CSIR-National Institute of Science, Technology and Development Studies (NISTADS), New Delhi

Cordially invites you to

CSIR-NISTADS Collective Intelligence Policy Series

In collaboration with Vijnana Bharti (VIBHA) and Unnat Bharat Abhiyan (MHRD)

Water Resource and Quality Management for Sustainable Development

Date: July 21, 2020

Time: 10.00 am-12.30 pm

Chief Guest

Dr. Shekhar C. Mande

DG, CSIR and Secretary, DSIR, Government of India

Distinguished Panelists

Dr. Laxman Singh Rathore
Former Director General
India Meteorological Department (IMD), Delhi

Dr. Sunil Chaturvedi
Vibhavari Founder, NGO, Madhya Pradesh

Dr. V. M. Tiwari
Director
CSIR-National Geophysical Research Institute (NGRI), Hyderabad

Dr. Jayant Kumar Tripathi
Professor
School of Environmental Sciences
JNU, Delhi

Prof. Molly Kaushal
Head, Janapada Sampada
Indira Gandhi National Centre for the Arts, Delhi

Dr. Girija K. Bharat
Founder Director, Mu Gamma Consultants Pvt. Ltd., Gurugram

Patrons

Prof. Ranjana Aggarwal
Director, CSIR-NISTADS

Shri Jayant Sahasrabudhe
National Organizing Secretary, Vijnana Bharti

Prof. Vivek Kumar
Unnat Bharat Abhiyan (MHRD)

Organizing Committee

Dr. Sujit Bhattacharya
Chief Scientist, CSIR-NISTADS (Chairman)

Coordinators

Dr. Sumit Kumar Mishra
Principal Scientist, CSIR-NPL
Dr. Madhulika Bhati
Principal Scientist, CSIR-NISTADS (Moderator)
Pinaki Das Gupta
Ph.D Scholar, IIT, Delhi (Moderator)
Dr. Shiv Narayan Nishad
Scientist, CSIR-NISTADS

Highlights of the Policy Discussion

Water Resource and Quality Management for Sustainable Development

CSIR-NISTADS' Collective Intelligence Policy Series

In collaboration with Vijnana Bharati (VIBHA) and UNNAT BHARAT

21st July, 2020

Genesis of Collective Intelligence Policy series

COVID-19 pandemic has created a widespread global disruption and exposed serious flaws in many critical areas. The pandemic has highlighted, for example, the unpreparedness and inefficiency of existing models of health care systems globally including drug and vaccine development, inefficiency of production and global supply chains, urban infrastructure, transportation, food security among others. It has also shown how one can efficiently reorganize workplaces, education, health care, etc. through online modes. A close reading of recent global discussions on these issues underscore India's influential role in the present crisis. The world has high expectations from India in stabilizing the global economy, and in developing an environment-health-safety ecosystem that can address the post-COVID challenges. A new 'window of opportunity' has emerged for India to address the critical gaps by exploiting the opportunities that benefit India and the world at large. The Government of India has already taken strategic decisions that would enable India to be the global production hub of drug and vaccine including new drug/vaccine development, manufacturing, and integrating more aggressively in the global production supply and value chain. On the other hand, there is a strong policy focus on strengthening digital infrastructure, rural enterprise creation, strengthening the health care system, transportation, and urban infrastructure.

CSIR-NISTADS is a policy research think-tank that undertakes evidence-based policy studies on science-technology-innovation with an interdisciplinary perspective. The focus of the studies is for providing policy inputs and advocacy to Government for societal and industrial development through S&T interventions. The opportunities and challenges of COVID-19 for India motivates NISTADS to develop focused policy documents that can strengthen the government's efforts. A strong slant will be towards aligning the studies with sustainable development goals. NISTADS will host Webinars to bring in thought leaders, professionals and eminent experts. This exercise is expected to provide clarity, understanding and a clear direction towards bringing out focused policy documents. The key themes and topics to be covered under the policy discussion are highlighted below.

1. Healthcare system
2. Environmental Studies
3. Energy
4. Urban Planning (including Transport) and Capacity Building
5. Agriculture
6. Inclusive Development of Rural Sector
7. Digital Eco-system including Human Resource Development
8. Traditional Systems
9. Education
10. New & Existing Enterprise Development Science Diplomacy

With this aspiration, CSIR- NISTADS has organized first virtual Collective intelligence policy series on

“**Water Resource and Quality Management for Sustainable Developmen**t” in collaboration with Vijnana Bharati (Vigyan Bharati) VIBHA and Unnat Bharat Abhiyan (MHRD).

