arid places will displace between 24 million and 700 million people.
- Sub-Saharan Africa has the largest number of water-stressed countries of any region.

Going Beyond Awareness Building

Spreading awareness and imparting skills for better management of water is what we need to continue as we strive to instill a sense of responsibility and accountability among the people towards the judicious use of our valuable water resources. Many stakeholders including the government and administration, the civic bodies, the educational institutions, the nonprofit world, the media and the society need to play a role in the process because this is the single most important step towards achieving the tough goal of water independence.

However, awareness has many dimensions and multiple aspects attached to it and hence, it is important to understand what exactly should people care about. Is it practicing austerity in water consumption, or conservation of water and water resources? Is it judicious storage of waste water or recycling of used water? Is it protecting the catchment areas and river basins or protecting water resources of all kind (groundwater, surface, rivers, oceans and glaciers) from various forms of pollution? Is it refraining from senseless exploitation of groundwater by digging deeper and deeper, avoiding plantation of trees and crops which consume excess water or using modern water harvesting techniques? Is it rejuvenation of water bodies or a long-term campaign for afforestation?

The above questions are only symbolic ones as in reality, there lies a huge ignorance on water issues in the society. We not only need to answer such questions but also address some practical challenges that people face such as what will happen to farming if we don't use groundwater and how can we harvest water when we don't have the knowhow and required financial resources needed. While the government is making its own efforts at the Centre and State levels, we should also consider a to put a structure in place which can help, guide and actively participate in the process of finding answers to the tough questions we face at the grassroots level.

Skilling as the Answer

Putting in place an army of people skilled in various aspects of water management spread across the country is among some of the steps we need to take in order to meet the challenge. If not fully addressing the problem of water scarcity, it can surely help in reducing its severity. Countries such as the Philippines have been actively experimenting with such programmes under the United Nation's International Center for Technical and Vocational Education and Training. If the Philippines can do so, why can't we who have a comprehensive infrastructure for skilling and learning in place covering both aspects of learning; formal and non-formal.

Interestingly, in many of our states we have traditionally seen various kind of 'water experts' at service of the society, including the *Sunghas* in Rajasthan, *chowkidars* in Kumaon hills of Uttarakhand, *Kollalus* in Garhwal, *jagliyas* or *patkaris* in Maharashtra, etc. Why not have new age experts in place who are equipped with age-appropriate knowledge and technical knowhow apart from the conventional wisdom related to water resources? If we can combine both; the traditional knowledge and the modern know-how, it can turn out to be a beneficial combination for the society.

I have called out the conventional wisdom a few times in this article because India has indeed had a very rich tradition of treating its water resources with great respect and wisdom. Even today there are people following conventional modes of water conservation and engaged in activities like rejuvenation of defunct water bodies and building new water resources successfully. The water problem in our area is largely a fallout of the situation and events in our vicinity. However, it can also be affected or aggravated by global and regional factors. Of these, the local factors are to a large extent in our control if we act as an awakened society and resolve to work together to save our area from a looming water crisis.

Government Initiatives

In December 2019, while launching the Atal Jal Yojana, the Prime Minister Shri Narendra Modi had urged farmers to opt for less water intensive crops and irrigation methods that will help conserve water. The Atal Jal Yojana is aimed at improving groundwater level in seven states. The Prime Minister mentioned that his government is trying to free the subject of water from a compartmentalised approach to a more comprehensive and a holistic one, by forming the Ministry of Jal Shakti. He had also said that villages with low groundwater level should prepare water budget and farmers should be encouraged to grow crops accordingly. The Prime Minister emphasised that water-related schemes should be made according to the situation at village level.

This is a clear vindication of the fact that a campaign to address the water problem must be comprehensive and holistic which essentially mean that the schemes, missions and programmes must be run at a national level; ranging from the villages to the national capital.

Notable is the fact that under some central government programmes lakhs of people have been trained in water management issues already. For example, more than 7 lakh *Swachhagrahis* are part of the Swachh Bharat Mission, who have been imparted with skills and knowledge around sanitation which is deeply linked with water issues as well. Under the Atal Bhujal Yojana too, there are thousands of *Bhujal Jankaars* (people knowledgeable in ground water issues) and a sizable workforce is available under the Jal Jeevan Mission as well. These are good resources which can be further trained in water management and conservation issues and leveraged at the national level.

As we aim to inculcate a culture of managing water judiciously, we also need to focus on skilling students and youth in our educational institutions. Possibilities are endless if we take advantage of the large number of students we have across the country as they can be actively engaged in awareness building as well as water bodies rejuvenation. Such skilled youth may also be employed in some of the government schemes so that their skills and energy can benefit the society.

Some of the areas in which the youth can be skilled include water resource management at river basin level or watershed level. This may include rainwater harvesting and storage of rainwater

to augment supply mechanism. Groundwater management is another important area to skill the youth as the groundwater levels are constantly going down in many parts of the country. This is the result of overexploited aquifers and these youth could be of help in dealing with the problem. Infrastructure management such as pipeline and canal maintenance are another domains of expertise and so is the ability to put together a judicious mechanism for distribution of water to users and monitoring of quality.

The formal ecosystem needs to play a crucial role here. Across a large number of gram panchayats, Village Water and Sanitation Committees and Water User Associations have been formed and they should have a role in awareness building and skill development programmes at the local level apart from ensuring proper planning and implementation of water management programmes. Here, we should not forget the fact that a mechanism to skill such committees is needed as well which can be run at the district level.

The Silent Heroes

While important programmes are already in place and new local-regional-national programmes are getting regularly conceptualised and introduced by the governments, there are a few bright instances of civil society organisations and volunteers making admirable contributions to the society by working among the people to transform the situation. They are not only skilling local people but working hand-in-hand to help their regions avert a potential problem.

A shining example in this context is that of the Tarun Bharat Sangh, headed by the 'Water Man' Mr. Rajendra Singh, who has been working for restoring and reviving water conservation structures across many states in the country for a few decades. In Rajasthan's Alwar district alone, the Sangh has revived many waterbodies resulting in a much improved water availability through wells and tube wells in the relevant areas apart from the presence of small tanks and dams which store water throughout the year. Tarun Bharat Sangh is also active in states of Uttar Pradesh, Bihar, Jharkhand and Uttarakhand and also skilling people. However, Tarun Bharat Sangh is not the only of its kind though as many social and religious organisations are also engaged in activities like this.

Samerth is another great example of how community-based approach can be successful in dealing with the challenge. The organisation is active in the Kutch district in Gujarat - it is a drought-prone area and known for the Rann (desert) which has been facing a severe drought situation for decades or in fact centuries. Samerth is providing safe water to the Rapar and Bhachau blocks since year 2000. The Organisation has been working with the villagers and local communities to skill them in basic water management issues. It has combined the best of both worlds; the traditional wisdom and the modern knowledge to put a water security plan for the relevant villages. The programme, authenticated, funded and implemented in the guidance of the village Panchayat, is helpful in managing water in the area when the area receives a poor monsoon. Needless to say, collective efforts taken at various levels by relevant stakeholders can help the country in building a society which is skilled, informed and capable of treating its water respectfully and avoiding a dreaded water crisis.

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Water Management in Agriculture

Dr. Jagdeep Saxena

Demand of freshwater in agriculture sector is rapidly increasing while its supply is constant. Rainwater harvesting is limited due to low water storage capacity and lack of awareness. Due to unsustainable extraction of groundwater, water table is receding at an alarming rate of 0.3 meter per year. In agricultural water management, irrigation is a major component but it also includes water conservation practices and micro-irrigation techniques. Rice and sugarcane consume almost 60 percent of the country's irrigation water. New technologies and improved agronomic techniques can save irrigation water in significant quantities. Micro-irrigation techniques, such as drip and sprinkler, increase water use efficiency, save water and also lead to higher yields. Participatory Irrigation Management has emerged as a very effective tool for irrigation water management in villages.

'The earth, the land and the water are not an inheritance from our forefathers but on loan from our children. So, we have to handover to them at least as it were handed over to us.'

- Mahatma Gandhi

Water is the most critical input for agricultural productivity having a determining effect on the eventual yield. All other inputs/investments (quality seeds, fertilizers, high-end technologies, etc.) fail to achieve their full potential if crops are not optimally watered. Being a predominantly agricultural country, India needs huge amount of water for farming and allied activities. But, the country has only four percent share of global freshwater resources which is managed to support nearly 18 percent of world population. Increasing population coupled with food and nutritional security has created additional pressure on

water resources. Demand of water from various sectors of economy (urban, industry, and agriculture) is rapidly increasing while the supply of freshwater is constant. As a regular source of fresh water, India receives nearly 4,000 BCM (Billion Cubic Metre) of precipitation (rainwater, snow, hails etc.) per year, but approximately 80 percent of this is received during monsoon season (June-September) only. This results in huge run-off losses during monsoon and calls for irrigation investments for rest of the year. Due to limited water harvesting infrastructure, only less than one-third of this precipitation can be utilised. The per-capita storage capacity is India is low as compared to other countries. Annual utilisable surface and groundwater resources are estimated to be 690 BCM and 431 BCM respectively. Average flow of rivers is estimated to be 1869 BCM. Groundwater is a replenishable source which gets nearly 74 percent recharge from rainfall and the rest is contributed by canals, ponds, reservoirs and other water conservation practices. Agriculture sector uses 89 percent of the groundwater for irrigation, while 11 percent is consumed in the domestic and industrial uses. Overall, the agriculture sector is the largest freshwater user in the country accounting for almost 85 percent of the total water usage. This is mainly due to cultivation of water intensive crops such as rice, wheat, sugarcane and cotton, and very low irrigation efficiency. The common pool nature of groundwater and the difficulty of observing it directly make the resource challenging to monitor and regulate. Hence, unsustainable extraction levels that exceed natural recharge rates are depleting groundwater resources rapidly. Water table is receding at an alarming rate of 0.3 meter per year. The Central Groundwater Board has categorised 16.2 percent of the total assessment units *(Blocks, Mandals* or *Talukas*) numbering 6,607 as 'over-exploited'. Additional 14 percent units have been categorised at 'critical' or 'semi-critical' stage. However, if rainfall is collected and managed properly with the help of rainwater harvesting and artificial recharge structures for augmentation of ground and surface water, this can reduce dependence on groundwater to the tune of about 500 BCM out of the total annual water requirement of 1200 BCM for all sectors. The unsustainable groundwater use necessitates demand management and supply augmentation measures for increased water use efficiency in agriculture sector. In this context, agricultural water management is an imperative in the country. Although irrigation is a major component in agricultural water management, it also includes soil, land, and water conservation practices; improving the efficiency of water use in irrigation; and technologies for lifting, storing and conveying water. Further, the National Water Policy 2012 recommends conservation of existing water bodies, rivers, river corridors, etc.

