सत्यमेव जयते
Government of India

DECEMBER
09-14, 2021

(Virtual Mode)

Sixth India Water Impact Summit (IWIS)

Valuing Water | Transforming Ganga

cGanga
Centre for Ganga River Basin Management and Studies
Indian Institute of Technology Kanpur

NMCG
National Mission for Clean Ganga
Ministry of Jal Shakti, Government of India

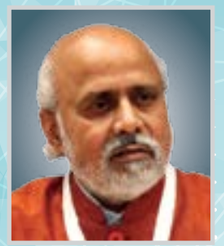
A CONSOLIDATED REPORT ON

SIXTH
INDIA WATER IMPACT SUMMIT
(IWIS)

09-14th DECEMBER 2021

(VIRTUAL MODE)

Preface



VINOD TARE
Professor and Founding Head
Centre for Ganga River Basin Management & Studies (cGanga),
Indian Institute of Technology Kanpur

RAJIV RANJAN MISHRA
Director General, NMCG
Ministry of Jal Shakti

The National Mission for Clean Ganga (NMCG) and the Centre for Ganga River Basin Management and Studies (cGanga) warmly welcome all participants from India and abroad to the Sixth India Water Impact Summit (IWIS-2021). The Namami Gange programme, being implemented by NMCG, is an integrated mission for the restoration and conservation of River Ganga and its tributaries. Towards this goal, a comprehensive Ganga River Basin Management Plan (GRBMP-2015) was developed by a consortium of seven IITs, which is being further developed by cGanga. cGanga acts in the capacity of a comprehensive think-tank to NMCG in its stated goals and objectives vis-à-vis the Ganga River Basin. Namami Gange aims to restore the wholesomeness of the river by ensuring Aviral and Nirmal Dhara, and maintaining its geo-hydrological and ecological integrity. Integrated River Basin Management (IRBM) approach is followed in Namami Gange with multi-sectoral and multi-agency interventions such as for (i) pollution abatement (Nirmal Ganga), (ii) improving river flows (Aviral Ganga) and ecology, (iii) strengthening people's river connect (Jan Ganga), and (iv) facilitating diversified research, scientific mapping, and evidence-based policy formulation (Gyan Ganga).

India Water Impact Summit, which was started as a one-time event nearly a decade ago, is now an annual event organized jointly by NMCG and cGanga. At the outset, a brief overview of the past five Summits is outlined here to elucidate how the present IWIS theme evolved. The 1st Summit, held in 2012 during the preparation of the Ganga River Basin Management Plan (GRBMP) by the IIT Consortium, was an aggregate of the then prevailing activities on India's water resource management. The 2nd Summit, held in 2017, attempted to establish a new multi-disciplinary, multi-stakeholder forum to bring together policy makers at national and regional levels, technology and engineering firms, finance and investment specialists, and interested civil society members to brainstorm on pressing issues of India's water environment. The 3rd Summit, held in 2018, reviewed the manifold efforts undertaken by government agencies to meet Namami Gange's goals of rejuvenation and conservation of India's National River Ganga, especially in the most critical Ganga Basin States – Bihar, Delhi, Uttarakhand, Uttar Pradesh, and West Bengal. The 4th IWIS in 2019 went further to explore ways and means of integrating science and policy for Integrated Water Resource Management, to assess and prepare for major water impacts in urban and rural areas of India, and developing new and innovative financing mechanisms through the Water Finance Forum initiated in IWIS-2017.

THE PRESENT SUMMIT

focuses on the assessment of different types of river resources, how these resources produce useful ecosystem services for human benefit, and how unplanned extraction, over-extraction and misuse of these resources adversely affect the resulting river ecosystem services

The ideas and suggestions that emerged from these four Summits led us to find comprehensive means to integrate river conservation in India's developmental path in the 5th IWIS (IWIS-2020). IWIS-2020 attempted to do this from the perspective of Arth Ganga, an ancient Indian concept revived by the Hon'ble Prime Minister to energize economic activities around the Ganga river. IWIS-2020 also intensified efforts to financially strengthen water management and river conservation in India through synergy between planners, executors, financiers, investors and regulatory bodies.

In pursuance of the issues and concerns that evolved from the previous Summits, a more focused assessment was needed on different types of river resources, how these resources produce useful ecosystem services for human benefit, and how unplanned extraction, over-extraction and misuse of these resources adversely affect the resulting river ecosystem services. This exploration, the main theme of IWIS-2021, was felt necessary to disseminate the means to firmly entrench river conservation in national development through sustainable river resource planning and management over the long term to meet the concerns of diverse stakeholders and instill clarity and comprehensiveness for planners, policy-makers and financiers.

The Plenary Sessions of the present Summit are devoted entirely to the main theme of the Summit with plenary discourses by keynote speakers of central and state governments elucidating their views on river resources allocation planning and management for large rivers on basin scales and on regional scales. With India's National River, the Ganga, in focus, the views of the political-governmental leadership of India and the main riparian States of Uttarakhand, Uttar Pradesh, Bihar and West Bengal are expected to throw profound insights into a properly coordinated river resources planning framework over the entire river network.

As in past Summits, the present Summit will cover the overall scientific, technological and policy issues in Track A. In the first session of this track, considering that some ecosystem services of rivers may be obtained without any significant resource abstractions or alterations while other services depend on anthropogenic interventions such as dams, diversions, landing ports, embankments, sand mining, etc., that affect river resources and, hence, the river ecosystem itself, a review of our present understanding of river ecosystem services vis-à-vis anthropogenic interventions will be undertaken for planning optimal and sustainable river ecosystem services on river basin scales. The roles and responsibilities of various stakeholders and governmental agencies in the monitoring, accounting and

A SPECIAL FEATURE

of the present Summit is to bring to fore the thrust and substance of some of the most important experiences and potential international partnerships with India to propel India's journey in water and river management and to help other developing and developed countries with India's knowledge and experience in this field

budgeting of river resources on basin scales is the subject of the second session of the Track. The third session is dedicated to the balancing of river resources with anthropogenic interventions in order to ensure healthy rivers through sustainable resource usage. The fourth session will focus on ways and means to empower local unorganized stakeholders to participate meaningfully in river resource conservation alongside various governmental agencies and mainstream institutions. Finally, the policy measures, planning tools and monitoring mechanisms to develop and implement a sustainable river resource management plan are to be considered in the fifth session of Track A.

Financial resources are essential for sustained efforts to integrate river resource management in development. Track B explores various needs and avenues of financing the comprehensive management of sludge from wastewater treatment plants, promotion of sustainable agriculture, water recycling and trading market, circular economy in comprehensive water management and green technology efforts in restoring and managing River Ganga.

As in the past Summits, IWIS-2021 will also showcase some of the most promising new technologies and innovations waiting to enter the Indian water space. As in many other spheres of Indian science and industry, digital water and data management have acquired great importance, and some of the innovations will focus on these aspects. Many other innovative approaches and inventions of great importance in environmental cleanup and green technologies for rivers and water usage are to be presented and discussed in detail in Track C.

A special feature of the present Summit is to bring to fore the thrust and substance of some of the most important experiences and potential international partnerships with India to propel India's journey in water and river management and to help other developing and developed countries with India's knowledge and experience in this field. The proposed sessions in Track D will highlight the key features of the experiences of many developed countries and of international partnerships with India involving EU, Norway and BRICS nations.

Finally, it is obvious that critical bottlenecks exist in India's laws, policies and governance principles that have been affecting river resource management and conservation efforts until now. A critical review of such bottlenecks are to be undertaken in Track E with a view to evolve pragmatic solutions that meet stakeholder expectations within India's cultural milieu and resource constraints.

In conclusion, we wish to thank our strategic partners, panelists, speakers, staff and volunteers who have had full faith in our objectives and ability, and have dedicated much hard work into making this Summit a success.

We hope that you find this Summit to be no less illuminating and constructive as the previous five Summits, and look forward to your valued participation.

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TRACK D

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TRACK E

POLICY, LAW & GOVERNANCE

Inaugural Session:
"River Resources Allocation – Planning and Management at the Regional Level – Overall Basin"

DAY 1:
Thursday; December 09, 2021
11:00 – 13:00 hrs

MODE:
Virtual

WELCOME AND OPENING REMARKS:
Rajiv Ranjan Mishra [DG, NMCG]

INTRODUCTION TO 6TH IWIS THEME:
Vinod Tare [Founding Head – cGanga, IIT Kanpur]

GUEST OF HONOUR:
Prahlad Singh Patel [Hon'ble Minister of State, Jal Shakti Ministry, GoI]

INAUGURAL ADDRESS:
Gajendra Singh Shekhawat [Hon'ble Minister, Jal Shakti Ministry, GoI]

Shri Rajiv Ranjan Mishra (DG, NMCG) warmly welcomed Chief Guest, Shri Gajendra Singh Shekhawat, Hon'ble Minister of Jal Shakti, the Guest of Honour, Shri Prahlad Singh Patel, Hon'ble Minister of State, Jal Shakti, and other conference participants. In his introductory address, he recounted the lively journey of NMCG's multi-sector Namami Gange programme founded on the Ganga River Basin Management Plan formulated by IIT Consortium, with the programme having now reached a mature stage wherein a planning cycle can be developed with valuable knowledge inputs emanating from each IWIS and other sources. Professor Tare (Founding Head – cGanga) briefly introduced the Summit's Theme, emphasizing that "river restoration and conservation efforts are fruitful only if there is systematic and balanced use of river resources for all contenders (including humans and river species)."