Water Resource and Quality Management for Sustainable Development

Conceptual Background

There is no question that today the world is looking at an inevitable water crisis. Large areas of our rivers have already been polluted above acceptable levels; most urban and municipalities have water shortages every year; large sections of the population have no access to safe water; overuse of groundwater has placed stress in much of the country; surface and groundwater contamination has created health issues. Rapidly disappearing water bodies have reduced the resilience of water systems; low efficiencies in irrigation water use have resulted in significant water wastage and poor water management practices and policies at all levels have contributed to the overall water crisis. Broadly water related problems can be categorized in four major subdomains which are inter-related namely: Availability, Accessibility, Quality and Sustainability. These aspects concerns the world at large and are of major concern of developing and large emerging economics like India.

Various studies such that of Niti Aayog’s highlight about 600 million Indians face high to extreme water stress and about two lakh people die every year due to inadequate access to safe water. It further estimates that by 2030, the country’s water demand would be twice the available supply, calling for an immediate attention to the crisis at hand. The creation of the new Jal Shakti Ministry and their flagship programme National Water mission and the clarion call for water conservation by the Honourable PM are steps in acknowledging and addressing the situation. To achieve the objectives of this program requires extensive efforts across the whole chain involving different stakeholders and the public at large. New perspectives based on evidences and knowledge sharing can strengthen this important programme. Some important learning for natural rejuvenation of water bodies and quality of water also came from the lockdown during this COVID pandemic that led to closure of all industrial and developmental activities and vehicular movement. This to a large extent echoes Indian philosophical and social underpinning of respecting our environment which can mitigate many of the global sustainability issues which we are facing.

CSIR-NISTADS intends to discuss many of these issues surrounding water sustainability including the various challenges we are facing. It also intends to develop through knowledge partnerships a policy document that draws from different perspective and provides new insights and directions to address many of the challenges. With this inspiration, CSIR- NISTADS is organizing first virtual Collective intelligence policy series on “Water Resource and Quality Management for Sustainable Development” in collaboration with Vijnana Bharati (Vigyan Bharati) VIBHA and Unnat Bharat Abhiyan (MHRD).

The policy series covered the different dimension of water sector; traditional knowledge/intellect for water resource and quality management, river processes, groundwater and post COVID -19 strategies to sustain the gain we achieved and also challenges in water sector due to this pandemic. The boarder themes were as follow:

Theme 1: Traditional intellect/knowledge base for integrated water sustainability

Theme2: Water use efficiency in agriculture

Theme 3: Ground water challenges and Technology and Policy intervention

Theme4: River processes, Environment flow and sustainability

Theme 5: Policy framework for Reuse of Treated Wastewater

CSIR-NISTADS, being a think tank are making effort to provide policy inputs and advocacy to Government by conducting these collective intelligence series.

Brief Highlights

Prof. Ranjana Aggarwal, Director CSIR-NISTADS initiated the collective Intelligence Policy series with her welcome address. She expressed NISTADS gratitude to all the eminent persons who have taken their time and efforts to be in this discussion meeting. She welcomed the Chief Guest Dr. Shekhar C. Mande, DG CSIR and Secretary DSIR, Govt. of India. She extended her welcome to Shri Jayant Sahastrabudhe, National Organizing Secretary Vijnana Bharti, Prof. Vivek Kumar, Deputy coordinator, Unnat Bharat Abhiyan and distinguished panelists Dr. Laxman Singh Rathore, former DG IMD; Dr. Sunil Chaturvedi, Founder, Vibhavari Foundation; Dr. V.M. Tiwari, Director CSIR-NGRI; Dr. Jayant Kumar Tripathi, Professor, JNU, Prof. Molly Kaushal, Head IGNCA and Dr. Girija K. Bharat, Founder Director Mu Gamma Consultants Pvt. Ltd and participants in the inaugural session of CSIR-NISTADS' Collective Intelligence Policy Series. She appreciated the effort of organizing committee: Dr. Sujit Bhattcharya, Chief Scientist, CSIR- NISTADS (Chairman of this committee), Dr. Sumit Kumar Mishra, Principal Scientist, CSIR-NPL, Dr. Madhulika Bhati, Principal Scientist, CSIR-NISTADS (Moderator), Mr. Pinaki Dasgupta (Co-Moderator), Ph.D scholar, IIT Delhi, and Dr. Shiv Naryan Nishad, Scientist, CSIR-NISTADS