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) is the most comprehensive scheme launched in 2015 to increase irrigation facilities, promote micro-irrigation and support development of water conservation and recharge structures. State Governments have also implemented their own specific irrigation schemes. In addition to Ministry of Jal Shakti, Central Ground Water Board is also working towards aquifer rejuvenation, water conservation and artificial recharge. Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) is also significantly contributing in water conservation efforts across rural India.

Managing Water at Source

Soon after independence, Government of India pushed 'Creation and Expansion of Irrigation Facilities' into its top agenda to mitigate recurrent famines and hunger. During initial years, development of canal irrigation remained a priority area in which Government of India invested profusely through various irrigation projects across the country. As a result, the area irrigated by canals increased from 71 lakh hectares during 1950-51 to 144 lakh hectares during 1980-81; and further reached a peak level of 173 lakh hectares by the year 1991-92. However, during 1980s groundwater irrigation expanded at a much faster rate than canal irrigation. Consequently, area under canal irrigation not only stagnated but declined and hovered around 160 lakh hectares during 2011-12 to 2014-15, which is 10 lakh hectares less than what was achieved 20 years back. As a result, the share of canal irrigation in the total irrigated area has declined from 37.5 percent in 1984-85 to 23.43 percent in 2014-15. There are some specific reasons for making canal irrigation out of favour : low reliability and reduced flow of water at source; poor maintenance of canal and tributaries; poor utilisation of the irrigation

potential created; and an increase in cultivation of water intensive crops; and adoption of water intensive practices. Presently, canals are irrigating those lands, which have large plains, fertile soils and perennial rivers. The plains of north India are mostly canal irrigated.

Meanwhile, many major (Cultivation Command Area, CCA, more than 10,000 hectare), medium (CCA 2,000 – 10,000 hectare) and minor (CCA less than 2,000 hectare) irrigation schemes were launched to improve status of irrigation in India. Water resources development and management are planned, funded, executed and maintained by the State Governments as per their own state-specific priorities and resources, while Government of India supplements /supports the efforts of State Governments by providing financial and technical assistance through various schemes and programmes. With collective and concerted efforts at various levels, utilised irrigation potential (surface and groundwater combined) has reached to 87 million hectare, while ultimate irrigation potential touched 140 million hectare. As per latest estimates (2018-19), against total agricultural land of 1,80,888 thousand hectares, the cultivated land in the country was 1,53,888 thousand hectares, out of which net 71,554 thousand hectares was irrigated. Rest of the cultivated area, nearly 54 percent, is rainfed; that is, depends on rainfall for irrigation. Even if ultimate irrigation potential is achieved, nearly 31 percent of cultivable area will remain under rainfed condition. There has been substantial disparity in rainfall, it varies from less than 100 mm in western Rajasthan to

more than 2500 mm in north-eastern part of the country. Such condition necessitates formulation of different set of strategies to manage irrigation for whole year.

It is generally observed and well recognised that Indian farmers use 2 to 4 times more water to produce a unit major food crop than in China or Brazil. Hence, wise and efficient use of water is a must for sustainable development of agriculture sector and national food security. In this context, two crops–rice and sugarcane–deserve special attention as only these two crops consume almost 60 percent of the country's irrigation water. Technologies are available which can produce the same output with nearly half the irrigation water in these two crops. For instance, around 3,000 litres of water is used to produce one kilogram of paddy grain under the traditional flood irrigation. Whereas, under drip system of irrigation the requirement can be slashed to just 842 litres. New technologies, such as Direct Seeded Rice (DSR) and System of Rice Intensification (SRI) can also save 25 to 30 percent of water compared to traditional flood irrigation. In sugarcane, trench farming has been found very effective in saving water. About 300 farmers in Uttar Pradesh have been able to reduce water usage using trench farming and they have saved an estimated 60 million litres of water during 2019-2021. State Governments need to motivate farmers for adoption of scientifically designed cropping patterns to ensure optimum utilisation of water. Scheduling of irrigation is another simple and effective methodology to save water and energy. In the process, the correct frequency and duration of watering is determined on the basis of moisture in the soil and stage of the crop growth. About 35-40 percent water can be saved by scheduling of irrigation along with significant reduction in fertilizer use. Moisture sensors and automated irrigation systems which can be controlled by a farmer using smart phone, will help in deciding the time and amount of irrigation to be carried out.

The traditional methods of irrigation, mainly flood irrigation, have low irrigation efficiency (38 percent) due to excessive seepage loss and inequitable and untimely supplies. Adoption of water saving technologies such as sprinkler and drip irrigation systems have proven extremely effective in not just water conservation but also lead to higher yields. It has been observed that among various methods of irrigation, drip irrigation has achieved highest application efficiency of 90 percent with over-all efficiency ranging between 80-90 percent. New agronomic practices such as raised bed planting, ridge-furrow method of sowing, sub-surface irrigation and precision farming are also helpful in increasing irrigation efficiency. In this context, Government of India has launched new policies and schemes to increase area under irrigation and enhance water use efficiency.

Pushing Irrigation to New Heights

Among various schemes launched by Central Government, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) is the most comprehensive one aiming at protective irrigation for all agricultural farms in the country. Launched in 2015-16, it has the following 4 major components.

- Accelerated Irrigation Benefit Programme (AIBP),
- Har Khet Ko Pani (HKKP),
- Per Drop More Crop (PDMC), and
- Integrated Watershed Management Programme.

AIBP covers major to medium irrigation projects that involve an area of more than 2,000 hectare. During 2016-17, 99 on-going major/medium irrigation projects have been prioritised in consultation with States for completion in phases. Out of this, 44 projects have been reported to be completed/almost completed and an additional irrigation potential of 21.45 lakh hectare has been reported to be created by these projects. HKKP-Command Area Development and Water Management (CADWM) programme aims to utilise created irrigation potential as soon as project is completed. Further, its objectives include improving water use efficiency; increasing agricultural productivity and production; and bring sustainability in the irrigated agriculture in a participatory environment. So far, about 14.85 lakh hectare cultural command area has been developed. Under HKKP-Surface Minor Irrigation scheme, the total number of sanctioned projects are 6,213 and 3,098 schemes have been completed

upto March, 2020. During 2017-20, Surface Minor Irrigation (SMI) scheme could achieve irrigation potential of 1.20 lakh hectare. HKKP also runs a specific program for repair, renovation and restoration of water bodies. Out of 2,319 water bodies approved, 1,359 have been renovated as of March, 2020 with net irrigation potential of 0.5283 lakh hectare. Watershed Development Programme, running across the country, has successfully and significantly improved the availability of surface and groundwater in project areas. Since 2014-15, 7.09 lakh water harvesting structures have been created/rejuvenated and an additional area of 15.17 lakh hectare was brought under protective irrigation up to third quarter of 2020-21. The programme has also led to increase in productivity, vegetative cover, livelihood opportunities and household incomes causing socio-economic transformation. 'Per Drop More Crop' component of PMKSY focuses on enhancing water use efficiency at farm level through micro-irrigation systems (Drip, Sprinkler, Fogger etc.). This component also supports micro level storage or water conservation/management activities to supplement source creation for micro-irrigation. During 2015-16 to March, 2021, micro-irrigation has achieved an impressive coverage of 53.69 lakh hectare on All-India basis. In addition, 4.84 lakh micro level water harvesting/secondary storage structures have been created to supplement the micro-irrigation. To provide impetus to micro-irrigation, Government of India created a special Micro-Irrigation Fund with a corpus of Rs. 5,000 crore during 2018-19 with NABARD as implementing agency. This fund facilitates the States in further mobilising the resources to provide additional incentives to farmers beyond the provisions available under PMKSY-PDMC. This fund is facilitating to bring another 12.83 lakh hectares area under micro-irrigation in the States of Andhra Pradesh, Gujarat, Tamil Nadu, Haryana, West Bengal, Punjab and Uttarakhand. In view of growing interest of many other States in micro-irrigation, Government of India, in its budget for 2021-22, has doubled the initial corpus of Rs 5,000 crore by augmenting in by another Rs 5,000 crore. In addition to efficient use of water, micro-irrigation ensured higher productivity, reduction in labour cost, saving in power consumption, and reduction in fertilizer use. Micro-irrigation techniques help farmers to get better returns due to higher productivity, high quality of produce and savings on other inputs.

Several State Governments also acted simultaneously and designed their own participatory irrigation management programmes. In the State of Bihar, interventions by 'Jal Jeevan Hariyali Abhiyan' have increased the number of water structures (over 2,600 checks dams constructed); developed plantations (over 41,600 plantations); and enhanced the use of micro irrigation significantly. In Chattisgarh, construction of small dams, canals and dykes resulted in additional groundwater recharge. The State of Jharkhand launched a special scheme, 'Neelambar Pitambar Jal Samridhi Yojana' in May, 2020 for creation of field bunding, rejuvenation of *nalas* and construction of soak pits. As a result, currently, on an average five schemes of water conservation are running in every village in the Lohardaga district of Jharkhand. 'Birsa Munda Krishi Kranti Yojana' in Maharashtra has increased micro-irrigation area and took up construction of new wells and ponds along with repair of unused wells. Now, irrigation water is available in water scarce tribal areas.

Conservation is Another Key

Among various water conservation techniques, mulching is a simple, 'easy-to-do', effective and comparatively low cost means that reduces water loss by checking evaporation from soil surface. Mulch is any covering material, either organic or inorganic, applied on soil surface to create a barricade which does not allow escape of soil moisture. The moisture is conserved for many days thus reducing the demand of irrigation during the period of crop cultivation. Additionally, mulching improves soil structure, reduces soil salinity and also controls weeds. Various types of plastic mulches are available in market, but mulching can also be effectively done by using agri wastes such as wheat straw, gross clippings, leaf debris, etc. Plastic film lining has proved to be an effective tool against loss of water through seepage in canals, ponds and reservoirs. By reducing seepage losses up to 100 percent, it improves water availability over a longer period of time for irrigation purposes. It also prevents soil erosion and is highly useful in porous soils where water retention in ponds in a

Participatory Irrigation Management (PIM)

Participatory Irrigation Management (PIM) broadly refers to the formation of groups of water users, mainly farmers, in a formal body for the purpose of managing parts or whole of an irrigation system. Such bodies are generally called Water Users' Associations (WUA), but are also known by the names such as *Pani Panchayat, Pani Samiti* or irrigation cooperatives. In this approach, water users/farmers are involved as active stakeholders in management of irrigation systems right from planning and design to construction, design, maintenance, distribution and even financing. PIM policy of Government of India aims to create a sense of ownership of water resources and irrigation system among the users, so as to promote economy and efficiency in water use. Such type of ownership encourages better use of water through better choice of crops, cropping sequences and also regulates timing, period and frequency of water supply for optimum utilisation of irrigation water. In PIM based irrigation systems, it is the combined responsibility of the farmers to collect water charges from users and make payment to irrigation agency. Thus, a healthy relationship gets created and maintained between the irrigation agency and users.