Shri Prahlad Singh Patel (Hon'ble Minister of State, Jal Shakti Ministry, GoI) highlighted the role of rivers with their waters, soil, nutrients, minerals, biodiversity and neighbouring forests in fostering a healthy environment. Thus, tourists also are immensely attracted to rivers and waterbodies, he said. But he also pointed to river-related disasters like floods and droughts. Hence, the government has been strongly promoting the inter-linking of rivers (like the Ken-Betwa river interlinking project) to maximise their benefits and minimize the risks, for which inter-state cooperation is essential. He also made a fervent plea for change in lifestyles and attitudes to help overcome the present and future challenges that we face.

Shri Gajendra Singh Sekhawat (Hon'ble Minister, Jal Shakti Ministry, GoI) highlighted the Hon'ble Prime Minister Shri Narendra Modi's resolve to restore and conserve River Ganga through a holistic basin-wide plan focussing on "Aviralta" and "Nirmalta" of the river. Since then, the government has worked incessantly and achieved unprecedented results meeting its goal much faster than almost any major river restoration project in the world – be it the Thames of UK, Europe's Danube river or any other river, and now it is time to work speedily on other rivers of India. And to further achieve the Prime Minister's resolve of Arth Ganga, the government is now incorporating Ganga Tourism, Ganga-based Medicines, and other livelihood and economic issues into the programme along with Ganga Aarti and Jan Ganga activities. He also commended the significant brainstorming in IWI Summits and looked forward to early incorporation of the present Summit's recommendations. He ended his speech with an invocation from the Vedas for everyone to work jointly with a common purpose and unified approach.

Highlights

"Namami Gange programme was founded on the Ganga River Basin Management Plan formulated by IIT Consortium, with the programme having now reached a mature stage wherein a planning cycle can be developed with valuable knowledge and inputs emanating from each IWIS and other sources."

-Rajiv Ranjan Mishra

"River restoration and conservation efforts are fruitful only if there is systematic and balanced use of river resources for all contenders including humans and river species."

-Vinod Tare

"भविष्य में हमारे सामने चुनौतियां ही चुनौतियां है, इसलिए बिहेवियर चेंज की जरूरत है। हमको अपनी जीवनशैली में परिवर्तन करना होगा।"

-Prahlad Singh Patel

"समानी व आकूतिरू समाना हृदयानि वरू।
समानमस्तु वो मनो यथा वरू सुसहासति॥"

अर्थात 'हमारे मन एक रूप हो, हमारा उद्देश्य एक रूप हो, हमारे विचार एक रूप हो, हमारे प्रयत्न सिंथेसाइज्ड हो। पूरेविश्व में हम सबको एक साथ खड़ा होकर, मिलकर, इस संकल्पना के साथ चुनौतीयों का सामना करने कि आवश्यकता है।"

-Gajendra Singh Sekhawat

River Resources Allocation – Planning and Management at the Regional Level – Upper Segment

DAY 2:
Friday, December 10, 2021
11:00 – 13:00 hrs

MODE:
Virtual

WELCOME ADDRESS:
Rajiv Ranjan Mishra [DG, NMCG]

INTRODUCTION TO 6TH IWIS THEME:
Vinod Tare [Founding Head – cGanga, IIT Kanpur]

KEYNOTE ADDRESS:
Guillermo Mendozo [US Army Corps of Engineers]
DP Mathuria [ED (Technical), NMCG]
G Asok Kumar [Mission Director, National Water Mission]
Lior Asaf [Water Attache, Embassy of Israel, New Delhi]

VOTE OF THANKS:
Rozy Agrawal [ED (Finance), NMCG]

Following the welcoming of dignitaries and introduction of the day's theme, Dr Guillermo Mendozo (US Army Corps of Engineers) delivered the first keynote address. Dr Guillermo underscored the uncertain future of climate change and its consequent uncertainty for Integrated Water Resource Management. Hence, he argued for scenario-based planning, keeping the worst-case dangers in mind, and thereafter arriving at an economic evaluation of the risks. In the following address, Shri DP Mathuria from NMCG provided quantitative estimates of the Ganga Basin's water resources, yields and utilizations, and how it is necessary to assign some rights to the common people. Dr Lior Asaf, Water Attache, Embassy of Israel, New Delhi then spoke on Israel's very efficient and reliable water management system. He delineated the much higher per capita freshwater use in India (about 6 to 13 times) as compared to Israel despite Israel's 24x7 water supply. This was possible despite Israel's limited freshwater sources because of technically sound water use, maximum water recycling/ reuse, water quality control, seawater desalination, comprehensive data availability, integrated water resource management, and its focus on sustainable, resilient systems. In the final keynote address of the day, Shri G Asok Kumar, Chairman, National Water Mission expounded on the success of NWM's nationwide "Catch the Rain" campaign wherein nearly 4.3 million water harvesting structures (WHS) were constructed, encroachments removed from 1.66 lakh WHS, 366 million trees were planted, and 278 Jal Shakti Kendras were established, along with intent to enumerate and geo-tag waterbodies.

Highlights

"54 percent of India already faces extremely high water stress. India must devise how it can meet its water needs for domestic, agricultural, energy, and economical development, and for nature in a sustainable manner."

-Lior Asaf

"Planning for deep uncertainty must bring back the human story of what is the most worrying problem."

-Guillermo Mendozo

"There is a sense in carrying forward missions like Jal Shakti Abhiyan, educating the people, creating small storages, as well as looking for other viable strategies."

-DP Mathuria

"There is a problem of multiple agencies handling water in India. Hence we established almost 278 Jal Shakti Kendras to handle all water related information in about 700 districts."

-G Asok Kumar

River Resources Allocation – Planning and Management at the Regional Level – Middle Segment

DAY 3:
Saturday, December 11, 2021
11:00 – 13:00 hrs

MODE:
Virtual

WELCOME ADDRESS:
Rozy Agrawal [ED (Finance), NMCG]

INTRODUCTION TO 6TH IWIS THEME:
Vinod Tare [Founding Head – cGanga, IIT Kanpur]

KEYNOTE ADDRESS:
DP Mathuria [ED (Technical), NMCG]
Victor Shinde [Programme Manager, National Institute of Urban Affairs]
Anil Prakash Joshi [Founder, Himalayan Environmental Studies and Conservation Organization (HESCO)]
Debashri Mukharjee [Additional Secretary, Ministry of Jal Shakti, GoI]

CONCLUDING REMARKS:
Rajiv Ranjan Mishra [DG, NMCG]

VOTE OF THANKS:
Rozy Agrawal [ED (Finance), NMCG]

Shri Rozy Agarwal welcomed guest and Dr Vinod Tare explained the theme for the session. Mr DP Mathuria, described the challenges in allocation of river resources between various competitive stakeholders. He also briefly described the importance of small rivulets in middle Ganga stretch.

DR VICTOR SHINDE, PROGRAMME MANAGER, NATIONAL INSTITUTE OF URBAN AFFAIRS
Dr Victor Shinde spoke about how NMCG and NIUA worked together and developed a framework known as urban river management plan. He also talked about the idea of creating riparian zone along either side of the river. This zone will act as a shock observer, protecting the river from detrimental impacts of the city.

DR ANIL PRAKASH JOSHI, FOUNDER, HIMALAYAN ENVIRONMENTAL STUDIES AND CONSERVATION ORGANIZATION
Dr Joshi said today 10,000 villages of the state of Uttarakhand are facing water scarcity. The rivers originating from the Uttarakhand area quench the thirst of the whole country. The area which is situated on the lap of the Himalayas is facing water scarcity. The biggest reason for this conflict is that neither we have the understanding about the water and water bodies nor we observe nature. Today our rivers are shrinking and drying up. We are observing shrinking rivers but not the shrinking forests. If the forests shrink, the rivers will also start shrinking.

During the recent COP 26 conference 80 countries pledged to plant forests under the leadership of Britain. It is a good thing, but it is important to understand that only by planting trees the forest does not grow. Forests have a relationship with the soil and the climate of the area. The knowledge of this relationship is hidden in the folk science there.

MS DEBASHRI MUKHARJEE, ADDITIONAL SECRETARY, MINISTRY OF JAL SHAKTI, GOI
It is extremely important effort to try and holistically assess the river resources and understand how they're being used. Who are the competing users? Before that we have to develop an understanding about water as a whole rather than in irrigation, urban, drinking water, sanitation.

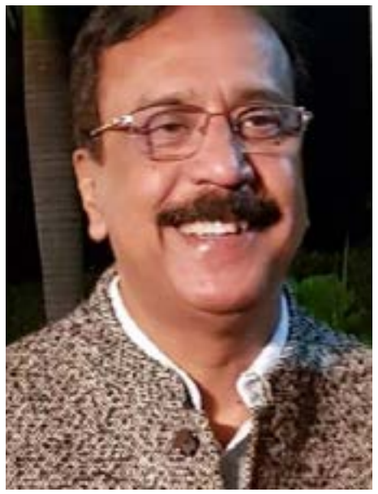
Once we've done periodic assessments of river resources, are we going to evolve processes by which we create a consensus in terms of planning and executing further interventions? The big question is how do we bring in the stakeholders? How do we bring in people into this process? How can we make this resource assessment central to further development planning? We have to find the answer together.