Prof. Aggarwal provided a comprehensive overview of the genesis of this collective intelligence series. She underscored that the policy series has been initiated with the aim to bring together the thought leaders, professional and eminent experts in common platform. The Collective Intelligence Policy Series has been conceptualized in the context of the outbreak of Covid-19, which has drawn attention to many unforeseen challenges of unprecedented scale for mankind. She discussed the key themes that the policy intelligence series intends to cover, highlighting how through various partnerships the different issues under the various themes are being taken up.

She draw attention then to the discussion that is being organized under the theme 'water'. She hoped that with this eminent panel it is expected that it will help provide clarity, understanding and clear direction towards developing a focused policy document that can address the challenges that we see surrounding various aspects of 'water'.

She also explained the reason of choosing the theme 'Water' for inaugural session for Collective Intelligence Policy Series due to its importance for socio-economic and sustainable development, energy, food production, healthy ecosystem and human survival. She also described the issue of inevitable water crisis due to climate change, un-regulated and free access of fresh water and inefficiency in waste water treatment. Some of the responsible factors are poor management of water systems, growing water intensive crops in agro-climatic zones and poor implementation of policies. She explained the aim of this event to suggest policy inputs to institutional and structural changes needed to improve governance and benefit of India's water resources.

Dr. Sujit Bhattcharya, Chairman, Organizing committee and Chief Scientist, CSIR-NISTADS introduced the DG, CSIR, and Secretary DSIR Dr Sekhar. C. Mande. DG, CSIR. Dr Bhattacharya highlighted some major contributions of Dr Mande and how his work has led to start of many national initiatives. CSIR is now actively involved in various interventions for addressing the challenges emerging from Covid-19. This has been possible due to the leadership provided by Dr Mande.

Dr Mande in his inaugural address specified that CSIR is along with its high focus on developing the best of science and technology that helps to bring new processes and products, is also deeply involved in interventions that can create social impact. CSIR he said is devoted towards the helping the rural society that has suffered during COVID pandemic due to the migration from urban to rural areas, etc. He appreciated NISTADS for starting this policy series and was particularly pleased to see the theme for today's discussion. He said that CSIR would be happy to support any initiative that emerges from the discussionHe also expressed his happiness that CSIR-NISTADS is partnering with VIBHA and Unnat Bharat Abhiyan in this. He wished the meeting all success.

Dr. Sumit Kumar Mishra, Principal Scientist, CSIR-NPL introduced Dr Jayant Sahasrabudhe. He highlighted the role played by Dr Sahasrabudhe in developing various initiatives that has helped science to reach out to the society at large. Dr. S Sahasrabudhe congratulated CSIR-NISTADS and knowledge partners on starting policy discussion on this emergent issue. He underscored how in this current scenario, it is important to come up with policy inputs required to ensure water sustainability.

Dr. Madhulika Bhati, Principal Scientist, CSIR-NISTADS introduced each panelist. In the opening remarks, each panelist highlighted Challenges, S & T gaps and actionable policy interventions.

Theme 1: Traditional Intellect/Knowledge Base for Integrated Water Sustainability

Science allows us to understand the essence of water's properties and function. Ethics helps us decide how to conserve, protect and distribute Earth's water resources. Spirituality helps us to identify our core convictions about the meaning and value of water. Water was the very foundation of the creation of the world, and because there can be no life without it, water was the main thrust of Rig Veda. Many of the biggest divinities, like Indra, Rig Veda's greatest king, are connected to water somewhere. We need to treat water as a protected treasure so awareness of Jal sanskriti's role in ensuring water sustainability should be learned in modern societies. Traditional societies have always carefully and consciously interacted with 'mother nature' in order to manage their everyday life. This ecocentric and reverent attitude of traditional societies is widely reflected in their attitudes towards plants, animals, rivers, the earth and their day-to-day activities.