To develop and popularise PIM as a viable tool of irrigation water management, a legal framework was needed in the country. Accordingly, the Ministry of Water Resources brought out a Model Act to be adopted by State Legislatures for enacting new irrigation acts or amending the existing ones to facilitate PIM. A good number of States have enacted new irrigation acts which now govern/regulate the constitution and functioning of Water Users Associations. Farmer Organisations are tier for minor and medium irrigation projects, four-tier for major irrigation projects are mentioned below:

- **Water User' Association (WUA):** In a WUA, all water users are its members and it has a Managing Committee (President and 4-10 members). Each WUA has a delineated command area. Generally it covers a group of outlets or a minor irrigation system.
- **Distributary committee (DC):** It comprises five or more WUAs. All the presidents of WUAs will comprise general body of the Distributary Committee.
- **Project Committee (PC):** This is the apex committee of an irrigation system and presidents of the DCs in the project area shall constitute general body of the PC.

Water Users Associations are scripting impressive success stories across the country in terms of saving of water, increase in irrigated area and productivity. For example, WUAs formed in collaboration with the Waghad project in Nashik district (Maharashtra) have not only effectively saved water but also increased the yield. The current irrigation level of the farm land at Waghad is more than 140 percent of the targeted area for irrigation. The project has 24 WUAs with 16,958 members. There are a total of 234 directors for these WUAs who run the system. Of these 234 directors, 72 are women. Farmers are now able to produce crops even during drought. It has also elevated the lifestyle of members.

challenging issue.

Rainwater harvesting and recharging groundwater is one of the most popular strategy by which rainwater is gathered and stored for irrigation during lean periods. Rainwater harvesting systems are cost-effective and considerably easy to maintain with additional benefit of recharging local aquifers. Rainwater harvesting structures allow collection of large amounts of water that have the potential to mitigate the effects of drought. It also reduces soil erosion and flood hazards by collecting rainwater and reducing the flow of storm water to fields and rural habitats. Various schemes run by Central and State Governments are promoting/financing construction of new water harvesting structures such as check Dam/Cement Plug/ Nala Bund, Percolation Tank, Dugwell Recharge, Contour Bund, Gully Plug etc.; and also helping rejuvenation/repair of old and traditional water harvesting structures. Although rainwater harvesting seems to be a modern concept, India has a long tradition of rainwater harvesting methods which are still in use in various regions. *Baoli, Dighi, Johar, Kund, Tanka, Dang, Kul, Naula* and *Zing* are some of the popular structures seen in rural areas of the country.

To further accelerate the pace of rainwater harvesting, Ministry of Jal Shakti launched a special

campaign 'Jal Shakti Abhiyan: Catch the Rain' with the tag lines '*Catch the rain, where it falls, when it falls*' during 22 March to 30 November 2021. It covered all blocks of all districts across the country including both rural and urban areas. Campaign included creation of new and maintenance of old rainwater harvesting structures and revival of traditional rainwater structures; to motivate farmers for growing less water intensive crops; afforestation; preparation of scientific water conservation plans; and most importantly setting up of Jal Shakti Kendras. In this context, ICAR-Krishi Vigyan Kendras organised training and awareness programmes for farmers across the country. Ministry of Jal Shakti, under its National Water Mission, launched a special awareness programme called 'Sahi Fasal' in 2019 to nudge the farmers to grow less water intensive crops in water stressed areas. A series of workshops were organised in desired regions wherein exports recommended cultivation of appropriate crops with micro-irrigation techniques. 'Atal Bhujal Yojana', a centrally sponsored scheme, is dedicatedly pursuing sustainable ground water management in identified water stressed areas through community participation and demand side interventions. Currently, the scheme is being implemented in 8,774 gram panchayats of 81 districts of seven States (Haryana, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh). Central Ground Water Board (CGWB) is working towards aquifer rejuvenation, water conservation and artificial recharge by implementing innovative schemes. It has prepared a 'Master Plan for Artificial Recharge to Groundwater-2020' indicating various structures for different terrain conditions. The master plan envisages construction of about 1.42 crore rainwater harvesting and artificial recharge structures to harness 185 BCM of monsoon rainfall. Further, CGWB is organising Public Interaction Programmes at grassroots level to disseminate nuances of the aquifer management plans for the benefit of stakeholders. So far, over 1,000 such programmes have been conducted in different regions in which over 84,000 people have participated.

Over the last eight years, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) has emerged as a driving force in water conservation efforts across rural India. Nearly 75 percent activities (works) permissible under the scheme directly improve the water security and water conservation efforts. The major works taken up under natural resource management include construction of check dams, ponds, renovation of traditional water bodies, land development, embankment, fields bunds, field channels, plantations, contour trenches, etc. Encouraged by the results, many States are pooling their own resources along with MGNREGS funds to take up water conservation works. A national evaluation has found increase in productivity, income of farmers, fodder availability acreage and significant rise in water table due to NRM works.

Way Forward

Management of water in agriculture is vital not only for increasing productivity of crops but also for sustainable employment and income in agriculture sector. In this context, farmers need to be educated on various aspects of irrigation management to increase water use efficiency and equity. Use of Information Technology, drones and other cutting-edge technologies in management of irrigation systems can play a positive role in sustainable use of water. Participatory Irrigation Management has been conceived as the thrust area as progressive involvement of farmers in water management has yielded desirable results in terms of equity, efficiency and economy. Creating appropriate infrastructures and adopting scientific management practices will help augment water resources and improve the efficiency of the facilities. In nutshell, the future programmes and policies of the Government for irrigation development need to be focused on increasing per capita availability of water; reduction in cost and time of irrigation projects; rationalisation of water rates; better maintenance of works and infrastructures; and sustainable management of all natural resources including water.

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AGNIi Mission: Leveraging Technology and Innovation for Clean Water

Garima Raj and Sanchita Joshi

Universal availability and accessibility of clean drinking water needs to be accorded top priority by governments and policymakers. In the Indian context, significant steps like the Jal Jeevan Mission have been taken in the recent past. However, the challenge of clean drinking water for all continues to persist especially in rural areas. Going ahead there is a need to extensively leverage emerging technology and innovative solutions to ensure provisioning of clean water for large swathes of Indian population. In this quest, Government of India's AGNIi Mission based on its past achievements, is set to play a pivotal role in facilitating high impact, affordable, scalable, and sustainable technological solutions along with relevant stakeholders for clean water provisioning across rural and urban areas, inclusive of geographically difficult and remote locations of the country. This will undoubtedly transform lives for millions of Indians.

Clean water is a necessary resource that sustains human life and fuels socio-economic processes. Hence, it is an essential pre-requisite for sustainable development. The inclusion of Goal 6 on Clean Water and Sanitation in the Sustainable Development Goals 2030 fortifies the same. Clean water has both intrinsic and instrumental importance. Intrinsically, clean water is an end in itself as it is vital for life. Instrumentally, the lack of availability or access to clean water imposes a significant burden on public health with ultimate negative consequences on multidimensional poverty, human development, and economic growth.

In the Indian context, the clean water problem comprises two parts. First, lack of an improved source of drinking water within household premises and second, lack of adoption of proper drinking water treatment facilities. According to the latest National Family Health Survey (NFHS – 5), about 99 percent and 95 percent of urban and rural households respectively have access to an improved source of drinking water[1], a promising statistic. However, the improved source of drinking water is *'piped into dwelling/yard/plot'* only for 54 percent of the urban and a meagre 23 percent of rural households. Hence, a significant percentage of Indian households both rural and urban, lack an improved source of drinking water within the household premises. Further, NFHS-5 data suggests that 58 percent of Indian households do not treat water prior to drinking. With respect to treatment as well rural areas are trailing. While 44 percent of urban households do not treat their water, corresponding statistic for rural India stands at 66 percent. Additionally, while 44 percent of urban households use an appropriate treatment method[2], in rural areas this figure stands at only about 21 percent. Thus, official estimates categorically highlight that availability of and

[1]According to NFHS-5, improved sources of drinking water include – piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, rainwater, tanker truck, cart with small tank, bottled water, and community RO plants

[2]Appropriate water treatment methods include boiling, adding bleach/chlorine tablets, filtering, electronic purifying, and solar disinfection (Source: NFHS – 5)

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access to clean drinking water, particularly in rural India, is a challenge that poses a significant public health as well as a socio-economic development burden. As per estimates about 21 percent of communicable diseases in India are water related translating into a loss of 73 million days of labour imposing an estimated economic cost of USD 600 million annually. Hence, it becomes imperative for governments and policymakers to pay immediate and adequate attention to the clean drinking water challenge that afflicts a significant percentage of Indian population, primarily in the rural hinterlands.

In this regard, the untiring efforts of the Government of India need to be lauded. In 2019, the Government formed the Ministry of Jal Shakti by merging the earlier two ministries of – Water Resources, Rural Development and Ganga Rejuvenation, and Drinking Water and Sanitation to address India's water problems holistically and comprehensively. Additionally, the government has taken proactive cognisance of the clean drinking water issue. An institutional mechanism in the form of the Jal Jeevan Mission (JJM) was created to ensure provisioning of safe and adequate drinking water via providing individual Functional Household Tap Connections by 2024 to all rural Indian households. At the launch of the Mission on August 15, 2019, only 17 percent of rural Indian households had a tap water connection. However, in just a matter of three years this percentage has significantly increased to 50 percent[3].

Additionally, besides development of rural piped water supply infrastructure, undertaking technological interventions to improve water quality is an important component of the JJM. Adoption of technical solutions and innovations can play a pivotal role in providing rural Indian households with clean drinking water. They can help overcome barriers such as inhospitable geographies, groundwater contamination, in-situ geogenic contamination. Technology and innovation solutions help nations and communities to do more and achieve better outcomes with limited resources. Hence, their deployment in the water segment especially in the Indian context becomes crucial as the country houses 18 percent of the world's population with just 4 percent of its water resources. Further, climate change is set to exacerbate India's existing water stress.

At this juncture it becomes critical to highlight the transformational role that AGNIi Mission (Accelerating Growth of New India's Innovations), a flagship Programme under the Office of the Principal Scientific Adviser (PSA), Government of India is playing in facilitating adoption of technologies and innovations for clean water.