Highlight

"हमारे घरों के उपर लगी टंकी में और घर के भीतर नल में पानी की चिंता हमें बहुत सताती है लेकिन टंकी तक पानी कैसे आता है, कैसे आएगा? इस बारे में भी सोचा करो। जंगल, पहाड, प्रकृति और पानी को समझना है तो लोकविज्ञान को समझना होगा। प्रकृति ने पानी के जो रास्ते बनाए थे, उन्हें हमने बंद किया । उन बंद रास्तों को खोलना होगा तभी आने वाली पीढ़ीयों को पानी मिलता रहेगा।"

–अनिल प्रकाश जोशी

River Resources Allocation – Planning and Management at the Regional Level – Lower Segment



DAY 4:
Monday, December 13, 2021
11:00 – 13:00 hrs

MODE:
Virtual

WELCOME ADDRESS:
Rozy Agrawal [ED (Finance), NMCG]

INTRODUCTION TO 6TH IWIS THEME:
Vinod Tare [Founding Head – cGanga, IIT Kanpur]

KEYNOTE ADDRESS:
Ruchi Badola [Scientist, WII]
Syed Ainul Hussain [Scientist, WII]
Ritesh Kumar [Director, Wetland International South Asia]
Srinivas Chary [Centre Director & Professor, Administrative Staff College of India]

CONCLUDING REMARKS:
Rajiv Ranjan Mishra [DG, NMCG]

VOTE OF THANKS:
Ashok Kumar Singh [ED (Project), NMCG]

PROF SYED AINUL HUSSAIN AND DR RUCHI BADOLA, SCIENTIST WII

Following the welcoming of dignitaries and introduction of the day's theme, Prof Syed Ainul Hussain & Dr Ruchi Badola, in their keynote speech spoke about water abstracting scenario. They said that the gangetic plains is the most affected part in the country, where very high overdraft has been observed. Consumptive surface water use is also very high in the Ganga basin and the groundwater use is also very high across the country and also in Ganga plains. This over abstraction has subsequently resulted in river fragmentation. The Ganga basin is again the most affected part leading to river fragmentation and subsequently there is loss of species.

There is a global trend in species loss among them fresh water and flowing fresh water species are rapidly declining than any other ecosystem. Ganga river is home for eleven per cent critically endangered species, 16-17 per cent of endangered species and 25 per cent of vulnerable species, excessive resource extraction is a major reason for species loss in Ganga river and this is the high time to discuss about river resource management and allocation. We have to come up with triangle shape solutions consisting of micro planning at lower level and with horizontal linkages as well as vertical linkages with the district level.

DR RITESH KUMAR, DIRECTOR SOUTH ASIA WETLAND INTERNATIONALS

In a special address on River and Wetlands Dr Ritesh Kumar from Wetlands International shared significant information on the current condition of Wetlands and their role in maintaining the ecosystem. He said that if we continue to deal with rivers in isolation with wetlands, we have to face some dangerous consequences. Wetlands are like sponges for the river system. If you remove sponges the hydrographs will be far sharper. He talked about the wetland Index and said that the natural wetlands have been on a conspicuous decline across the globe, which is not a positive Indicator. To protect our river and river ecosystem we have to get wetlands firmly embedded within water security solutions. We have to understand that we could not achieve flood protection by destroying wetlands.

PROF SRINIVAS CHARI, CENTER DIRECTOR, ADMINISTRATIVE STAFF COLLEGE

Prof Srinivas Chari said that the corporates across the world are creating mass dialogue by getting influencers to speak their agenda. When we talk about rivers, we get only religious experts as influencers. We need to create influencers who talk about the river, who will engage the masses in our river related campaigns. By giving an example of Incredible India campaign, he said that we should also start campaigns like Incredible Ganga, Incredible Yamuna, Incredible Kaveri, etc.

He emphasised on the public participation in River management and said that not only Ganga but proper management of every river basin of the country is possible only by people participation. River basin management is connected not only with science but also with administration. That's why every district collector in the country should do RBM (River Basin Management) course in the same way as every district collector is completing Bharat Darshan course.

Highlight

"Wetland Management cannot be handled singly by the environment or forest department. Unless water resource planners, fisheries, energy planners, revenue planners, people who deal with bio diversity and tourism sit together, it is not possible to generate a sustainable solution."

-Ritesh Kumar

River Resources Allocation – Planning and Management at the Regional Level – Deltaic Region

DAY 5:
Tuesday, December 14, 2021
11:00 – 13:00 hrs

MODE:
Virtual

WELCOME ADDRESS:
Ashok Kumar Singh [ED (P), NMCG]

INTRODUCTION TO 6TH IWIS THEME:
Vinod Tare [Founding Head – cGanga, IIT Kanpur]

KEYNOTE ADDRESS:
Mike Pandey [Nature Filmmaker]

SPECIAL ADDRESS:
Yogesh Kumar [Additional Commissioner, MGNREGA-UP]
Anamitra Anurag Danda [Director, Sundarbans Programme Office, WWF]
Manu Bhatnagar [Principal Director, Natural Heritage Division, INTACH]

MR YOGESH KUMAR, ADDITIONAL COMMISSIONER, MGNREGA
As per MGNREGA about 65 per cent of the total amount is allocated for the schemes related to environment protection. Under this scheme efforts have been made to revive local water sources like wells, ponds, and small lower order rivers, etc.

While explaining about work done under MGNREGA he mentioned that the use of NREGA scheme for river rejuvenation started sometime in 2018-19 when work on five rivers was initiated. Very good results were seen in the Karnavati river in Chitrakoot. Next year i.e. in 2019-20 in order to rejuvenate 19 small rivers, it was pointed out that for making a river healthy, maintenance of other water resources of the catchment area is also necessary, and so work on conservation of 698 ponds was undertaken. There were many small rivers, whose names were forgotten even by the local people, such as Yellow, Sasur Khadedi, Pandu, Badora, Morwa, etc. These rivers may be small in size, but they play a vital role in bringing water to the medium and bigger rivers and therefore their protection is also necessary. In 2021 work was done in the catchment area and course of 21 rivers. When workers join this task, they work with dedication and demonstrate an emotional connect with the river.

DR ANAMITRA ANURAG DANDA, DIRECTOR, PROGRAMME OFFICE OF SUNDARBAN, WWF
Sundarban is considered as one of the biggest delta regions and the biggest delta is facing the biggest challenges. The effect of all the changes in river stream and its basin is clearly visible in the delta region of the river. When the river is as big as the Ganga, then the challenges of the delta region become even bigger which cannot be solved in the delta region alone.

THERE WERE MANY
small rivers, whose names were forgotten even by the local people, such as Yellow, Sasur Khadedi, Pandu, Badora, Morwa, etc. These rivers may be small in size, but they play a vital role in bringing water to the medium and bigger rivers and therefore their protection is also necessary

By looking at the map of 1830, it can be noticed that the Sundarbans was situated right at the edge of Kolkata, today it has shifted to the south and we have a very small part of it. Despite this, however, it is still the largest mangrove ecosystem in the world. It has the highest biodiversity in the world.

Till now many efforts for cleaning the rivers are made but it is crucial to deliberate on how to distribute the resources of the river among human beings and other living beings. How to establish a balance between the human needs and the needs of other living beings dependent on the river? The Sundarbans is home to the national animal tiger and the national aquatic animal, the Ganges dolphin.

However, the sources of fresh water to some areas of the Sundarbans were disturbed. As a result, the Sundari mangroves, by which the Sundarbans are known, are almost lost from the Indian area of the Sundarbans today. Actually, Sundari mangroves cannot tolerate saline waters. For other species of mangroves, growth and condition is better than Sundari compared to the area inside

Highlights

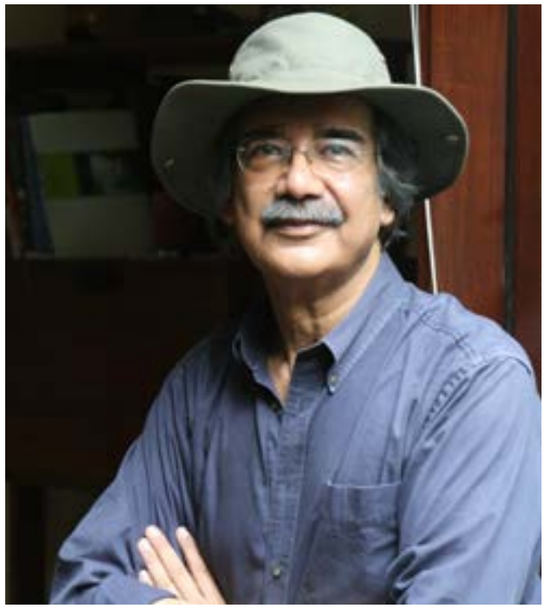
"As per MGNREGA about 65 per cent of the total amount is allocated for the schemes related to environment protection. When workers join this task, they work with dedication and demonstrate an emotional connect with the river."

-Yogesh Kumar

"Till now many efforts for cleaning the rivers are made but it is crucial to deliberate on how to distribute the resources of the river among human beings and other living beings. How to establish a balance between the human needs and the needs of other living beings dependent on the river? The Sundarbans is home to the national animal tiger and the national aquatic animal, the Ganges dolphin."

-Anamitra Anurag Danda

River Resources Allocation – Planning and Management at the Regional Level – Deltaic Region



Bangladesh borders. Actually, the Hooghly River and its tributaries are the source of fresh water in Indian part, in which human intervention is very high. On the other hand, the Brahmaputra and its tributaries are the source of fresh water in the area of Sunderban coming under the jurisdiction of Bangladesh, in which human intervention is comparatively less.

Apart from this, there are many other reasons which adversely affect the natural conditions of the Sundarbans. However, proper distribution of river resources can play an important role in resolving these problems. For this, systematic distribution of river resources will have to be done not only in the delta region but also in the entire basin.

MR MANU BHATNAGAR, PRINCIPAL DIRECTOR, INTACH

When the river reaches the plains and the sediments start accumulating in the river bed, then as a result of some natural geographical phenomena, islands develop in the river. When the seeds reach the land of the island, by birds, by wind or other similar natural causes, the plants grow there. These plants eventually turn into trees and stabilizes the island's surface and land.

River islands have been an untouched subject of the river in the context of research and study. Has dams stopped the accumulation of silt on the river bed? Is it affecting the origin of the islands or is the proportion of silt flowing with the rains increased? Is it causing the islands to grow? There should be research on these subjects.