Information base of water resources and quality management methodologies have been used for thousands of years in India. In order to ensure successful implementation and produce meaningful results within a limited time span, region-specific amalgamated traditional knowledge optimized with focused policies that turn natural heritage guardians-indigenous peoples-into valuable owners in surveillance and compliance with approved development are very important. This will provide strong foundation for realistic policy development on the protection of natural resources like water and the fight against climate change.

Dr. Sunil Chaturvedi, Founder, VIBHAVARI, NGO, Madhya Pradesh in his talk's elaborated that human beings begin to get evidence of civilization as well as water conservation traditions. 800 -600 BC The Hindu scriptures specifically refer to the arrangements of irrigated fields, river expressions, reservoirs, wells, etc., especially in the verses of the RigVeda. 321-297 BC Kautilya, guru of Chandragupta Maurya, the first emperor of India, has scripted the then administration and economy, which framed policies such as tax redemption for five years on construction of dams, reservoirs for water conservation, fines on misuse of water. It is evident that even then dams, reservoirs, wells were constructed to store rainwater in India.

He further underscored even in the Mohan Jodaro civilization, there has been evidence that at that time every third house had wells, the water of rivers was transported to the fields for irrigation through shallow pits. In the 5-6 century, Varrah Mihir has mentioned several methods of detecting ground water. In summary, he told water conservation and management of water begin with human civilization, whereas geo - hydrology is a very later phenomenon. Water conservation tradition in India is very ancient. In line with the need and local geography in different parts of the country, the society, incorporating various techniques from its traditional knowledge and experience, not only created water conservation structures but also built management and discretional use of water.

He emphasized that despite these rich traditions, we are undergoing water crisis today. The Niti Aayog report says that 70% of our country's population will not have drinking water in the coming time. It said "*We considered our traditions and culture as historical or mythical, and we thought our pursuit was backward. This was our biggest mistake. I learned to study these traditional water conservation systems when I started to work at ground level in a social institution called Vibhavari*". He further said "*Traditions are not just historical or mythical, but they are undoubtedly nurtured by the experience of generations and are part of our culture. Over the last 30-40 years, with the influence of European culture, we have assumed that our traditions have not a sense of scientific thinking, so we abandoned it*"

Prof. Molly Kaushal, Head, IGNCA drew attention to how our tradition has never considered five elements of the nature (Water is one of them) as commodity. She said "Human *being is not the center. Nature should be in the center. Human being considered themselves as controller. It is the main reason we are suffering from such kind of situations"*. She emphasized with community participation, we can have mass movement in form of JAL CHETNA OR JAL KRANTI

Policy Recommendations:

- Integration of the region-specific amalgamated traditional knowledge and modern knowledge optimized with focused policies to protect natural resources.
- Documentation and validation of traditional knowledge through scientific studies is needed

Theme 2: Water Use Efficiency in Agriculture

In India, 85-89% of water usage is for agricultural purposes and about 5% usage is for drinking and domestic purposes. Hence, even a small percentage saving of water in agricultural usage will have a significant impact in water availability for drinking and domestic purposes. The policy interventions for India 's agriculture and other livelihood systems, as well as cropping patterns to match the agro-eco-climatic characteristics of each region keeping in mind water endowment of the regions will provide strong foundation to achieve water and agriculture sustainability.

Dr. Laxman Singh Rathod, Former DG, Indian Meteorological Department has elaborated the issue and provide policy recommendations. He mentioned that the main challenge faced by agriculture is to produce enough food for a continued increase in population. However, in the context of ever-growing competition for water and land, climate change, droughts and anthropic water scarcity, and less-participatory water governance etc., the innovative issues in agricultural water management and practices at field level to basin scales is required along with overhauling the water management systems, mainly in irrigation to maximize the water use efficiency. India needs to enhance farm level availability of water & accessibility with desired quality on sustainable basis with due focus on environmental friendliness, and welfare of rural society.

Innovation issues in the water-agriculture-food nexus aim at various essential problems and objectives:

- Developing integrated approaches to water and food policies and practices;
- Improving water management in agriculture;
- Adaptation of agricultural systems to enhance water use and water productivity to face water scarcity and climate change;
- Ensuring sustainable management and conservation of natural and anthropic ecosystems favouring high-quality food production; and
- Fostering a participative and inclusive governance of water for food security and population welfare.