AGNIi Mission

AGNIi is one of the nine missions under the Prime Minister's Science, Technology, and Innovation Advisory Council, working under the aegis of the Office of the PSA and executed at Invest India, the National Investment Promotion and Facilitation Agency. The AGNIi Mission focuses on helping to capture the value of Indian technology: assisting Indian innovation, engage key national priorities designated by the Office, in domains ranging from human development through ecological sustainability to public safety. AGNIi's approach focuses on the following:

1. ***Bridging the Gap between Innovators and Adopters:*** AGNIi helps resolve the mismatch between innovations and adopter needs. AGNIi partners with agencies and organisations – understanding their strategic, policy, and programmatic priorities at leadership tier, and their operations in the field; surfacing and identifying pain-points which, if resolved, would help adopters achieve their own internal priorities. Around these pain-points, AGNIi formulates operational scenarios that these agencies themselves would recognise: describing 'a day in the life' of enduring that pain-point, both for field officers and leadership. To detail these, the AGNIi team will run professional mixed-method research initiatives, combining quantitative surveys with ethnographic research techniques.

   This allows AGNIi executives to understand, as closely as possible, what the world looks

[3]https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx

like through their partners' eyes. Then, against these operational scenarios, AGNIi outlines technology stacks, comprising Indian innovation (e.g., from Indian technology startups) that can resolve these pain-points. AGNIi innovation teams reach out across innovator networks to identify these Indian technologies. Field technology showcases facilitated by AGNIi help innovators understand the needs of the adopter better and also allows the later to experience technology solutions first hand.

2. ***Creating a Scalable Impact:*** AGNIi helps Indian technologists and innovators engage major adopters – and their networks. For example, in rural livelihood domains, AGNIi will partner with women's Self-Help or Common Service Centre groups – which are part of communities scaled nationwide across rural India. This ensures that innovations are presented to a larger network, thus, creating an ecosystem for enabling impact at scale with a built-in feedback mechanism.

   Robust dissemination channels are must for successful innovation diffusion. As a programme of the Office of the PSA, AGNIi is therefore able to translate its role into institutional engagement that maximises the beneficial impact of Indian innovation, for Indian citizens. AGNIi institutional partnerships establish channels that help to better understand community needs, to build relevant technology use cases, and to facilitate end-user adoption.

3. ***Empowering the Bottom of the Pyramid:*** A primary AGNIi aim is to ensure that Government's guiding principle of Antyodaya – that the poor, marginalised, and those left behind – are engaged to the maximum possible extent, with the capacity Indian technology can create. AGNIi seeks, in its partnerships, to ensure that grassroots and field-level insights are prioritised in AGNIi operational scenarios, and technology stack development. AGNIi's tasking often focuses on ensuring Indian emerging technology and innovation solutions are targeted at grassroots economic and human development outcomes.

4. ***Supporting the Competitiveness and Capturing the Value of Indian Technology.*** AGNIi has refined its technological focus. This includes engaging Indian innovation in the domains of artificial intelligence, quantum computing, robotics, cyber-physical, materials, and energy. By connecting pain-points to, and defining operational scenarios for, Indian innovators: AGNIi offers insight into opportunity for Indian innovation to evolve solutions and scale.

With respect to clean water, AGNIi is playing a significant role by way of mapping rural pain points, building India's clean water technology ecosystem, and collaborating with stakeholders to facilitate high technology interventions. The Mission's roles and activities in each are elaborated below.

Mapping Rural Pain Points

Evidence-based technology intervention forms the core of AGNIi's work. Primary surveys, field-visits, focus group discussions (FGDs), and key informant interviews are utilised to gauge rural pain points, technology preferences, and barriers to technology adoption.

In the context of clean water, AGNIi executed a primary survey among 2,142 Village Level Entrepreneurs (VLEs)[4] from Bihar, Chhattisgarh, and Madhya Pradesh to understand water, sanitation, and hygiene (WASH) challenges. Additionally, the survey probed on impact of COVID on the existing challenges, and the VLEs technology preferences. Findings indicate that 93 percent of the surveyed VLEs perceived 'access to clean drinking water' as an important challenge and 93 percent VLEs also felt that the same has been aggravated by the pandemic. On the brighter side, 95 percent of the surveyed VLEs opined that technology that 'improves water quality' can be an effective technology solution for resolving WASH challenges. Further, 96 percent VLEs stated that for them the priority features of technology solutions would be 'low maintenance cost', 'simple and easy to use', and 'environment friendly'. Moreover,

[4] VLEs are the operators of the Common Service Centres under the Ministry of Electronics and Information Technology, distributed equitably across rural India.

FGD conducted with a sub-sample of surveyed respondents highlighted access and availability challenges pertaining to clean potable water and the health repercussions of the same.

Building India's Clean Water Technology Ecosystem

AGNIi extensively interacts and collaborates with innovators and technology providers to address India's pressing clean water challenges. The clean water management ecosystem in India is at a growth stage wherein increasing resources are being infused to develop sustainable, low-cost, and cutting-edge technologies. These clean water specific technologies and innovations developed by both startups and public R&D labs, many of which are also a part of AGNIi's portfolio, are targeted towards improving availability as well as quality of water to ease challenges faced by Indian citizens.

Improving Water Availability

Innovative technology solutions like Atmospheric Water Generators (AWGs) are alternatives that can help make affordable clean water available to Indian citizens. AWGs essentially extract water from humid ambient air and convert the same into potable water. These are decentralised, economical and environment friendly systems that generate clean water through a multi-stage filtration process and then mineralise the same before dispensing. Such systems developed by indigenous startups are available in various sizes and have capacity to process 30 to 2,000 litres of water/day. Recently such solutions have gained traction and have been installed in public spaces such as the Secunderabad railway station in Telangana[5] by the Indian Railways and schools in Uttarakhand[6] to ensure availability of improved quality water. Additionally, as noted above a major clean water availability challenge in India is lack of clean drinking water within the household premises. In this context, there are indigenous solutions available that enable doorstep delivery of safe drinking water through remote supervision and control through GPRS connectivity in real time. Such solutions have been deployed across locations in Gujarat, Maharashtra, Uttar Pradesh, and Delhi. Last but not the least, leveraging technology and innovations for restoration of water bodies is another sustainable method for improving water availability. Water bodies become the first victim of water pollution. Rapid urbanisation and industrialisation are the major causes of depletion of water bodies as they become dumping ground for industrial effluent, garbage, and silt. Technological solutions can help

[5] https://inc42.com/buzz/secunderabad-railway-station-gets-indias-first-water-from-air-system/.
[6] https://timesofindia.indiatimes.com/city/dehradun/scientists-install-atmospheric-water-generator-units-in-15-schools-in-uttarakhand-to-tackle-water-supply-issues/articleshow/91841997.cms

restore these water bodies and reverse the effects of pollution. Such innovations utilise artificial intelligence based electromagnetic mapping technology that enables them to predict presence of perennial water sources with high accuracy (90 percent and above) and develop the source within 100-120 days.

Improving Water Quality

Availability of water is half the battle won. The other half is to ensure that the available water is free of contaminants and fit for human consumption as otherwise it has severe repercussions for human health. In the context of water quality, innovative technology solutions can be broadly classified into two categories:

- **Filtration solutions:** The Indian innovation ecosystem provides various sustainable water filtration and membrane-based cost-effective technologies for treating water. Indian startups have developed patented water purifier technologies to produce clean potable water. Meanwhile, from the public R&D ecosystem, the Council of Scientific and Industrial Research (CSIR)- Central Salt and Marine Chemicals Research Institute, Bhavnagar has developed an indigenous hollow-fiber membrane technology that provides sustainable cost-effective process with nearly 100 percent water recovery to treat water containing suspended particles, pathogens, and other harmful micro-organisms. Similarly, CSIR- Indian Institute of Toxicology Research, Lucknow has developed *Oneer* an innovative water technology that eliminates pathogens such as virus, bacteria, fungi, protozoa, and cyst to provide safe drinking water to communities as per national and international standards prescribed for potable water. The community level model is of 450 LPH (liters per hour) capacity and can be scaled up to 5,000 to 1 lakh liters per day.
- **Monitoring solutions:** Water monitoring systems essentially utilise sophisticated tools such as IoT that enables low-cost, low-power, and real time monitoring of water quantity (water levels, flow, soil moisture, and rainfall intensity) and quality (pH, conductivity, turbidity, dissolved oxygen, trace metals, and microorganisms). Additionally, advance sensors, and data analytics systems also help in efficient monitoring of drinking water quality in a cost-effective manner. Platform solutions also address water monitoring concerns by generating information such as groundwater levels, quality, and quantity, calculate daily water footprints among other things.

Collaborating for Clean Water

AGNIi collaborates with various stakeholders to fulfill India's clean water needs. These stakeholders include non-profit organisations, government departments, ministries, and corporates among others. Below are some of the major water engagements that have been led by AGNIi.

1. Quenching Eastern India's thirst

Metallic groundwater contamination is a major problem in the Ganga-Brahmaputra plains of India. As a result, a large section of the Indian population that resides in these fertile river basins faces severe drinking water quality challenges. In this context, AGNIi collaborated with Aga Khan Foundation[7] in December 2018 to conduct a technology scouting exercise for identification of affordable water filtration technologies to be deployed by the Foundation in selected sites in Eastern India. AGNIi recommended water purification technologies developed by Bhabha Atomic Research Centre (BARC). These technologies addressed issues related to arsenic, iron, and multi-contaminants. AGNIi helped facilitate the engagement between the Foundation and BARC. Through AGNIi Mission's support, Aga Khan Foundation entered into a licensing agreement with BARC for deployment of these solutions at selected sites.

2. Strengthening Grassroots Networks

MeitY's CSC network with its strong on-ground presence can play a pivotal role in facilitating adoption of clean water technologies to rural remote areas of the country. To this end,

[7]kdn.org/our-agencies/aga-khan-foundation

AGNIi collaborated with CSC in February 2021 to organise a technology showcase for VLEs of Uttar Pradesh. The theme for the showcase was affordable and sustainable solutions for water purification and portability. A total of five startups and public R&D institutes presented their solutions to the VLEs. These solutions ranged from water filtration technologies to water portability solutions. Multiple engagements were facilitated between the VLEs and innovators for deploying these solutions in remote areas of Uttar Pradesh.

3. Partnering with Global Stakeholders

WaterAid[8], a multinational NGO works towards empowering local communities and ensures delivery of right innovations and technologies in pursuit of clean water and sanitation for all. In pursuance of these objectives in India, WaterAid partnered with AGNIi to organise a virtual technology showcase in early November 2021. Two clean water technology specific startups from AGNIi's portfolio that are associated with development of AWGs were shortlisted by WaterAid to present their solutions. These startups interacted with the WaterAid India team to understand the applicability of these solutions in different sites identified by the NGO.