River islands today have become the last refuge for many endangered species, on the other hand human intervention is increasing on these islands. Settlements are being established. The land is being cultivated by removing the natural vegetation. Is all this good for the river and the environment? There should be study on this aspect also. Who will have administrative rights over the islands of the river, it is also not clear. Some islands are located between the two banks of the river, so it is even more difficult to define the administrative jurisdiction over the island.

Recently Majuli Island situated in the middle of the river in Assam has been declared as an administrative district. It is the first district in India which is situated on the island of the river.

In such a situation, where human activities are increasing on river islands, the institutions working in the environmental sector including academic institutions should look into this aspect of the river. This aspect should also be included on the assessment and allocation of river resources.

Highlight

"River Island offer the last refuse for many species including turtles. Some Island act as wildlife corridors for the movement of several fauna. There is lot of value in terms of ecosystem services from this Island."

-Manu Bhatnagar

Valedictory Session

DAY 5:
Tuesday, December 14, 2021
16:00 – 17:45 hrs

MODE:
Virtual

WELCOME ADDRESS:
Ashok Kumar Singh [ED (Project), NMCG]

SUMMING UP OF IWIS 2021:
Vinod Tare [Founding Head – cGanga, IIT Kanpur]

ADDRESS BY:
Yamini Aiyar [President and CEO, Centre for Policy Research]
Rajiv Ranjan Mishra [Director General, NMCG]
Bishweswar Tudu [Hon'ble Minister of State, Ministry of Jal Shakti, GoI]

VOTE OF THANKS:
Rozy Agarwal [ED (Finance), NMCG]

Launch of Leather Trade Information Portal (LTIP) developed by Solidaridad in association with NMCG

DR VINOD TARE, SUMMIT CHAIR

Summit was conducted in five different tracks. First track was the plenary sessions where elected representative, government officials expressed their views on the theme of the summit, that is, river resource allocation planning and management at the regional level.

During different sessions participates got the chance to understand about the resources of the rivers in various segments i.e. right from the mountainous stretch to the deltaic region including middle stretch (as the river enters into the plains) and the lower stretch (as the river is ready to get engrossed into the sea). Each segment of the river has different kind of challenges, has different kinds of resources, and is capable of carrying out many processes and functions. Many goods and different kinds of services for various purposes are offered, and it is our responsibility to ensure that the capability of the river system remains intact for the humanity to be served forever.

MS YAMINI AIYAR, PRESIDENT AND CEO, CENTRE FOR POLICY RESEARCH, NEW DELHI

Ms Aiyer introduced her institution and said that she is pleased to sign MOU with NMCG today. She said, it will be our endeavour to support NMCG in fulfilling the objectives of mission. She said that the institution is looking forward in making various strategies for the mission and sharing of knowledge and information in river and water related matters which they are getting from various researches globally.

SHRI BISHWESWAR TUDU, HON'BLE MINISTER OF STATE, MINISTRY OF JAL SHAKTI

Shri Bishweswer Tudu congratulated all involved in organizing 6th edition of IWIS, and making this edition as meaningful and successful, if not more, than the previous editions. He Said that the efforts being made to save Ganga River from Gangotri to the Bay of Bengal, are visible not only on the banks of the river but in all parts of the country. He gave an example of Odisha; where work is being done on Mahanadi. He spoke about Indian culture of considering river as the mother and also said that in some way the rivers also take care of us, by saving them, we are actually securing our future. In this context he applauded the concepts of "Samarth Ganga" and the five pillars, namely Aviral Ganga, Nirmal Ganga, Gyan Ganga, Jan Ganga, and the Arth Ganga as well as considering the name Ganga as synonym to the river that has been clearly brought by cGanga through deliberations in this edition of IWIS. He expressed hope for a visible Impact of the knowledge exchange happened during the five days summit IWIS.

"The concepts of "Samarth Ganga" and the five pillars, namely Aviral Ganga, Nirmal Ganga, Gyan Ganga, Jan Ganga, and the Arth Ganga as well as considering the name Ganga as synonym to the river that has been clearly brought out by cGanga through deliberations in this edition of IWIS will give directions in not only India but to the on the efforts of river restoration and conservation".

SHRI RAJIV RANJAN MISHRA, DIRECTOR GENERAL, NMCG

Director General NMCG Rajiv Ranjan Mishra conveyed thanks to all participant and panellists. He spoke about the journey of NMCG and the journey of IWIS. He talked about the GRBMP 2.0 and wished good luck to all associates. He said that everyone imagines river from their perspective. To develop a complete understanding of the river, NMCG and cGanga has to work with lot of institutions and carry forward this particular quest for learning. The quest for understanding the river should remain the core of NMCG and its knowledge partner cGanga.

Valedictory Session:

Releases of Reports

1-3: These three Atlases depict the most relevant natural and anthropogenic features of the basin and its river network from the perspectives of the natural boundaries and the administrative boundaries of the river basin.

4. The “Samarth Ganga” framework, constituted of Aviral Ganga, Nirmal Ganga, Gyan Ganga, Jan Ganga, and Arth Ganga, is a multi-pronged approach that definitively leads to an Able Ganga which can fully perform all its natural functions and processes. Adoption of the "Samarth Ganga" framework can continue to serve the humanity for ever i.e. fulfilling the Sustainable Development Goals (SDGs).

Report 1: **Uttarakhand River Atlas**
Report 2: **Alaknanda and Bhagirathi River Basins Atlas**
Report 3: **Yamuna River Basin Atlas**
Report 4: **Samarth Ganga**

TRACK

A

THEMATIC SESSIONS' PROCEEDINGS

SCIENCE, TECHNOLOGY & POLICY

PANELISTS

Mallika Bhanot

Hubert Lohr

Michael McClain

Prashast Kumar Dixit

Birgit Vogel

Srinivas Chary

Syed Ainul Hussain

Priyank J Sharma

Kunal Satyarthi

Venkatesh Dutta

Manish Kr Goyal

Hemant Dhyani

Kees Bons

Barth Hilhorst

Ruchi Badola

Vikrant Jain

Bhawna Badola

MS Mohan Kumar

Anshumali

Christoph Hauer

Suresh Babu

Stefan Schmutz

Ajith Radhakrishnan

Maciej Zalewski

SK Srivastav

Alok Sikka

Yogesh Kumar

Priyanka Niranjan

Praveen K Thakur

Sejal Worah

6th India Water Impact Summit [IWIS 2021]

River Resources Allocation: Planning and Management at the Regional Level

Large rivers are rich in various resources that have been used by humans in their civilizational journey from foragers to agricultural settlers to industrial societies for an increasing number of uses. River resources tend to vary in amount and composition in time and along the lengths of rivers. Hence their abstraction or usage fulfils different needs in different times and in different regions. In the pre-industrial age humans mostly abstracted river resources in amounts or rates that did not exhaust the resource regeneration capacities of rivers, and rivers could recover their healthy ecological states even when over-exploited for short periods. But rapid, unplanned and often indiscriminate resource abstraction in modern times has led many rivers to degenerate, and even cease to exist in extreme cases. Systematic assessment of river resources and their regenerative capacities in different rivers and along different stretches of a river is, therefore, imperative in order to meet modern-day human needs optimally.

Usage of river resources by humans is generally identified in terms of goods and services provided by river ecosystems. The resources include diverse entities such as water (including dissolved solids & nutrients), sediment, biota (including biotic components), energy, and river space. River resources vary in amounts and proportion along their lengths, thereby offering variable ecosystem goods and service benefits in different river stretches. Thus, large rivers like the Ganga, Brahmaputra, Narmada, Kaveri and Godavari in India, while having their own characteristic resource troves, may also exhibit a common pattern in the distribution of resources as the river flows down from its upland source to its final destination to the sea. Rivers also tend to exhibit a common pattern in the distribution of resources over time (such as over annual cycles). Inventorizing and quantitative estimation of river resources in different stretches and over different time intervals are, hence, a first step in optimal allocation of resources for various purposes.

Secondly, the allocation of river resources must take into account the needs of different contenders in different regions or near different river stretches. The main contenders of river resources are riverine organisms (including amphibian species) apart from humans and other terrestrial organisms that benefit from rivers. Among these contenders, river biota are a primary contender of river resources since almost all river resources are vital for their sustenance and growth. However, the resources needed by river organisms may be significantly different from those used by humans in amounts and proportion. Hence the river resources of value to riverine organisms and humans (and other terrestrial organisms) need to be assessed independently.

The allocation of river resources to various contenders also needs to take into account that the different resources – and hence the different goods and services of rivers – are often interdependent. Hence the abstraction of one resource from the river may affect the availability of other resources. For instance, water abstraction from rivers may affect sediment flows, biodiversity, hydropower potential, navigability, aesthetic appeal, etc. Likewise, sand mining from river beds may adversely impact downstream river morphology and stability, habitat structures and biodiversity, water quality, etc. As another example, energy abstraction reduces the kinetic energy of flow and its sediment–carrying capacity; hence it can affect river morphology and flow turbidity, which in turn affects the ecological balance between rapid-water species and placid-water species or between species suited for turbid flows and those for clear water flows; etc. The interactive aspects of river resources and, hence, of river goods and services must, therefore, be taken into account for optimal and sustainable resource allocation. Simultaneously, the impact of selective resource abstraction from particular river stretches on resource availability in upstream and downstream stretches and on their regeneration/ replenishment over time also needs to be assessed to ensure sustainable resource use.