These issues cover a variety of challenges faced by the irrigated agriculture, which represents 16% of the world cropped area, but is expected to produce 44% of world food by 2050. In general, the term efficiency is used to quantify the relative output obtainable from a given input. Referring to the use of water in irrigation, efficiency may be defined in various ways, depending on the nature of the inputs and outputs to be considered.

- Economic efficiency
- Conveyance efficiency
- On-farm application efficiency or field application efficiency

The main argument that was made was the need to minimize all losses e.g. evaporation, percolation and enhance physiological leverage)

Quite different from strictly technical criteria of efficiency is the physiological index, known as *crop water-use efficiency*. The relevant measure here is the response of the crop to irrigation, not in percentage terms but as total biomass produced (above-ground dry matter) per unit mass of water taken up by the crop. Since, as mentioned above, well over 90 percent of the water taken up by plants in the field is normally transpired, crop water-use efficiency is in effect the reciprocal of what has long been known as the *transpiration ratio*.

To maximize crop water-use efficiency, by either of the above criteria, it is necessary both to conserve water and to promote maximal growth. The former requires minimizing losses through runoff, seepage, evaporation and transpiration by weeds. The latter task includes planting high-yielding crops well adapted to the local soil and climate. It also includes optimizing growing conditions by proper timing and performance of planting and harvesting, tillage, fertilization and pest control. In short, raising water-use efficiency requires good farming practices from start to finish.

Conservation of water

- Reduce conveyance losses by lining channels or, preferably, by using closed conduits.
- Reduce direct evaporation during irrigation by avoiding midday sprinkling. Minimize foliar interception by under-canopy, rather than by overhead sprinkling.
- Reduce runoff and percolation losses due to overirrigation.
- Reduce evaporation from bare soil by mulching and by keeping the inter-row strips dry.
- Reduce transpiration by weeds, keeping the inter-row strips dry and applying weed control measures where needed.

Enhancement of crop growth

- Select most suitable and marketable crops for the region.
- Use optimal timing for planting and harvesting.
- Use optimal tillage (avoid excessive cultivation).
- Use appropriate insect, parasite and disease control.
- Apply manures and green manures where possible and fertilize effectively (preferably by injecting the necessary nutrients into the irrigation water).
- Practice soil conservation for long-term sustainability.
- Avoid progressive salinization by monitoring water-table elevation and early signs of salt accumulation, and by appropriate drainage.
- Irrigate at high frequency and in the exact amounts needed to prevent water deficits, taking account of weather conditions and crop growth stage.

Policy Recommendations:

- Enhancing collaboration of knowledge generation and transfer between public and private actors,
- Transparent dissemination of information to strengthen governance & management of water use,
- Guide framers to make rational production decision including weather & climate information-based water management system,
- Streamline risk management policies etc.

It is also crucial to improve understanding of overall financial, environmental, soil health, water health and well-being situation of farm household to maximize WUE.

Theme 3: Ground Water Challenges and Technology and Policy Intervention

Ground water is contaminated due to the presence of one or more contaminants. Presence of Arsenic, Fluoride, Nitrates, Salinity, heavy metals etc. beyond the permission limit has been reported in many parts of India. Besides the contamination problem, unregulated groundwater extraction has led to overuse in many parts of the country, causing the groundwater table to plummet, drying springs and aquifers. The current challenges and existing technology and policy intervention, Gaps and future S & T intervention require and help to prepare the future action plans

Dr. V.M. Tiwari, Director, CSIR-NGRI is his talk mentioned the advanced decision support tools which can be helpful for water security in India. He mentioned the successful stories of CSIR-NGRI to help the farmer in the Hyderabad region to revive the sub surface water reserve. He also emphasized the integration of traditional knowledge and modern science based technologies is a better approach to achieve the water sustainability. He further underscored the need to integrated policy formulation keeping in mind the strong relationship of water, food and health.

Recommendation:

- Integration of traditional knowledge and modern science based technologies is a better approach to achieve the water sustainability.
- Integrated policy approaches keeping in mind the strong relationship of water, food and health.

Theme 4: River Processes, Environment Flow and Sustainability

The aspect of water management with environmental goals in India is still given much less importance than that for socio-economic purposes Due to increasing demand for domestic, industrial and agriculture uses, most river basins are water stressed. Focused technology and Policy intervention will play important role to balance between the environmental flow and socio-economic purposes.