Conclusion

Lack of clean water poses a significant human development challenge that can severely compromise the capabilities of large swathes of Indian population in contributing positively towards the country's economic growth and development. Taking cognisance of the same the Government of India has taken concrete steps like the JJM to resolve India's clean water challenges. Assisting the Government of India in this quest, AGNIi will continue to work to facilitate high impact water related interventions, to leverage affordable, scalable, sustainable, and universal technology and innovation solutions to ensure provisioning of clean water to Indian citizens, both rural and urban inclusive of those residing in geographically difficult and remote locations. Going ahead, AGNIi's focus would be to utilise indigenous innovations and technologies to – (a) ease the water related challenges accentuated by climate change events to ensure ecological sustainability and climate resilience across rural and urban India; (b) provide for the primary sector's water needs to help improve agricultural outcomes and India's food and nutritional security. This emanates from the fact that water, primarily groundwater is a critical input for agriculture; and (c) and last but not the least, cater to urban India's rising water demands. As per estimates, India's urban population is expected to add another 416 million people to its urban areas by 2050[9]. This rapid pace of urbanisation calls for immediate and better utilisation of technology solutions to meet India's water requirements effectively and efficiently. Thus, AGNIi remains committed to help India achieve its climate related goals, better public health outcomes, improve agricultural and industrial output, and propel the country towards timely achievement of SDG 6 as well as overall better socio-economic and human development outcomes.

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[8]https://www.wateraid.org/in/

[9]https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html

Keeping Water Resources Clean

Kanchan Puri and Ritesh Joshi

With continuous rise in population, the demand for water in India is expected to rise drastically. To reduce the burden of water borne diseases, clean drinking water is pre-requisite which ultimately help in overall improvement of public health. Water resources being finite, its replenishment every year is required and also to be consumed judiciously without polluting the sources. It is of utmost importance to periodically assess and monitor groundwater levels to understand availability and quality of water resources over time and across aquifers. It is critical that we understand a pro-environmental behavior is required to save our precious natural resources.

India is endowed with a rich diversity of natural resources, water being one of them. About 71 percent of the earth's surface is covered with water and almost all the water on the earth is contained in oceans, rivers, lakes, ice caps, as groundwater and in the atmosphere. For humans, water is an essential requirement and a critical resource for the maintenance of socio–ecological systems. India's water availability varies substantially across the regions, and over time. Of the total rainfall of about 4,000 BCM, 1,260 BCM are estimated to be available as the internally renewable water resources (https://publications.iwmi.org/pdf/H041798.pdf). The amount of water recommended by the United Nations for drinking, washing, cooking and maintaining proper hygiene is a minimum of 50 litres per person per day. Considering the current environmental issues due to climate change, water scarcity is one of the major threats. The global warming may affect the hydrological cycle which could result in further

intensification of temporal and spatial variations in precipitation, melting of snow and water availability. The report on "India's Initial National Communication to the United Nations Framework Convention on Climate Change" published by Ministry of Environment, Forests and Climate Change, in the year 2004 identifies the following projected impacts of climate change on water resources.

- Projected climate change resulting in warming, increase in sea level and melting of glaciers will adversely affect the water balance in different parts of India and quality of groundwater along the coastal plains.
- Climate change is likely to affect ground water due to changes in precipitation and evapo-transpiration.
- Rising sea levels may lead to increased saline intrusion into coastal and island aquifers, while increased frequency and severity of floods may affect groundwater quality in alluvial aquifers.
- Increased rainfall intensity may lead to higher runoff and possibly reduced recharge.

To address these issues, National Water Mission (NWM) was devised to ensure integrated water resource management helping to conserve water, minimise wastage and ensure more equitable distribution both across and within states. The Mission takes into account the provisions of the National Water Policy and to optimise water use by increasing water use efficiency by 20 percent through regulatory mechanisms with differential entitlements and pricing. It aims that a considerable share of the water needs of urban areas are met through recycling of waste water. It also ensures that the water requirements of coastal cities with inadequate alternative sources of water are met through adoption of new and appropriate technologies such as low temperature desalination technologies that allow for the use of ocean water. Also, building public awareness through national portals, media engagement, civil society involvement, curricula reform and recognition / awards is imperative.

The objective of Sustainable Development Goal (SDG) 6 focuses on the sustainable management of water resources, wastewater and ecosystems so as to ensure safe drinking water and sanitation for all. In the 2030 Agenda for Sustainable Development, countries have committed to engage in systematic follow-up and review of progress towards the Goals and Targets, using a set of global indicators. Further by 2030, it is also targeted to improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, reducing the proportion of untreated wastewater by half and substantially increasing recycling and safe reuse globally. As per the records mentioned by United Nations (https://www.sdg6data.org/indicator/6.3.1) around 56 percent of the world's domestic wastewater is safely treated. Wastewater collection and treatment help to protect freshwater systems, the oceans and also human health.

Under the visionary leadership of Hon'ble Prime Minister, Ministry of Jal Shakti launched Jal Shakti Abhiyaan. It is a time-bound, mission-mode water conservation campaign. The intervention areas under this programme include water conservation and rainwater harvesting; renovation of traditional and other water bodies/tanks; reuse and recharge structures; watershed development; and intensive afforestation. National Water Mission's (NWM) campaign 'Catch the Rain' with the tagline *'Catch the rain, where it falls, when it falls'* is to nudge the states and stakeholders to create appropriate Rain Water Harvesting Structures (RWHS) suitable to the climatic conditions and sub-soil strata before monsoon. Catch the Rain campaign creates mass awareness on segregation of grey water (wastewater coming from the kitchen, laundry, shower, floor cleaning, etc.) and black water (waste water coming from toilet) through different drains at household level. Also, it focuses on reuse of grey and black water separately after providing appropriate treatment to them individually for groundwater recharge and agricultural purposes. States have been requested to open Jal Shakti Kendra (JSK) in each district –in Collectorates/ Municipalities which shall act as a knowledge centre for the public to get information related to water and water sources in the district. The activities consists of revival of wetlands and protection of flood-banks; protection of water

catchment area; springshed development and management; geo-tagging and making inventory of all water bodies; and development of scientific district water conservation plans.

Further, the Jal Jeevan Mission aims to achieve the objective to provide safe and adequate drinking water through individual household tap connections by 2024 in rural India. The budget for Jal Jeevan Mission in 2021-22 has been increased to Rs 50,011 crore from 11,000 crore in 2020-21. At the announcement of Jal Jeevan Mission in August 2019, only 3.23 crore (17 percent) rural households were getting tap water supply in their premises. However, during the last one and half years, more than 4 crore new tap water connections have been provided in villages/ rural areas. Today, about 50 percent of rural households are having tap water supply. This is the speed and scale, with which the mission is working to change the lives of people living in rural areas. The mission has shifted the focus of water supply from villages/ habitations to households with provision of tap water supply to every rural household so that every family gets potable water in adequate quantity and of prescribed quality on regular and long-term basis.

The water supply scheme is planned and implemented as per a Village Action Plan, prepared with participation of the village community and approved by the Gram Sabha. Also to leverage the new technologies, steps have been taken to promote digital governance. Online Jal Jeevan Mission dashboard provides status on provision of tap water supply in rural areas. Water Quality Management Information System has been developed using the reports generated from water quality testing laboratories.

To sustain these efforts, we need to be careful about the wastage during supply of water through pipes, the leaking taps in buildings and other places. The limited resources of fertile land and freshwater are diminished by non-sustainable use. Unnecessary use of water and overdrawing groundwater should be avoided. Understanding the principles of pond water management and aquaculture is needed towards a sustainable blue revolution. Increased diversion of water for agriculture and industrial sector would require enhanced aquacultural water productivity. Therefore, integrated water management is the need of hour so as to provide clean water to the growing population.

In India, tanks, ponds and lakes have traditionally played an important role in conserving water for meeting various needs of the communities. We have at many places in India an age old practice of water storage and water recharge like the *bawris. Bawri* was the traditional way of collecting water. As per 5th Minor Irrigation Census 2013-2014, there are 5.16 lakh tanks and storages in the country as minor irrigation sources, out of which 4.62 lakh tanks are in use, and the remaining 0.53 lakh tanks are not in use. Many of these water bodies have gone into disuse because of the development of ground water irrigation systems, inadequate maintenance, encroachments, less discharge of water, storage not being filled up fully, siltation of storage, salinity, drying up, system getting destroyed beyond repair, etc. A study done by the Indian Institute of Science in Bangalore in 2016 suggested that if Bangalore were to harvest its rainwater and to recyle and reuse its water, it could meet its entire domestic water requirements. There is a need to encourage people to value water by creating the right incentives for conservation and judicious use.

Jal Abhyaranya Programme

Mountain natural springs are the main fresh water sources which serve nearly 40 millions of people across the Himalayas. Springs are areas on the ground that show groundwater outflow from aquifers below. Also known as *dhara*, *prava*, or *nola*, springs hold cultural significance in the Himalayan region. It has ecological importance as well for providing water to the rivers and providing water to communities living in the Himalayan region. The inhabitants of the Indian Himalayan Region (IHR) rely heavily on springs as a primary water source. Springs form the backbone of communities living in Leh, Ladakh and other northeastern states of the country. Spring water is used for drinking purpose as well as agriculture purposes. From an ecology perspective, a substantial amount of 23.9 percent of surface flow irrigation systems are based out of springs in HR. Scarcity of water in mountainous regions has always been a matter

Case study: *Naula* and *Dhara*- Traditional Water Harvesting Systems in Kumaun Himalaya

The Uttarakhand Himalayan region, which is situated in western Himalaya is endowed with natural water reservoirs in the form of natural springs/*naulas* (small aquifer where water deposits through seeping naturally)/*dharas* (springs)/*gadhera* (small annual river tributaries). *Naula* and *Dhara* (commonly called as natural spring or mountain spring) are the traditional water resource management systems, which are an important part of the history and cultural heritage of Uttarakhand. Most of the *naulas* and *dharas* located in the Kumaun region in Uttarakhand were constructed during medieval times to eighteenth century. *Naulas* exhibit unique architectural features in the Himalayas. These historical water sources were once commonly used for drinking water, are slowly dying. Interestingly, these water sources are still serving various communities in many hilly areas in the Kumaon region. In order to manage and conserve natural water sources for people, small tank like structures are made where water is collected from the porous floor and covered with a rough boundary of stone. As *naulas* have been considered as sacred sites, in order to cover the *naulas*, temple like structures were also made surrounding the area. At some places sculptures of Lord Vishnu or any local deity were also carved onto the walls. Generally, the entrance of *Naulas* is very small, in which only one person can enter at a time. *Naulas* are crucial to restore ecosystems in hilly tracts.

of concern. The water problems of hilly towns like Shimla are a direct result of drying of springs. According to estimate, almost all 58,000 inhabited villages in Indian Himalayan Region (IHR) are dependent on the natural water springs or small streams originated from springs, of which at least half of the springs are drying up or have witnessed decline in water discharge resulting in acute water shortages across thousands of Himalayan villages and hill towns. According to a Niti Aayog report, nearly half of the perennial springs have already dried up or are turning seasonal by limiting flow only during monsoon. Discharge of springs has reduced substantially directly impacting the people socially and economically.