River Goods and Services vis-à-vis Anthropocentric Interventions for Basin Resource Planning

THE INTERACTIVE

aspects of river resources, and hence of river goods and services, must be taken into account for optimal and sustainable river resource allocation between different contenders

DAY 1:
Thursday, December 09, 2021
14:00 – 15:45 hrs

MODE:
Virtual

CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

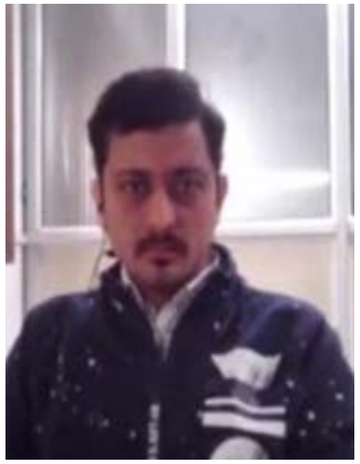
PANELISTS:
Birgit Vogel [Project Manager, GIZ]
Kunal Satyarthi [JS & Advisor, NDMA]
Mallika Bhanot [Member, Ganga Ahvaan]
Michael McClain [IHE DELFT]
Priyank J Sharma [Assistant Professor, IIT Indore]
Ruchi Badola [Scientist G, WII Dehradun]
Syed Ainul Hussain [WII Dehradun]
Sejal Worah [Director, WWF India]

A1.1 PROBING THOUGHTS

Our present understanding of river ecosystem services, i.e. the benefits people obtain from river ecosystems, comprise: (i) provisioning services such as food, water, fibre, genetic resources, and medicines; (ii) regulating services such as regulation of floods, drought, land degradation, water purification, and disease; (iii) supporting services such as soil formation and nutrient cycling; and (iv) cultural services such as recreational, spiritual, religious, aesthetic, and other nonmaterial benefits [Millennium Ecosystem Assessment, 2003, "Ecosystems and Human Well-being: A Framework for Assessment", Island Press, Washington, DC. (https://www.unep.org/resources/report/ecosystem-and-human-well-being-framework-assessment)]. These ecosystem services are directly dependent on the abundance of various river resources such as water, sediments, nutrients, biota, energy and space. The main contenders of the river resources are riverine organisms themselves (including amphibian species) since almost all river resources are vital for their sustenance and growth. But the resources needed by river biota may differ in amounts and proportions from those that benefit humans. Hence the river resources of value to riverine organisms, humans, and other organisms need to be assessed independently. This is especially important since human use of river resources often involve significant resource abstraction or alteration rather than limited use in situ. Selective resource abstraction from specific stretches also affects the availability of other resources and alters the resource balance of rivers. The interactive aspects of river resources, and hence of river goods and services, must therefore be taken into account for optimal and sustainable river resource allocation between different contenders.

Since the optimal and sustainable human benefits from rivers depends on interactive resource use and are subject to temporal and spatial variations, it is necessary to also consider the manner in which they are availed. While some ecosystem services may be obtained without any significant abstractions or alterations of the river ecosystem, other services depend on anthropogenic interventions such as dams, diversions, canal abstractions, landing ports, embankments, sand mining, fishing, etc. For optimal and sustainable planning of river ecosystem services on basin

River Goods and Services vis-à-vis Anthropocentric Interventions for Basin Resource Planning



scales, it may therefore be desirable to review our present understanding of river ecosystem services vis-à-vis the anthropogenic interventions that may be needed to avail them.

A1.2 KEY QUESTIONS

In the above context some critical issues that need to be addressed and resolved for comprehensive river basin management are:

- Identifying important River Resources such as Water, Sediments, Nutrients (both dissolved and solidified), Energy, Biota and Biotic Components, Morphological River Space, etc.
- What methods can be adopted to identify the Resource Needs and Priorities of Different Contenders: (a) River Biota, (b) Human Beings, and (c) Other Terrestrial Organisms.
- Identifying which river resources are interdependent, and on what spatial and time scales?
- Inventory of Potential Human Benefits vis-à-vis Anthropogenic Interventions: (a) Which goods and services are dependent on anthropogenic interventions in rivers and to what extent? (b) What are the impacts of these interventions on river resources and on other goods and services over different time and spatial scales?
- Review of River Goods and Services for Planning and Management of River Resources Allocation:
  (a) How should river goods and services be conceptualized given their varying dependence on anthropogenic interventions?
  (b) What criteria and methods should be adopted for resource allocation planning for availing optimal and sustainable river services?

A1.3 DISCUSSIONS

River resource allocation needs to address river resources identification, assessment, monitoring, evaluation, pricing, impact of abstractions/extractions (locally, as well as on upstream and downstream sides), community empowerment for resource utilization and upkeep, and equitable allocation. To what extent and manner we use or extract river resources so that the river health status remains reasonably good is of concern. For this purpose it is important to describe the natural characteristics of entire river basins and include all ecosystems and their habitats, and to especially assess the status of riverine biology and population. Rivers are normally valued most as a water resource, but rivers have multiple resources and multiple values, yet water acts as a switch to control all ecosystems services. The impacts of all water uses like hydropower, sediment mining, water extraction, on ecosystems need to be understood, and the areas of high ecological value and of extreme water use in these ecosystems should be delineated.

Rivers also have multiple stresses that arise largely from the terrestrial surroundings. The natural boundaries are those of the river basin, but to act on it we follow administrative boundaries. Combining this requirement of implementation within administrative boundaries and planning within natural boundaries is a challenge. We have to follow the bottom up approach in implementation, that is starting from the base

River Goods and Services vis-à-vis Anthropocentric Interventions for Basin Resource Planning

of the river network pyramid – the approach adopted in GRBMP 2.0 – for river restoration. Glacier-fed rivers would have different basin planning compared to rain-fed rivers. In river basin planning, we have to look at the physical barriers that we have created. Particularly in the mountains, rivers are largely obstructed by hydropower projects. Ganga is derived from the root word "gayam gachh": that which flows is Ganga; if she is not flowing, that's not the Ganga. We have already reached a threshold point and conservation is the need of the hour. We have to have the policies away from the aspect of sustainability to what is actually realistic on ground.

All facets of a river – hydrology, geomorphology, ecology and biochemistry – are interconnected at different spatial and temporal scales. Due to the hierarchical nature of river landscapes, the identification of river resources should consider the cascading effects of human-nature interactions along the river. By considering the scales at which anthropogenic interventions interact with river systems and threaten them, the utilizable rivers goods and services should be planned carefully from micro to macro levels, considering different complexities involved at each level. Our uses may be recreational, cultural, spiritual, economic, hydrological, or environmental – for each purpose the anthropogenic interventions can be monitored and tracked and negotiations can be conducted. The upstream-downstream linkages become extremely important for integrated river basin management planning for the synergies and payoffs among ecosystem services. Also, the role of climate needs to be explored because climate change exacerbates anthropogenic interventions and makes situations more complex. Thus the present understanding on river ecosystem services vis-a-vis anthropogenic interventions certainly needs to be reviewed.

Critical decision-makers are often people who are not at the grassroots level, and decision making is still happening in a top down manner. What is also lacking in planning is inadequate understanding of what drives many of the sectors that are dependent on rivers, so there are significant and often competing demands on rivers. We need to break the cycle of resistance from critical sectors like hydropower and navigation, and the key to this is communication.

Hence we need to break down big studies into smaller ones where we can start talking about real issues with real people. Despite information gaps, we need to understand the tradeoffs and negotiate. Now, Arth Ganga – meaning the holistic value of rivers – implies that river conservation and development are two sides of the same coin. Hence, there has to be a paradigm shift in our understanding of development. To include Arth Ganga into river basin management planning, we need to start planning from the lowest unit at the village level of the Panchayati Raj System. The decision support system has to be transported into planning at the lowest level. Ecosystem services of rivers being the services that are provided without our interventions, we need to use different languages for different stakeholders. Hence we can use different terminology such as goods & services and ecosystem values depending on the stakeholders being addressed. Overall, our goal should be towards an equitable participation to make Samarth Ganga. In Samarth Ganga, we make Ganga capable, self-sufficient, sustainable and powerful.

A1.4 RECOMMENDATIONS

The following recommendations may be distilled from the discussions presented above:

1. River resource allocation involves river resources identification, assessment, monitoring, evaluation, pricing, impact of abstractions/ extractions (locally, as well as upstream and downstream), community empowerment, and equitable allocation.
2. Rivers have multiple resources – not just water – and multiple stresses, but water acts as a switch to control all ecosystems services.
3. The impact of all river uses such as hydropower, sediment mining, and water extraction on ecosystems need to be understood, and the areas of high ecological value and the areas of extreme water use in these ecosystems should be delineated.
4. The natural characteristics of entire river basins – including all ecosystems and their habitats – should be considered, and the status of riverine biology and population should be assessed.
5. Due to the hierarchical nature of river landscapes, the identification of river resources should consider the cascading effects of human-nature interactions along the river.
6. By considering the scales at which anthropogenic interventions interact with river systems, the utilizable rivers goods and services should be planned from micro to macro levels, with integration of upstream-downstream linkages into river basin management planning to optimize the synergies and payoffs among ecosystem services.
7. We have to follow the bottom-up approach – that is, starting from the base of the river network pyramid, the approach in GRBMP 2.0 – for implementing river restoration.
8. Critical decision makers are often not people at the grassroots level, hence planning is based on inadequate understanding of what drives many of the sectors that are dependent on rivers and make significant – and often competing demands – on rivers. We need to break down the big studies into smaller pieces, and understand the tradeoffs and negotiate.
9. We need to break the cycle of resistance from critical sectors like hydropower and navigation, and the key to this is communication, using different terminology such as goods & services and ecosystem values for different stakeholders.
10. To include Arth Ganga into river basin management planning, we need to start planning from the lowest unit of the Panchayati Raj System at the village level.
11. Our main goal should be towards an equitable participation to make Samarth Ganga. In Samarth Ganga, we make Ganga capable, self-sufficient, sustainable and powerful.