Dr. Tripathi, Professor, School of Environmental Sciences, JNU mentioned that Rivers are the lifelines on landmasses; they, not only are conduits of water to regulate hydrological cycles but also transfer and distribute water, nutrients, and sediments for the use of ecosystems on the land and ocean for their services to the humankind and the planet. However, these developments related to electricity generation, water storage, and abstractions for the use of industry, agriculture, and urbanization, mightily stressed rivers for its functioning. The health of the rivers deteriorated to the extent, some of them are either are without flow or just remaining as wastewater flow, which the downstream ecosystems have disturbed and their ecosystem services got disrupted. The availability of clean and continued supplies of water is vital to all economic growth and developments. In the river basins, water management infrastructures are built to secure water supplies and manage the risks of floods and droughts. Construction of water management infrastructures, such as dams, reservoirs, canals, and other features, results in the changed flow regimes, which fulfill requirements and reduce problems of water availability to the humankind. To increase supply, minimizing risk, and maximize economic gains, water has been managed since urbanization started in ancient times. These modifications of river flows also resulted in a reduced availability of water for the uses of downstream stakeholders or ecosystems. Therefore, the concept of environmental flows, also called E-flows, emerged in the mid-twentieth century to care for the downstream impacts on freshwater and coastal ecosystems. Humans are an essential part of interconnected socioeconomic and ecological systems and are the main beneficiaries of the full range of benefits that environmental flow provides.

Apart from the developmental challenges, climate change, and its impact on the hydrological cycle has become essential to consider E-flows to manage water as a component of adaptation strategies and a necessary factor for resilience. The in-depth assessment of uncertainties of the natural flow of the rivers, and integration of the outcomes to the basin-scale management strategies, has become essential for equity of the water resource for all competing users, its sustainability and water security for the future. According to Sustainable Water Partnership (SWP, 2017), E-flows are a critical building block of water security. SWP suggests, "it is the adaptive capacity to safeguard the sustainable availability of, access to, and safe use of an adequate, reliable and resilient quantity and quality of water for health, livelihoods, ecosystems and productive economies." The implementation of E-flow is very challenging in the present social, economic, and political scenarios and its different contexts, including the physical environment. It is an operative tool to manage water supply, water-related risk management, energy, food security, livelihoods, economic development, sanitation, community resilience, and climate adaptation. It cares for everybody, industry, agriculture, people, ecosystem and its services, upstream as well as downstream stakeholders, climate, etc. Therefore, keeping these things in mind, the Brisbane Declaration on Environmental Flows (2018) declares environmental flows are essential to protect and restore biodiversity, aquatic ecosystems, and the ecosystem services they provide for all societies. The modified declaration (of 2007) defines "Environmental flows describe the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being." Many of the Sustainable Development Goals (SDG) have a direct dependency on Environmental flows, for example, SDG (6)-Clean water and sanitation, SDG (13)-Climate action, and (15)-Ecosystem and biodiversity, and many of the SDGs have an indirect dependency on E-flows.

To consider E-flow for a basin, it requires a detailed assessment that may not apply to other basin and vice versa. As the basin in consideration has its unique contexts regarding physical, legal, governance, stakeholders, data availability, and technical capacity, each basin need to be assessed for the contexts, water availability and level of alteration, environmental water demands, trade-offs and cost benefit, negotiating water allocation among competing users and monitoring and evaluation (SWP, 2017). Regarding the environmental water demands, the hydrological, hydraulic, habitat simulation, and holistic methodologies are used, where the first three are single-purpose contexts. The holistic approach integrates all components of the aquatic system in terms of duration, timing, magnitude, and frequency (SWP 2017). The applications of existing methodologies have included hydrological index methods, desktop hydrological analyses, hydraulic habitat analysis, and the Building Block method (BBM). The Holistic approach of the Building Block method (USAID 2017) describes three main components of E-flow regimes, i.e., survival flow, low flow, and high flow. Many countries assessed for, and implemented the E-flow programs; however, they are different for different countries. Some of the nation's brought legislation (e.g., Kenya and Tanzania) and made policy decisions on E-flows.