Under the National mission on Himalayan studies programme of Ministry of Environment, Forest and Climate Change, the G.B. Pant National Institute of Himalayan Environment is taking lead in maintaining the Geo Database of spring inventory and developing demonstrative models of Gram Jal Abhyaranya in at least one village of selected districts of 12 IHR States. It also promotes replication of field model for rejuvenation of drying springs in the Himalayan states through technology and community based approaches for providing water security to local communities by the year 2024 in collaboration with the state agencies.

Way Forward

According to Shri Sonam Wangchuk (Founder, Himalayan Institute of Alternatives), the ice stupas are one of the innovative water conservation technique which need very little effort and investment. These can be used to provide water for agriculture and other uses in early summer. The ice stupas are formed using glacial stream water carried down from higher ground through buried pipes, with the final section rising vertically. Due to the difference in height, pressure builds up and the water flows up and out of the pipe into sub-zero air temperatures. The water then freezes as it falls to gradually form an ice cone or stupa. In late spring the melt water is collected in large tanks and then fed onto planted land using a drip irrigation system.

With continuous rise in population, the demand for water in India is expected to rise drastically. To reduce the burden of water borne diseases, clean drinking water is pre-requisite which ultimately help in overall improvement of public health. Water resources being finite, its replenishment every year is required and also should be consumed judiciously without polluting the sources. It is of utmost importance to periodically assess and monitor groundwater levels to understand availability and quality of water resources over time and across aquifers. It is critical that we understand a pro-environmental behavior is required to save our precious natural resources. Although change in behaviour for positive environmental actions can't be achieved overnight, it is a constant process. As rightly said by Padma Bhushan Dr. Anil P. Joshi that true capital of a nation is its natural resources; future demands balance between economy and ecology.

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Rejuvenation of Rivers

Rajiv Theodore

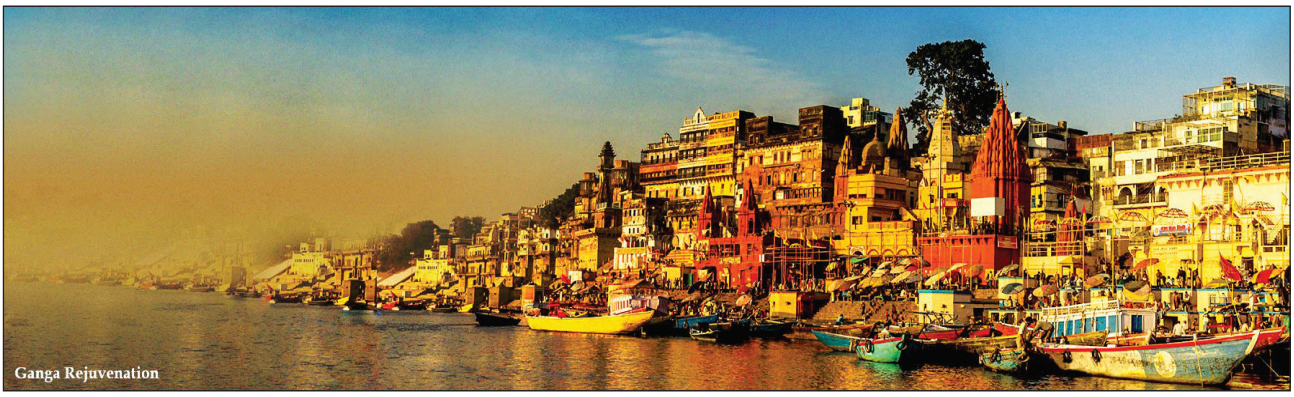
River rejuvenation is an effort aimed at restoring poor health of overexploited and polluted rivers and requires an understanding of the causes for the poor health and the restoration efforts. Depending on the level of deterioration, river rejuvenation aims at a new sustainable healthy river ecosystem that would go a long way in sustaining millions of livelihoods.

Rivers are undoubtedly one of the most ancient sources of water. It is common knowledge that the riverine systems have sustained civilisations after civilisations since the time immemorial. All the rivers and their tributaries are conventionally and dynamically the source of livelihood and help directly and indirectly in sustaining a diverse array of sectors –agriculture, power generation, fisheries, navigation, transport and tourism, poultry and livestock farming, pottery, sand-mining, art and craft, several small and medium scale industries, etc. Rivers also are integral to large-scale industries, such as leather industries, pharmaceuticals, electronics, textile, paper, tanneries, fertilizer, and oil refineries.

Today, there is an urgent need, especially in India, to resolve a looming water crisis that threatens to spill over to unprecedented levels. Looking from a broader viewfinder, the situation can threaten the socio-economic fabric unless water supply and flows are uninterruptedly distributed across the country. This is where river rejuvenation is the need of the hour—which must focus primarily on restoring the poor health of these overexploited and polluted water bodies.

Notwithstanding massive industrialisation post-Independence and ushering in of free-market after economic liberalisation in 1991, India's economy in essence remains agrarian with an estimated 65-70 percent of the population depending on farmland for sustenance, either as a landowner or farm worker. It means that water for irrigation has a direct bearing on not just the survival of rural India but also plays a decisive role in the country's food security. While the Green Revolution in the 60s enabled vast improvement in agricultural productivity, it also unleashed a surge in groundwater exploitation by using bore wells. Inefficient and unsustainable farming practices and loss of forests to farmlands depleted the access to water for agricultural and household use in rural India.

By 2030, 40 percent of the Indian population may not have drinking water if no effective measurement, including river rejuvenation, is executed. According to the 'Composite Water Management Index (CWMI) report, nearly 600 million Indians face high-to-extreme water stress–where more than 40 percent of the annually available surface water is used every year–and about 2,00,000 people are dying every year due to inadequate access to safe water. The situation will likely worsen as the water demand will exceed the supply by 2050. The National Institution for Transforming India (NITI) Aayog has developed the Composite Water Management Index (CWMI) to



Ganga Rejuvenation

enable effective water management in different states.

While Indian cities are grappling with water supply, the Aayog has called for "immediate action" as growing scarcity will also hit India's food security. States need to start managing their groundwater and their agricultural water, states the CWMI report–India's first comprehensive collection of nationwide water data. Groundwater in India has steadily depleted over the years while the average rainfall declined. Dry days — days without rain— during the monsoons have increased. The NITI Aayog report also stated if mitigation measures are not implemented, India can face a 6 percent loss in its gross domestic product (GDP) by 2050. Incidentally, India ranks 120th of 122 countries in a global water quality index.

The onset of climate change has already added a new dimension to the water and agriculture agenda, mainly in terms of enhanced adaptation at a regional, watershed, and household levels, including water storage, use of groundwater and surface water, wastewater capture and reuse, agroforestry, and investment in research. Special attention is needed for the uplands and mountains where much of the world's water supply originates. Currently, 80 percent of India's population depends upon the rivers for food, livelihood and other socio-economic pursuits. The river Ganges; for example, has the most populous basin in the world and perhaps the most polluted one too and has more than 750 polluting units releasing 501 MLD (million litres per day) of industrial effluents into the river. Most of the pollutants come from untreated wastewater, agricultural runoffs, and increased sediment accumulation. Pollution has become a rampant issue in most of the other rivers in India too.

Cities and towns need to formulate regulations and implement them to limit the number of pollutants that make their way into water bodies. Instead of channelling storm water into pipes and drains, a more natural method of water management having benefits for the environment and sustainable economy is required to be undertaken.

- Green Infrastructure—such as rain gardens, constructed wetlands or infiltration trenches can help filter out pollutants before they go into the river.
- Preserve natural features, such as floodplains with a natural vegetation buffer along streams that can slow, filter, and store polluted runoff.
- Street sweeping—picking up pollutants before they go down the catch basin and into the waterways.
- Separating sewer and stormwater lines – city municipality should upgrade old infrastructure and separate storm water pipe from rainwater pipes. There are various adverse effects of river pollution. Some of its effects may not be immediate and rest may recur after a long time. River pollution has been documented as a contributor to a wide range of health problems and disorders in humans.

Swinging into action the government has launched an ambitious mission to rejuvenate the rivers on a war footing. Thirteen key rivers are listed for a Rs 19,300 crore package that would address the whole gamut behind the real issue of dying rivers. Deforestation and forest degradation, scanty rainfall, flash floods, landslides, bank erosion, faulty agriculture and horticulture practices, soil erosion, excessive groundwater extraction, rapid urbanisation, unregulated floodplain, waste dumping, the release of effluents, unregulated tourism, pilgrimage, unregulated sand mining and riverbank encroachment have been outlined in another report as issues that are impacting the rivers in the country. The government stated that it has identified that the growing water crisis on account of depleting freshwater resources, especially due to the shrinking and degradation of river ecosystems, is a major impediment to achieving national goals pertaining to the environment, conservation, climate change, and sustainable development.

Various treatment models for natural, agriculture and urban landscape have been outlined in each of the delineated riverscapes. In agricultural landscapes it proposes agroforestry (bund and block plantations), high-density plantations, fodder plantations and plantation of fruit trees. In the urban landscapes a call for riverfront development, eco-park development,

industrial and educational estate plantations, and avenue plantations have been maintained. All this would help expand green cover along both sides of these rivers and their tributaries to increase groundwater recharge, reduce erosion and recharge aquifers as forests absorb rainfall and discharge water slowly into the river stream.

The rivers identified for this rejuvenation model include Yamuna, Krishna, Cauvery, Mahanadi and Brahmaputra. "The projects will alleviate growing water stress and help achieve national goals related to climate change and sustainable development," said Minister of Environment, Forest and Climate Change Mr Bhupender Yadav while jointly releasing in March this year 'Detailed Project Reports' (DPRs) of 13 rivers with 'Jal Shakti' (water resource) minister Mr Gajendra Singh Shekhawat. Thirteen rivers collectively cover a total basin area of over 18.90 lakh sq km that represents 57.45 percent of the geographical area of the country. The length of 13 rivers, including 202 tributaries within the delineated riverscapes, is 42,830 km.

The 13 rivers along with their tributaries will see forestry interventions in the catchment areas under different landscapes – natural, agricultural or urban. A total of 667 treatment and plantation models are proposed in all the 13 DPRs are meant for the proposed forestry interventions and supporting activities in different landscapes. Site specific treatments in terms of soil and moisture conservation and plantations of grasses, herbs, forestry and horticultural trees have been proposed for treatment of prioritised sites in the riverscape.

Each DPR incorporates detailed geospatial analysis of the delineated riverscape, exhaustive review on the river environment, factors responsible for the current state and prioritisation of areas using Remote sensing, GIS techniques along with field verification for proposed forestry interventions, designing and development of various treatment models for Natural, Agriculture and Urban landscape in each of the delineated riverscape and other conservation measures through an extensive consultative process.