WE HAVE TO FOLLOW

the bottom-up approach that is, starting from the base of the river network pyramid, the approach in GRBMP 2.0 – for implementing river restoration

Roles and Responsibilities for River Resource Assessment and Monitoring

DAY 2:
Friday, December 10, 2021
14:00 – 15:45 hrs

MODE:
Virtual

CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

PANELISTS:
Kees Bons [Deltares, Netherlands]
Syed Ainul Hussain [Scientist-G, WII Dehradun]
Bhawna Badola [Tree Craze Foundation]
Anshumali [Professor, IIT (ISM) Dhanbad]
Maciej Zalewski [Professor, Polish Academy of Sciences, Poland]
S K Srivastav [Scientist-G, IIRS-Dehradun]
Alok Sikka [IWMI-India]
Vikrant Jain [Professor, IIT Gandhinagar]

A2.1 PROBING THOUGHTS

Most large alluvial rivers are characterised in their upland stretches by steep slopes, narrow valleys and high flow velocities, but near the tail-ends of rivers before they meet the sea, the river slopes tend to diminish to near-zero, and hence they have decreasing velocities, besides being affected by high and low sea tides and considerable mixing of saline seawaters with the river's freshwater. In their intermediate stretches, river characteristics lie between those of the two end-stretches, but they are also influenced by the tributaries joining the rivers. These changes lead to different compositions of river resources along their lengths. Besides, river flows and river resources may also vary seasonally or from one year to another. Hence quantitative estimation of river resources and their variations along river lengths and over time are essential for the allocation of river resources for different uses.

Given the expanse of large river networks across conventional administrative boundaries and the wide variety of river resources of interest, it is necessary to plan comprehensively for river resource monitoring and inventorizing across extended time and spatial scales. Presently, some of these resources (such as river water flows) are partly collected and monitored by some central and state agencies, while others are virtually unknown. But even those resource data which are collected may be distributed among different agencies with no comprehensive data processing and management system. In addition, there are other factors that make resource data issues more complex on account of inter-basin and intra-basin transfer of river resources. In view of these shortcomings and difficulties, it is necessary to streamline river resource budgeting by determining the roles and responsibilities of various agencies in river resource monitoring, book-keeping and accounting.

A2.2 KEY QUESTIONS

Some key issues of importance that need to be deliberated are:

- **River Resource Assessment Methodology: Methods to identify which resources are available in what quantities in which stretches and during which time periods taking into consideration the resource regeneration capacities of rivers.**
- **Resource Data Collection and Inventory Responsibilities: Identification of appropriate agencies at Central and State levels to ensure resource data collection, processing and storage.**
- **Resource Monitoring: Deciding the roles of various stakeholders in monitoring the reliability and adequacy of resource inventories.**
- **Identifying and Overcoming Gaps in Resource Accounting: Due to various anthropogenic factors (such as inter-basin transfers) as well as natural constraints (such as natural calamities), unforeseen problems may arise in comprehensive accounting and budgeting of river resource allocation on basin scales. What mechanism of inter-agency and multi-stakeholder coordination should be adopted to overcome such problems?**

IT IS NECESSARY TO

streamline river resource budgeting by determining the roles and responsibilities of various agencies in river resource monitoring, book-keeping and accounting

A2.3 DISCUSSIONS

Planning and management of rivers and waterbodies is a cyclic process. For study and planning we need to look at the natural boundaries of the basin, but to implement we need to consider the administrative boundaries. The issues to be addressed include identification of river resources, their assessment, monitoring, valuation, pricing, local and upstream/ downstream impacts of river resources extraction, community empowerment for utilization and upkeep of resources, equitable budgeting allocation, and using the Arth Ganga concept for local rivers implemented at the district level. The methods available to identify the availability of different

Roles and Responsibilities for River Resource Assessment and Monitoring

resources and their quanta in different reaches and during different time periods, taking into consideration the resource generation capacities of rivers, need to be firmed up. Secondly the responsibilities need to be decided for resource data collection and inventory. Notably, rivers are the most important renewable water resources with high regenerative potential but also high vulnerability because they are in the lowest point of landscape. UNESCO's intergovernmental hydrological program 9th phase 2022 - 2029 defines the goal concerning basin scale water management to improve not only water quality and quantity, but also bio-productivity and biodiversity. The hydrological patterns specific for a given region or catchment plus a metabolism ecosystem are fundamental for optimizing the interplay between the water cycle and the ecosystem to generate services for society.

Countries in EU have agreed on the Water Framework Directive. India should also try to agree on a common objective where all member states should be free to act in independent ways as long as they adhere to the objectives agreed. Now, in all natural resource management, there is interconnectivity of water, energy, food, forest, and biodiversity. An interconnected approach to synergize the integrated management of water, energy, food and other resources for more inclusive and sustainable development is needed. However, a majority of river restoration programs have failed in the country because they didn't involve common people. Civil society has issues in trusting the government, and the government has issues in trusting civil society. Thus STPs are being created, but after their creation river improvement is not monitored. Hence the overall objective needs to be rethought of.

Suitable data collection is also important. The data needed is not only of water, but also of nutrients, microbiology, etc., at different spatial and technology scales. For river resource assessment – including biodiversity, forests, ecology, and so on – we need to establish basin-wise, sub-basin wise nodal points or consortium and alliances with an integrated modelling framework in the form of a decisions support system. The standardization of data collection protocol (SOPs) is a must to avoid data inconsistency involving data collection by multiple organizations. There is also a strong need to have GIS ready datasets so that the data are readily usable. Stakeholder capacities should also be developed as only experts need not monitor or collect data. There is also strong need for a central repository of all datasets related to river basins, with the datasets being accessible to different stakeholders and to the general public. Finally, data collection should lead to quantification of the ecological services to highlight the major advantage of data collection.

UNESCO'S INTERGOVERNMENTAL
hydrological program 9th phase 2022 - 2029 defines the goal concerning basin scale water management to improve not only water quality and quantity, but also bio-productivity and biodiversity

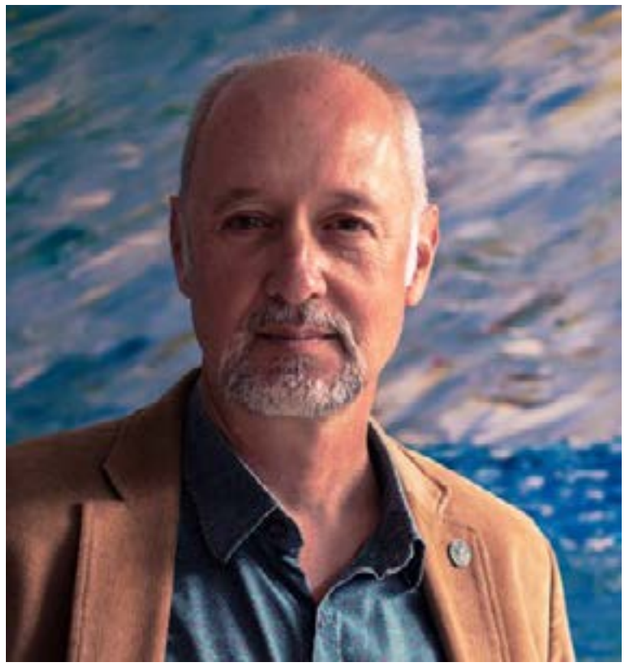
INDIA SHOULD
formulate a common objective where every member state is free to act independently as long as they adhere to the objectives agreed as is the case for EUs Water Framework Directive

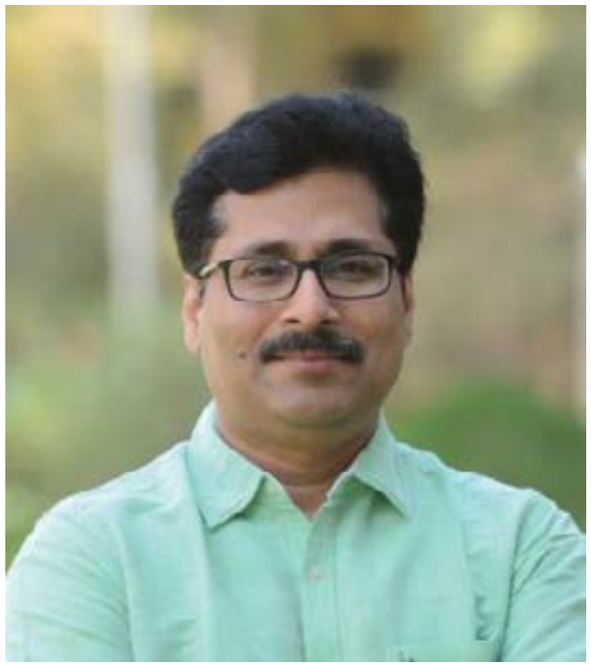
A2.4 RECOMMENDATIONS

The following recommendations emerge from the discussions presented above:

1. The hydrological patterns specific for a given stretch of river or catchment plus a metabolism ecosystem are fundamental for optimizing the interplay between the water cycle and the ecosystem to generate services for society.
2. India should formulate a common objective where every member state is free to act independently as long as they adhere to the objectives agreed as is the case for EU's Water Framework Directive.
3. An interconnected approach to natural resource management to synergize the integrated management of water, energy, food and other resources for more inclusive and sustainable development is needed.
4. The overall objective of STPs and other wastewater management activities need to be rethought of in terms of measurable river improvements.
5. River data collection – not only of water, but also of nutrients, microbiology, etc., at different spatial and technology scales – are needed with basin-wise and sub-basin-wise nodal points or consortia and with an integrated modelling framework in the form of a decisions support system.
6. The standardization of data collection protocol (SOPs) is a must to avoid data inconsistency involving dada collection by multiple organizations. There is also a strong need to have GIS ready datasets so that the data are readily usable.
7. Stakeholder capacities need to be developed to monitor and collect data.
8. There is strong need for a central repository of all datasets related to river basins, with the datasets being accessible to different stakeholders and to the general public.
9. Data collection should lead to quantification of the ecological services to highlight the major advantage of data collection.