The environmental flow study is very new to India. However, many dams and reservoir projects conducted E- flow studies based on hydrological approaches, despite its limitations. Those include the Nathpa Jhakri hydropower project, the Yamuna River at Delhi. Regarding the context of E-flow approaches, India varies in many subjects, such as its agrarian economy, tropical monsoon climate, spiritual and religious importance, etc. The holistic approach of E-flow assessment applying BBM has been recently conducted for the Upper Ganga Basin. The study for Sangam, Prayagraj, for the Kumbh Mela 2013 also used the BBM method.

He also opined that there are many difficulties in the development of E-flow assessment and implementation in India because of lack of hydrological data, lack of understanding on hydrology-ecology-geomorphology-chemistry connections, lack of resources, the gap between scientists and policymakers, the problem in enforcement and non-applicability of methods developed one river to other rivers.

He recommended:

- Assessment of E-flows to manage water as a component of adaptation strategies and a necessary factor for resilience. The in-depth assessment of uncertainties of the natural flow of the rivers, and integration of the outcomes to the basin-scale management strategies, has become essential for equity of the water resource for all competing users, its sustainability and water security for the future

Theme 5: Policy Framework of Reuse of Treated Wastewater

Industrial and municipal wastewater remains a major source of water pollution. The Central Pollution Board (CPCB) have chosen 17 pollutant industry categories which contribute to the environment. Approximately 77 per cent of factories pollute water, while 15 per cent pollute air and the remaining eight per cent pollute air as well as water. The policies and action plans to enhance percentage of reuse of waste water within stipulated time frame required an immediate attention.

Dr. Bharat underscored that in December 2019, during the National Ganga Council meeting, the Honorable Prime Minister of India had highlighted the need to reuse and recycle solid and liquid waste and develop suitable revenue models and State policies thereby promoting long term sustainability. Thus, emerged the focus on developing a National Policy on Treated Wastewater Reuse (TWWR) that we are developing under the guidance of the Ministry of Jal Shakti (MoJS), coordinated by the National Mission for Clean Ganga (NMCG) and GIZ. It is supported by the India-EU Water Partnership (IEWP) and the Support to Ganga Rejuvenation Project. Along with her, the team comprises Mr Jeremy

Bird, Mr Krishna Chaitanya Rao along with her.

The National TWWR Policy will focus on two levels. Firstly, it will set out the commitments and actions at central level to underpin, support and facilitate implementation of TWWR across the country. Secondly, it will provide a model framework for States to consider in the development and enhancement of their own policy, regulatory and implementation frameworks, allowing flexibility to adapt them to their own contexts and priorities. It will also lead to the development of guidance material on successful business models and create an enabling environment for innovation in technologies and institutional arrangements.

Wastewater can be viewed as a resource and economic commodity. It opens new opportunities in the Water Sanitation and Hygiene (WASH) sector and is one component of a more integrated approach to water resources management that recognizes the interconnectivity of actions and responses and the importance of the circular economy. It contributes to the Sustainable Development Goals. Achieving SDG 6 (Ensure availability and sustainable management of water and sanitation for all), is a crucial part of achieving all the other SDGs. The interventions to meet the targets of SDG 6 extend far beyond achieving SDG 6 because it also contributes to all the other SDGs. Water is required for agriculture (SDG 2), energy production (SDG 7), industrial processes (SDG 9), urbanization (SDG 11), and it impacts life below water (SDG 14), terrestrial ecosystem (SDG 15). Besides maintaining the integrity of the natural environment, water is also a key driver of economic and social development, including health (SDG 3), gender equality (SDG 5), climate action (SDG 13) and peaceful and inclusive societies (SDG 16). It enables many of the SDGs and in turn is being enabled by many of them.

Although treated waste water (TWW) is a State subject, however it requires governance at the national level such as ensuring common regulatory standards for water quality and food safety; providing technological guidance on appropriate business models and overall risk management; raising awareness of potential for TWWR; financial support; research and capacity building.

Water pollution (SDG 6.3) is a significant factor contributing to India's water crisis. Nearly 70% of the country's water is contaminated and India is ranked 120th among 122 countries in a global water quality index. Untreated urban and industrial wastewater—which is often discharged directly into surface waters—are the main sources of water pollution. India has an immense opportunity to capitalize on projects that treat wastewater for recycling and reuse. Widespread water recycling and reuse offers a reliable, long-term water supply source for helping meet both potable and non-potable demand. By reusing water, India can significantly increase the utility gained out of all available water and help bridge the supply-demand gap. Reclaimed water could also represent a key supply for meeting the country's vast agricultural demand, reducing the strain on depleted groundwater resources. Further non-potable uses of reclaimed water include landscape watering, toilet flushing, fire protection, dust control, etc. When water recycling and reuse is deployed onsite or relatively near an end use, energy can be saved by avoiding the need to transport water over long distances. Furthermore, tailoring water quality to specific water uses reduces the energy needed to treat water.