The DPRs focus on protection, afforestation, catchment treatment, ecological restoration, moisture conservation, livelihood improvement, income generation, ecotourism by developing river fronts, eco-parks, and bringing awareness amongst the masses. Research and monitoring have also been included as a component. The treatments are proposed to be spread over a period of five years with a provision for additional time for maintenance of plantations. In case of delay in initiation of the project, the proposed outlay of the DPRs shall be adjusted using the Wholesale Price Index (WPI) since the project outlay was worked out as per costs prevailing during 2019-20.

The projects that will be implemented by state forest departments. A 'Ridge to Valley approach' shall be followed and soil & moisture conservation works would precede the plantation operations. Flexibility has been provided in change of species and sites in case the circumstances at the time of implementation so demand. Steering and executive committees at the national level and state level have also been proposed in the DPRs (for better coordination).

These proposed activities shall help achieve potential benefits of increasing the green cover, contain soil erosion, recharge water table and sequester carbon dioxide in addition to benefits in the form of non-timber forest produce. Forestry interventions are expected to increase the cumulative forest cover by 7,417.36 km^2 across 13 riverscapes. The proposed interventions would help to sequester 50.21 million tons CO_2 equivalent in 10-year-old plantations and 74.76 million tons CO_2 equivalent in 20-year-old plantations. The proposed interventions in thirteen riverscapes would help in ground water recharge to the extent of 1,889.89 million m^3 yr^{-1}, and reduction in sedimentation to the tune of 64,83,114 m^3 yr^{-1}. In addition, Rs 449.01 crore is likely to be generated from expected non-timber and other forest produce. It is also expected that the employment of 344 million man-days shall be generated through planned activities as provisioned in 13 DPRs.

These efforts will play an important role achieving the international commitments of India such as NDC forestry sector goal of creation of additional carbon sink of 2.5 -3 billion tons of CO_2 equivalent through additional forest and tree cover

The programme is expected to be executed through the state forest departments as nodal departments and with the convergence of schemes of other line departments in the states towards the activities proposed in the Detailed Project Reports and funding support from the Government of India. The government is optimistic that the initiative will play an important role in helping India achieve the international climate commitments such as:

- The creation of an additional carbon sink of 2.5 billion–3 billion tons equivalent through additional forest and tree cover by 2030 made just before the 2015 Paris Climate Agreement.
- Restoration of 26 million hectares of degraded lands by 2030 as a land degradation neutrality target under United Nations Convention to Combat Desertification and halting the biodiversity loss by 2030 under Convention on Biological Diversity and Sustainable Development Goals.

by 2030 under the Paris Agreement of UNFCCC, restoration of 26 million hectare of degraded lands by 2030 as a land degradation neutrality target under UNCCD, halt the biodiversity loss by 2030 under CBD and Sustainable Development Goals. It will strengthen the country's progress towards *Panchamrit* commitment at CoP26 during November 2021 in Glasgow whereby India promised to reduce its projected carbon emission by one billion tonnes by 2030, meet 50 percent of energy requirements with renewable energy by 2030, enhance non-fossil energy capacity to 500 gigawatt by 2030, reduce the carbon intensity of its economy by 45 percent by 2030 and achieve net zero emission by 2070.

It is seen that the river rejuvenation is an effort aimed at restoring poor health of overexploited and polluted rivers and requires an understanding of the causes for the poor health and the restoration efforts. Depending on the level of deterioration, river rejuvenation aims at a new sustainable healthy river ecosystem that would go a long way in sustaining millions of livelihoods.

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Role of Women in Water Conservation

Karthik Aniket Vadapalli

As it is said that while men might be the breadwinners of the household, it is the women who put the water on the table. Recognising the fact that women have always been burdened with water collection and management at the household level, the Jal Jeevan Mission has placed an emphasis on including women as decision-makers on water management, a role traditionally that has been denied to them. The key is to empower the decision-makers through this mission, involving women in both upfront operations in the Village Water and Sanitation Committee through a quota as well as train them to complete backend functions such as testing of water purity, etc.

Access to water has been the basis of human civilisation from a nascent stage to the modern concept of the nation-state. A cursory glance at most ancient civilisations such as Nile Valley or Mesopotamian shows that they have grown and flourished on the bank of a large river. The same has also held true in India where the Indus valley civilisation derives its very name from the river that was its lifeblood. While it would be natural to think that as we progress and incorporate more technology into our modern lives, the dependency we have on proximity to water sources would alleviate, this overall has not held true. It is no coincidence that eight of the ten largest cities in the world are located next to the coast. The UN estimated in 2017 that nearly 2.4 billion people live within 100 km of the coast. To put that into perspective, the number of people living within 100 km of the coast in 2017 is equal to the total population of the earth in 1950.

Women's Role in Water Conservation

As the population of the earth rose rapidly (the world population in the last century has nearly tripled), the pressure on limited resources such as freshwater continued to increase. The UN in 2010 estimated that over 800 million people still live without access to 'improved sources of drinking water'. Further, they stated that almost a billion people have to collect their water from distant unprotected sources. Invariably, the burden of water collection in water deprived households falls on the shoulder of women. In fact in 80 percent of these types of households, women and girls are responsible for the collection of water from distant water sources. The effects of climate change such

as heat waves, droughts, and extreme weather events make it more likely that women and girls will travel even greater distances to just meet their basic water requirements. In this context, it could be said that while men might be the breadwinners of the household, it is the women who put the water on the table. Unfortunately, the repercussion of this burden is felt by girls and young women in the form of loss of education and reduction in enrolment rates. Aside from the obvious scourge of malnutrition and the risk of water-borne diseases, lack of access to clean drinking water has other socio-economic consequences. This can be seen in the fact that a one-hour reduction in time taken to collect water has a drastic improvement in enrolment rates for young women in schools. There is a need to tackle the injustice of water insecurity to improve the lives of the people of India but there must be a recognition of the plight of women and young girls who are particularly vulnerable due to water insecurity.

Jal Jeevan Mission

The National Policy for Women in 2016 was a major step towards recognising the pressure that inadequate water supply places on women. The policy recommended that it is imperative to design all relevant government programmes on water management keeping in mind that women are the primary stakeholders.

Keeping the directives laid down in the National Policy for Women 2016 in mind, Prime Minister Shri Narendra Modi envisaged a bold plan to improve the lives of all citizens by providing every household with clean tap water by 2024. To achieve this objective, the Jal Jeevan Mission was launched on August 15, 2019, under the ambit of the Ministry of Jal Shakti. The stated objective of the Jal Jeevan Mission is to provide Functional Household Tap Connections (FHTCs) to every rural household. The government has been mindful that there is a greater need for government aid to certain areas and certain sections of society over others, and an emphasis has been placed on villages in drought-prone areas and Saansad Adarsh Gram Yojna (SAGY) villages among other similarly vulnerable areas. Community infrastructure such as schools, Gram Panchayat buildings, health centres and other such locations were given particularly high emphasis as they can service the needs of the many.

The government was aware that it must upgrade already existing programmes that attempted to improve access to water, it implemented several steps that went beyond simply building infrastructure. With that objective in mind, it was decided that the government must continue to monitor tap connections and ensure that they maintain their functionality. Further, a community approach to water management was to be taken, the government looked to increase ownership in the local community with regards to the infrastructure already built through contributions in cash, kind and/ or labour and voluntary labour (*shramdaan*). It also made it a key point of the programme to have the capacity building at the local level itself in the field of construction, plumbing, electrical, water quality management, water treatment, catchment protection, O&M to create self-sufficiency right in the village level.

This holistic approach to development had an immediate impact on the daily lives of millions of Indians. At the start of the Jal Jeevan Mission, only 17 percent or 3.23 crore households in India had household tap water connections, despite the unprecedented COVID-19 pandemic and the resulting lockdown, by March 2022, almost 6 crore more households had gained access to FHTCs. At this pace, the government is well on track to achieve its target of Functional Household Tap Connections in every rural household by 2024. Already all households in 108 districts, 1,222 blocks, 71,667gram panchayats and 1,51,171 villages have been provided with drinking water through taps achieving the objective of *Har Ghar Jal*. In fact, the Jal Jeevan Mission has reached 50 percent connectivity for tap water in rural households.

The 'bottom up' approach of the Jal Jeevan Mission can be seen via the fact that in last 24 months, tap water supply has increased four-fold from 24 lakh (9.3 percent) to about 1.36 crore (40 percent) households in 117 aspirational districts. Similarly, more than 1.15 crore households (38 percent) have been provided with tap water supply in 61 districts affected by Japanese Encephalitis-Acute Encephalitis Syndrome (JE-IES). Prior to the announcement of Jal Jeevan Mission, only 8 lakh homes (2.64 percent) in JE-AES affected districts had tap water supply."

The true achievement of the Jal Jeevan Mission is not only statistical numbers but rather the way the programme rises from the ground to create lasting change. We can see this in the way support has continued to be extended after the infrastructure surrounding FHTCs has been built. The objective is not to just build infrastructure but rather to make sure that the infrastructure that has been built continues to function and helps the community fulfil its basic needs so that development can truly take place.

This targeted approach can also be seen in one of the keys of the Jal Jeevan Mission, namely its emphasis on the role of women in achieving water security.

Women in Jal Jeevan Mission

The Prime Minister stated on the occasion of World Water Day on 22 March 2022, "No one understands the value of water better than women, if water conservation is handed over to women, they will ensure unimaginable positive results,". The Prime Minister in a separate interaction with Gram Panchayats and *Pani Samitis* /Village Water and Sanitation Committees on Jal Jeevan Mission said, "This is a village-driven-women-driven movement. Its main base is a mass movement and public participation". This demonstrates that the emphasis on the participation of women in Jal Jeevan Mission has been envisioned and advanced straight from the highest levels of the execution. This mission to empower women to manage water resources is based on research that women are more efficient at water management. Women have been shown to be more equitable in the division of water resources regardless of scarcity leading to better socio-economic outcomes for the community as a whole. Recognising the fact that women have always been burdened with water collection and management at the household level, the Jal Jeevan Mission has placed an emphasis on including women as decision-makers on water management, a role traditionally that has been denied to them.

The Jal Jeevan Mission envisions sub-committees of the Gram Panchayats to take up the role of planning, operations, implementation, management, and maintenance of the infrastructure provided under the Jal Jeevan Mission. These sub-committees, namely Village Water and Sanitation Committee (VWSC)/ *Pani Samiti*/ User Groups, etc, usually comprise 10 – 12 members and have a 50 percent representation of women as well as a proportional representation of the weaker sections of the concerned area. This puts the day-to-day decisions regarding water management directly in the hands of women, allowing previously marginalised groups to be the decision-makers. This results in the upliftment of women's rights at the grassroots level.

This approach can also be seen in other parts of the Jal Jeevan Mission. Water quality monitoring and surveillance activities which are a key part of the Jal Jeevan Mission have been designed to include women from the inception.