Strategies to Balance River Resource Conservation with Anthropogenic Interventions





DAY 3:
Saturday, December 11, 2021
14:00 – 15:45 hrs

MODE:
Virtual

MODERATORS:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

PANELISTS:
Michael McClain [IHE DELFT]
Hubert Lohr [Team Leader, Nile Basin Initiative & GIZ]
Prashast Kumar Dixit [General Manager, NHDC]
Srinivas Chary [Director, Centre for Energy, ASCI]
Stefan Schmutz [Professor, IHG, Vienna]
Suresh Babu [Director, River Basins & Water Policy, WWF-India]
Venkatesh Dutta [Professor, BBAU]

A3.1 PROBING THOUGHTS

Since the onset of industrialization, rivers and other ecosystems in India have been subject to an increasing number and variety of interventions that are focussed on extracting maximum benefits for humans. This anthropocentric focus, however, has been myopic as it targets immediate gains of specific entities rather than availing a wide spectrum of benefits over the long term by ensuring sustainability of the ecosystems and their services. Thus, rivers have been over-exploited for fish, irrigation, hydro-power generation, wastewater disposal, sand mining, flood control structures, riverbed farming, floodplain occupation, and other anthropocentric purposes at different times and in different stretches. While such selective over-exploitation of specific river resources may have appeared almost harmless at the beginning, they invariably led to the realisation of overwhelming loss of multiple river resources over extended time periods. Scientific understanding of intricately woven ecosystem processes and the interactive structure of river resources can, therefore, lead to suitable techniques that temper anthropogenic interventions for resource use with the conservation of river resources to ensure healthy river functioning and sustainable resource use at the same time. Such scientific measures, however, need to be promoted and implemented through suitable policies and financial actions to ensure their successful implementation against the flow of conventional practices.

THE INTEGRITY OF
river channel composition is very important, hence we need to consider the processes and dynamics that help rivers to self-rejuvenate and restore themselves

A3.2 KEY QUESTIONS

Some key issues of importance on the above subject that need to be deliberated are:

A3.3 DISCUSSIONS

The most important issues concerning river resources are how to identify, assess, monitor, value, and ultimately – in terms of economics – price them. Only then can the impacts of abstraction or extraction of river resources on the health of such rivers locally or in upstream/ downstream regions be evaluated. Now it is crucial for the scientific community and society at large to define the health status of rivers to be maintained so as to get the maximum holistic value of rivers including both tangible values and intangible values. Hence river conservation and development must be treated as two sides of a coin, which is the real meaning of Arth Ganga. A major challenge in river resources allocation and planning at the regional level is the large number of stakeholders and actors whose main interests are livelihood and business, respectively. Hence the challenge is to empower stakeholders – who actually care for rivers – to take decisions. Another major challenge is to match studies and planning of rivers within their natural basin boundaries with the implementation processes being within administrative boundaries. The overarching question in this background is: What method should be adopted to ensure sustainability of river resources and deciding how river resources are to be monitored and by whom?

River scientists refer to flow as being the master variable because it has important

Strategies to Balance River Resource Conservation with Anthropogenic Interventions

influence on the river system, the biota and their habitats, the energy levels, and water quality. It is important to consider all these factors, but in river basin planning a hierarchy of influences need to be emphasized. Since the integrity of river channel composition is very important, hence we need to consider the processes and dynamics that help rivers to self-rejuvenate and restore themselves. A healthy flow regime with a diversity of flushing flows and subsistence flows needs to be maintained. A healthy river must also have a healthy riparian buffer or green river corridor, which can only happen through floodplain zoning act, and the river channel must be connected with the fluvial landscape. For some rivers it is important to use the resources but for others there are other considerations such as habitat considerations that matter. The ecosystem services concept helps better understand why we need healthy rivers to benefit humans, but implementing the ecosystem service concept in river basin management is not binding. Given the clear linkages in terms of livelihood and livelihood resilience to deal with river development linking it to climate change is important. But development also causes river discharges to change, whether it be in Ganga or in other rivers. Many streams also change their courses. Hence we need to do sediment budgets and to put a value to the losses in terms of sediment dynamics. Silt exclusion devices in water storage and water diversion structures also need to be adopted. In policy formulation, it is important to align the interests of science, technology, and public policy for better outcomes for river conservation and river basin management. Robust regulation is also needed in river resource allocation, and technology, science and policy need to be worked aggressively around the circular economy. For water, sanitation, hygiene, river resources, and their monitoring, innovations are essential and they must be given phenomenal impetus. The vision of GRBMP 2.0 of starting river restoration and conservation from the lower order streams gives a unique opportunity to involve local stakeholders for a shared vision. But the narrative has to be simplified by transforming stakeholders to shareholders.

A3.4 RECOMMENDATIONS

The following recommendations ensue from the discussions presented above:

1. It is necessary for the scientific community and society at large to define the health status of rivers to be maintained so as to get the maximum holistic value of rivers including both tangible values and intangible values.
2. A major challenge in river resources allocation and planning at the regional level is separating the large number of stakeholders and actors whose main interests are livelihood and business, respectively.
3. In river basin planning a hierarchy of influences – such as flow, biota and their habitats, the energy levels, and water quality – need to be emphasized.
4. A healthy flow regime with a diversity of flushing flows and subsistence flows needs to be maintained.
5. A healthy river must also have a healthy riparian buffer or green river corridor through a floodplain zoning act, and the river channel must be connected with the fluvial landscape.
6. For some rivers it is important to use the resources but for others there are other considerations such as habitat considerations that matter.
7. Given clear linkages in terms of livelihood and livelihood resilience to deal with river development, linking the latter to climate change is important.
8. It is important to align the interests of science, technology, and public policy – worked out aggressively around the circular economy – for better outcomes of river conservation and river basin management.
9. Robust regulation is needed in the allocation of river resources.
10. For water, sanitation, hygiene, river resources, and their monitoring, innovations are essential and must be given strong impetus.
11. The vision of GRBMP 2.0 of starting river restoration and conservation from lower order streams gives a unique opportunity to involve local stakeholders for a shared vision. But the narrative has to be simplified by transforming stakeholders to shareholders.

A HEALTHY RIVER

must also have a healthy riparian buffer or green river corridor through a floodplain zoning act, and the river channel must be connected with the fluvial landscape

Empowering Local and Small Stakeholders for Sustainable River Resource Management

DAY 4:
Monday, December 13, 2021
14:00 – 15:45 hrs

MODE:
Virtual

MODERATORS:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

PANELISTS:
Kees Bons [Deltares, Netherlands]
Suresh Babu [Director, River Basins & Water Policy, WWF-India]
Ruchi Badola [Scientist G, WII Dehradun]
Anshumali [Professor, IIT(ISM) Dhanbad]
Yogesh Kumar [Additional Commissioner MGNREGA]
Vikrant Jain [Professor, IIT Gandhinagar]
Manish Kumar Goyal [Associate Professor, IIT Indore]
M S Mohan Kumar [Former Professor, IISc Bangalore]

A4.1 PROBING THOUGHTS

River resources being used variously by various stakeholders from local riparian communities to basin residents, state governments and central governments, are multi-stakeholder ecosystems whose functioning is simultaneously affected by the different stakeholders, with different classes of stakeholders having different needs and expectations from rivers. Among such stakeholders, riparian residents and local communities have the most intimate and long-standing connections with rivers, their entire lives being often woven around the rivers themselves. It is therefore their primary interest to ensure healthy river functioning for their own security and wellbeing as against limited dependence on rivers by other stakeholders.
Given the primacy of locals in ensuring the restoration and conservation of rivers, it is essential that they are adequately empowered for river restoration and conservation, while overall conservation measures on larger spatial scales are overseen and supported by governments, educational-research institutions and interested private citizens or entities, pseudo-stakeholders being excluded from comprehensive decision-making processes. The entire process calls for identification and empowerment of local stakeholders vis-à-vis other stakeholders who may play lesser roles for the conservation and regeneration of small rivers and waterbodies of the larger river basin at local levels.

A4.2 KEY QUESTIONS

Some key issues of importance on the above subject that need to be deliberated are:

1. **What criteria should be adopted to identify the main stakeholders of rivers at local levels?**
2. **How can the existing social and governmental institutions be useful to empower the identified local communities/ people?**
3. **What should be the specific roles and responsibilities of various institutions and stakeholders in resource allocation at regional level?**
4. **What mechanism is needed to coordinate between local entities and regional institutions for optimal resource use and conservation measures across the entire river over the long term?**

A4.3 DISCUSSIONS

The second Ganga River Basin Management Plan adopts the principle of Arth Ganga for which the holistic value of a river – that is, the sum of its tangible and intangible benefits – need to be maximized. The holistic value will be very low if the river is highly degraded and high when it is slightly or moderately impacted. Thus, we need to decide in what state the river should be maintained in terms of availability or allocation of river resources. Using the concept of Arth Ganga, meaning ecosystem conservation synchronized with development as the guiding principle, modern science and technology can be applied together with ancient knowledge and traditional wisdom, thereby thinking globally but acting locally. Certain development sectors in India directly influence rivers like industry, agriculture, fisheries, energy, navigation, tourism, education, culture, forestry, etc., as they depend on rivers and rivers depend on them. Thus rivers are multi-stakeholder ecosystems whose functioning is affected simultaneously by different stakeholders. The alignment of stakeholder interests with Arth Ganga can only happen if we understand and then communicate that understanding to the stakeholders to ensure equitable resource allocation. Our understanding of river processes within natural boundaries also needs to be synergized with implementation within administrative mechanisms.
Given the primacy of locals in ensuring the restoration and conservation of rivers, it is essential to empower local communities, while conservation measures on larger spatial scales are overseen and supported by governments and educational-research institutions. Now river resources are essentially the river channel composition, including all biotic and abiotic components of the channel. Water is the major resource of rivers, but other resources can also be important for a healthy river. If river resources are monitored properly and locals are given the responsibility to balance local river resources, then it can also be a basis for monitoring the progress of restoration and conservation measures in the basin. Hence the pressing questions: How should the main stakeholders of rivers and waterbodies at local levels be identified? How can the existing social and governmental

Empowering Local and Small Stakeholders for Sustainable River Resource Management

institutions be used to empower the identified local communities or people? What roles should the various institutions and stakeholders have in resource allocation at the regional level, and what should be their responsibilities? And, finally, what mechanism is needed to coordinate between local entities and regional institutions for optimal resource use and conservation measures across the length of the river over the long term?