By recognizing the proactive reuse of treated wastewater requires a considerable shift in approach, looking at waste as a resource. A set of attributes are proposed for use as 'touchstones' to test the viability of the emerging provisions for the Policy. It should be:

Adaptive, Encouraging, Inclusive, Innovative, Integrated, Pragmatic, Resilient, Reflective, Robust, Transitional

The TWWR Policy does focus on the:

- Title / Terminology – perceptions about ‘waste’
- Vision and objective
- Mandatory usage of TWW
- Water quality
- Water entitlement
- Business models and incentives
- Tariff
- Institutions
- Information/analysis systems
- Ensuring compliance with policy implementation

The Covid-19 pandemic has indeed shown us that our rivers do not need cleaning, we should stop polluting and it self-rejuvenates. It has also raised questions on protection of the public from new pathogens which need to be addressed in future policy, so as to manage the risks of future diseases that could potentially be transmitted through wastewater. Studies by the scientific community and academic institutions are essential for pandemic-proofing and preparedness.

Research indicates that monitoring wastewater is a better strategy for detecting the viral infections in any population. Using reverse transcriptase quantitative polymerase chain reaction (RT-qPCR) of the extracted RNA in wastewater from wastewater treatment plant (WWTP) would suggest if there is a chance of COVID 19 spread from the same WWTP.

The ongoing pandemic situation can be utilized to test whether wastewater-based epidemiology (WBE) can act as an effective technique to observe and manage public health. WBE can be an important tool as most infections are thought to be asymptomatic or undiagnosed infections. WBE can provide critical knowledge on identification of hotspots and understanding the dynamics of the infection thereby alerting the public health community to take up effective preventive measures.

Dr. Madhulika, Principal Scientist and moderator of the session further summarized that the science on which solutions to present and future global water problems must be based does not fall within the purview of single disciplines but rather is truly multidisplinary and inherently interdisciplinary. It embodies the fundamental physical and biological sciences as well as application of those sciences and substantial contribution from the engineering science, and hydrology climatology and geology. A host of institutional, policy and management issue must be addressed by fundamental and applied social science, which has been largely neglected in recent decades. On traditional aspect, she mentioned that traditionally, we built highly sophisticated system, which varied to suit different ecosystem, for harvesting every drop of water, indigenous remarkable system of flood management. Ancient Indians well understood the art of the water governance. We need to relearn its art and science.

Mr. Pinaki Dasgupta, moderator (co moderating with Dr. Madhulika Bhati) asked the panel their views for upcoming National Water Policy. Each panelist provided the recommendations (as mentioned above)

Dr. Vivek, Deputy Coordinator, Unnat Bharat Abhiyan in his concluding remarks highlighted the importance of the traditional system of India to ensure water sustainability and briefed the following key points/recommendation that emerged from the discussion

Key Recommendations of the Policy Discussion

- Integration of the region-specific amalgamated traditional knowledge and modern knowledge optimized with focused policies to protect natural resources.
- Documentation and validation of traditional knowledge through scientific studies is needed
- Enhancing collaboration of knowledge generation and transfer between public and private actors,
- Transparent dissemination of information to strengthen governance & management of water use,
- Guide framers to make rational production decision including weather & climate information-based water management system,
- Streamline risk management policies etc.
- Improve understanding of overall financial, environmental, soil health, and water health and well-being situation of farm household to maximize WUE.
- Integration of the region-specific amalgamated traditional knowledge and modern knowledge optimized with focused policies to protect natural resources. Documentation and validation of traditional knowledge is needed
- Assessment of E-flows to manage water as a component of adaptation strategies and a necessary factor for resilience. The in-depth assessment of uncertainties of the natural flow of the rivers, and integration of the outcomes to the basin-scale management strategies, has become essential for equity of the water resource for all competing users, its sustainability and water security for the future.