The government has laid out that every village must have five women that have been trained to test water samples for any kind of contamination. These women will be trained to use Field Test Kits (FTK) which can test 9 parameters such as pH, alkalinity, chloride, nitrate, total hardness, fluoride, iron, residual free chlorine and H2S. The Field Test Kits will be provided to Panchayats who will in turn pass the same on to the trained women. The Jal Jeevan Mission has already trained more than 9.13 lakh women to test water quality in the villages through FTKs. The ability to check water purity right in the village means that the chances of contaminated water being detected are much higher and therefore the spread of waterborne illnesses is less likely.

This inclusion of women at every level has meant that women – the primary stakeholders in water management – have been elevated to decision-makers leading to the likelihood of better decisions taken right from the ground up.

The fruits of this labour can be seen in the international attention received by India. The United Nation Development Programme in collaboration with the Ministry of Jal Shakti, in June 2021, released a report to highlight the critical role women play in water conservation. The report was in the form of a compendium, which highlighted the journey of 41 women who took on the challenge of alleviate water scarcity. The inspiring paths taken by them helped spread sustainable water management despite ever-present gender barriers. Through independent actions, grassroots-level bodies such as Gram Panchayats, Self Help

Groups, etc these women brought about a positive impact on sanitation, hygiene, flood protection as well as water conservation. The capacity of women, especially in the field of water management has been recognised both at the village level as well as the highest offices in the country.

Conclusion

Conflicts over water from the village level all the way up to multi-lateral international bodies are on the rise. Be it the damming of rivers, the pressures of global warming, or the contamination of water bodies, there are more reasons for both individuals and countries to be aware of the fact that water is a precious resource and must be treated as such.

The Government of India had taken cognisance of this fact and despite a global pandemic it has taken major steps over the past few years to alleviate the scourge of water scarcity. In fact, since the launch of the Jal Jeevan Mission in 2019, the government doubled the amount of Functional Household Tap Connections that have been installed as was in place since independence till the start of the programme.

The difference between previous attempts in the field of water management and the Jal Jeevan Mission is the emphasis placed on making sure that the time, money, and effort put in by the government and matched by the local population creates lasting change. A key way to ensuring this is to empower the decision-makers through the government programme, involving women in both upfront operations in the Village Water and Sanitation Committee through a quota as well as train them to complete backend functions such as testing of water purity, etc. This has the added benefit of placing women in positions of power right at the village level, redressing many social issues that could have held them back from leadership previously. The rewards of a well thought out and meticulously planned programme such as Jal Jeevan Mission are seen both in the raw numbers of house with FHTCs as well as the socio-economic benefit to the villages which for so long were underserved and not given the opportunity to maximize their potential. As has been stated previously, since it is women and young girls who have the task of providing water for the household, it should be women who make the decisions regarding the management of the same.

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From SDGs to Themes – To Enable to Achieve with Local Self-Government

Jayashree Raghunandan

We believe now in the time of SDGs, that in the 9 Themes there is a vision. Presenting effectively an achievable vision to the PRIs drives response and builds ownership. Local Self-Governments need the enabling environment to be provided by the States.

"We are off track. We need to act now" – Secretary General, United Nations, September 2019 at the High-Level Summit of world leaders', presenting the Political Declaration calling for the Decade for Action on the Sustainable Development Goals (SDGs). The last two years of COVID-19 have impacted all, and caused immense hardship and losses - loss of livelihoods, loss of health, loss of life, loss of support, loss of education, loss of childhood, loss of security, loss of humanity, the list goes on. COP26 highlighted the serious development issue and risks to lives and livelihoods accentuated by climate change. We started this journey of the SDGs in September 2015, as an Agenda for Transformation, to be achieved by 2030. We have in time travelled half way, but given where we are, it is time for a serious mid-course correction. As India carries one-sixth of humanity, its contribution to the achievement of SDGs is one of the most important determinants of the success of this global ambition countries have set for themselves.

"This is a great scheme for the development of people." "With this scheme, we can change not only the village, but India itself". "Not only for the rest of India, but for the world itself, it is a model scheme to show." Village Panchayat Presidents said this in the beginning of this century, regarding a scheme, Namadhu Gramam, built around village panchayat needs and aspirations focusing on easily relatable and relevant goals- Water, Food, Health, Education, Zero Poverty, livelihoods, Gender empowerment, social issues, Social Security, Sanitation, Environment, renewable energy, Infrastructure, -sounds like the Sustainable Development Goals (SDGs)? Funds to a panchayat under State and Central Schemes and Finance Commission Grants were far less then. The strategy hallmarks - involvement of Panchayat Elected Representatives, continuous training and IEC, Village Development Plans, converging schemes and funds with energies of people,incentives for achievement of progress and recognition. Drew amazing response! But this was only a Scheme in Tamilnadu, that had a short span 2004-2006. Yet there still is a logo and a writing on the wall seen in some village.

2015, a landmark year in many ways – the SDGs adopted by 193 countries, quantum leap of funds to Rs 40,000 crores per year, with the XIVth Central Finance Commission grants (2015-2020), introduction of Gram Panchayat Development Plan (GPDP) by the Ministry of Panchayati Raj (MoPR) followed by the Rashtriya Gram Swaraj Abhiyan (RGSA) Scheme of the MoPR, that spearheads GPDP and involvement of Panchayati Raj Institutions (PRIs), which RGSA states in its Objectives, in the very first one, 'Develop governance capabilities of PRIs to deliver on the SDGs'; first of its Expected

outcomes – 'Enhanced capabilities of Panchayats for good governance and attainment of SDGs through participatory local planning'.

Governance and development are closely linked. Achieving the SDGs through the PRIs will bring a qualitative change in governance, with conferring more capacity and resources upon these local governments.

The questions to ask and answer are - Are Panchayats tuned in to achieving these Goals? And more importantly - Are States ready to enable, involve and support Panchayati Raj Institutions (PRIs)to plan and achieve relevant goals for them?

On the tuning, in 6 years, SDGs have not become part of villages plans. GPDP analysis has shown that it is a wish-list, focused primarily on infrastructure, from schemes of PMGSY, JJM, SBM, and MGNREGA funding available with the Village Panchayats. Women & Child Development, Health, Welfare for persons with disabilities and aged, poverty alleviation, use of non-conventional energy, find minor to miniscule place. PRIs perform more an Agency function than as a Local Self-Government.

The Tune that can play

For the village to relate to the goals, it is necessary for goals to resonate, striking the chords of relevance, need and aspiration.

The Government of India, Ministry of Panchayati Raj recently through Localisation of SDGs (LSDGs) in rural areas with PRIs, has initiated the way forward of bringing the 17 SDGs as 9 Themes for each village Panchayat to aspire to achieve for its people-

1. Poverty free and Enhanced Livelihoods village
2. Healthy village
3. Child friendly village
4. Water sufficient village
5. Clean and green village
6. Self-sufficient Infrastructure village
7. Socially secured village
8. Village with Good Governance
9. Engendered Development in village

The Revamped RGSA for the period 2022-2026 is supporting to achieve these 9 Themes that covers all the SDGs. The Azadi Ka Amrut Mahotsav week of MoPR in April 2022 focused on these 9 Themes. Joint Advisories covering 26 Departments and 19 Ministries of Government of India have been communicated to all States and Union Territories for convergent action using all schemes towards achieving these Thematic goals for the Panchayat.

Every Theme is a powerhouse for the Panchayat. Poverty Free and Enhanced livelihoods look at multi-dimensional poverty and covering SHGs, FPOs, MSME, Skilling etc. for livelihoods; Healthy village covers health and well-being for all at all ages; Child friendly village is on the 4 pillars of survival, development, protection and participation. Water sufficient village covers all uses, domestic, agriculture, institutional and sustainability addressing groundwater, rain water harvesting, water bodies; Clean and Green Village on sanitation, climate, ecosystems; A Socially Secured Village where everyone feels cared for -children have protection, all aged are cared for, all women are safe, people with disabilities are assisted to access all their entitlements, etc. Engendered Development brings focus on gender equality,and how far a village is responsive to various gender needs. Self-sufficient Infrastructure covers the Panchayat ghar, anganwadis, schools, health centres, roads, electricity, houses, threshing floors, fish drying yards etc. Good Governance in village on the 5 T framework – Teamwork, Technology, Transparency, Timeline and Transformation, directly deriving from SDG 16 can deliver better across all Themes. A comprehensive whole in 9 Themes covering SDG 1 to SDG 16 with multiple relevant targets from SDGs drawn into each. SDGs stand unraveled. Village Panchayats can tune and self-drive to address aspects from different Themes, based on its priorities, and needs, towards achieving the Thematic goals. No Theme is complete without its various aspects, and Panchayats work on the Sub Themes/Local Targets towards holistic and sustainable development. No Village Panchayat can ever be at its level of achievement if it has not built-in sustainability.

Enabling the Tune to play

The bigger question is the enabling environment part in the hands of the States. Schemes of different Departments are driven by Departments officials. There is no dearth of funds flowing through numerous Central and State Government schemes. But what is flowing and to where it is flowing is not information shared with Panchayats. Departments must inform and translate these flows into achieving the 9 Themes with active participation of PRIs. It is the PRIs which will make the maximum impact on the ground through delivery of services, with Leaving No One Behind. They have the resources and connections which can improve the efficacy of these large programmes and there will be a visible multiplier impact.

Climate change with global impact for a greener planet, can capture the attention of Villages to go 'Clean and Green'. National & State priorities such as Zero hunger, in the next 2 years, Anemia Mukt Bharat, Functional House Tap Connections by 2024, cannot be achieved without partnership with Village Panchayats and ensuring that it is convergent, systemic and sustainable, while simultaneously achieving on Socially Secured Village, Poverty Free and Enhanced Livelihoods village, Healthy Village, Water-sufficient Village, just contextualizing the mentioned priorities. Without making it too complicated, the PRIs can pursue Thematically the development goals more universally.

Certain areas would still be lagging behind. These are the areas where more support through Central and State assistance would be needed. What is also important is a cohort of development community, which can support the PRI institutions in integrating the Thematic (SDG) goals in their plans and schemes and with no village left behind.

To what extent the Themes will become a shared vision and will be achieved, depends more on the State Governments, as history has shown, 73rd Amendment to Constitution of India notwithstanding, Government of India's Ministries guidelines on Schemes for involving Village Panchayats notwithstanding, the ground realities are controlled by State Policy.

And so, we come back after almost 2 decades to village goals and processes that was hailed as a vision for transformation of Panchayats, India and the world. We believe now in the time of SDGs, that in the 9 Themes there is a vision. Presenting effectively an achievable vision to the PRIs drives response and builds ownership, leading to an orchestra for people, prosperity, planet, peace, and partnership. The orchestra needs the enabling environment to be provided by the States. Are we going to show the world how to enable to achieve?

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