It is important to build a shared vision of stakeholders for rivers, which is not just about water or water rights but also about sediments, fisheries, energy, and many other interconnected issues. Now since a river is only a manifestation of the entire river basin hence one cannot treat the river system by only considering the river channel. Also, greater emphasis should be given to interactive physical processes in the basin before empowering local communities. Since downstream communities may have different priorities relative to upstream communities involved in agricultural and other activities, hence the integration of interests of different communities with river processes at the basin scale can pose major challenges. We have to use a dependency filter to look at the interests of stakeholders: e.g., the dependency can be very high for a local farmer or fisherman, but equally important will be a hydropower operator or a regulator who may decide to come up with a dam. So how these stakeholders are brought together into the discussions around river and wetland conservation is very important. Many people interested in river and wetland conservation are low on influence, and it is important to lift them to a high influence level. As of now the entire exercise of river rejuvenation has become very person-specific with some individual administrators taking interest in river restoration. The task has to be institutionalized. Last year about Rs. 65000 crores of MGNREGA funds were invested in natural resource management namely, conservation of water resources, forest resources, and land resources. There is no regulation or law preventing river restoration activities under MGNREGA but for limited knowledge. For many rivers, at the basin level, there is no one platform which can actually take decisions. Thus the institutional framework needed to facilitate the decision-making processes, learning processes, and monitoring and evaluation has to be developed. It may also be noted that Panchayat is the smallest administrative unit in India. So river restoration has to be encouraged at Panchayat levels with the delineation of LULC. This step is important because river conservation at Panchayat levels address the three most important concerns of climate change, livelihood practices, and water security. Both the Rural Development Department and Panchayati Raj Department are sensitive towards these issues, but their capacities and skill levels must be enhanced for which people/ institutions with advanced knowledge can help develop tools on how river basins are to be managed.

A4.4 RECOMMENDATIONS

The following recommendations emerge from the above discussions:

1. We need to decide at the outset in what state a river should be maintained – un-impacted, slightly impacted or degraded – to maximize its holistic value for availability or allocation of river resources.
2. The alignment of stakeholder interests with Arth Ganga can only happen if we understand and then communicate that understanding to stakeholders for equitable resource allocation.
3. River resources are essentially the river channel composition, including all biotic and abiotic components of the channel. Water is the major resource of rivers, but other resources can also be important for a healthy river.
4. Since a river is only a manifestation of the entire basin, hence one cannot treat the river system by only considering the river channel.
5. It is important to build a shared vision for rivers among stakeholders while also identifying the river dependency and influence levels of different stakeholders.
6. Greater emphasis should be given to interactive physical processes in the basin before empowering local communities since integrating the priorities of downstream and upstream communities with river processes at the basin scale can pose major challenges.
7. Natural resource management, namely the conservation of water resources, forest resources, and land resources, have been a prime focus of MGNREGA. But the task of river rejuvenation through MGNREGA has to be institutionalized rather than being of individual interest, and it has to be supported with knowledge inputs.
8. River restoration has to be encouraged at Panchayat levels with the delineation of LULC, since Panchayat is the smallest administrative unit in India. But their capacities and skill levels must be enhanced with tools provided by institutions with advanced knowledge.
9. For many rivers, at the basin level, there is no single platform for taking decisions. The institutional framework to facilitate the decision-making processes, learning processes, and monitoring and evaluation has to be developed.

Methodological and Policy Measures for Resource Allocation Planning and Plan Implementation

DAY 5:
Tuesday, December 14, 2020
14:00 – 15:45 hrs

MODE:
Virtual

MODERATORS:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

PANELISTS:
Ajith Radhakrishnan [Senior Specialist, World Bank]
Barth Hilhorst [Senior Water Resource Specialist, GIZ]
Christoph Hauer [Institute of Hydraulic Engineering and River Research BOKU Vienna]
Hemant Dhyani [Member, Ganga Avahan]
Praveen K Thakur [Scientist, Indian Institute of Remote Sensing]
Priyanka Niranjan [DM, Jalaun, Uttar Pradesh]
Srinivas Chary [Director, Administrative Staff College of India]
Venkatesh Dutta [Professor, Babasaheb Bhimrao Ambedkar University]
Prashast K Dixit [General Manager, NHDC]
Priyank J Sharma [Assistant Professor, IIT Indore]

A5.1 PROBING THOUGHTS

The optimal sustainable allocation of river resource necessitates the evaluation of human resource needs and uses and the impact of such use on other contenders – especially of riverine organisms – such that the long-term sustainability of river resources are ensured. This task is encumbered by variable river processes as well as variable human resources demands over time and space. Evidently, given the limited understanding of river processes and of societal perceptions and needs, a flexible approach needs to be adopted combining scientific understanding of rivers with local and regional needs and institutional strengths. The basic requirements for sustainable resource use planning may be no different from those of other major ecosystems such as forests and deserts, but given the intimate connection of humans with rivers and waterbodies and the highly dynamic nature of rivers, a careful strategising of suitable policy planning and management is imperative.

A5.3 DISCUSSIONS

The guiding principle to be followed in river restoration and conservation is Arth Ganga along with the application of modern science and technology with understanding of ancient knowledge and traditional wisdom because Arth Ganga implies that river conservation and development are two sides of the same coin. Thus we need to obtain the highest total value or holistic value of a river by optimizing the human interventions and impacts on rivers. The three components to achieve this ideal state are "river health" as principal component, "river monitoring" as enabling component, and "circular economy" as engagement of principal components. Since industry, agriculture, fisheries, energy, navigation, and tourism affect rivers significantly, hence developing these sectors together with the conservation of rivers and waterbodies are important. Given the diversity of sectors, coalescing the diverse interests of all stakeholders and actors becomes challenging. It involves optimal sustainable allocation of river resources, and hence the evaluation of resource needs of humans and the impacts of such uses on other contenders, especially of riverine organisms, to ensure long-term sustainability of river resources. With limited understanding of river processes and of societal perceptions and needs, a flexible approach needs to be adopted combining scientific understanding of rivers with local and regional needs as well as institutional strengths to address the problem.

The primary target should be to improve the economic ecosystem services of rivers for which we need a comprehensive basin accounting framework that bring together all competing interests rather than fragmented priorities. Alternatives like water footprint network or water accounting system do not account for habitat health. The adopted framework must be competent to address different concerns including ecosystem services and the economic

TO MANAGE CONFLICT
among different contenders of ecosystem services one should effectively map and interlink the beneficiaries of government policies and schemes so that we can identify the gray areas where these schemes are not implementable

A5.2 KEY QUESTIONS

Some key issues of importance on the above subject that need to be deliberated are:

- What criteria and methods should be adopted for resource allocation planning?
- What are the possible policy interventions needed to make river resources sustainable without significantly impacting the economic and social benefits?
- What measures are needed to make the Plan implementable (e.g. changes in legislative and institutional frameworks, stakeholders' shareholdings, etc.)?
- What criteria and methods should be adopted to monitor implementation of the Plan?

A5: Methodological and Policy Measures for Resource Allocation Planning and Plan Implementation

interests of government, consumers and stakeholders. Now free flowing rivers have their own contributions to development, but they are much more valuable to the country otherwise. This value judgment is lacking in our policies. Moreover, to manage conflict among different contenders of ecosystem services one should effectively map and interlink the beneficiaries of government policies and schemes so that we can identify the gray areas where these schemes are not implementable.

Now stakeholders need to agree on a uniform valuation of water, but a shared understanding of the issues concerned is lacking since a comprehensive understanding of water resources issues is difficult. Water is related to everything and, often, the root causes for water resources issues is outside the water sector. Hence we need to have scientific water accounting for each sector, with detailed demand and supply at various spatial and temporal scales for hydropower, irrigation, municipal water use, etc. Secondly, the identification of water stresses – the low points and high points – are needed: e.g., during flood flows whether flood basins can store the extra flood water, and similarly for drought areas. All the affecting factors need to be included and connected through causal diagrams because they logically link how A leads to B which leads to C and so on. For instance, increased farm gate prices or improved value chains or a different system of pollution assessment is outside the water sector, but by these processes water resources allocation can be negotiated beneficially.

Financial and social incentives as well as awareness programs are needed to make the plan implementable. Combining GIS and SCADA systems can very effectively monitor the municipal and industrial waters. In the lower Ganga basin most tributaries have been encroached by farmers. For river restoration at local levels, a major problem is that nobody – such as land revenue department or irrigation department – owns rivers. Besides, irrigation or minor irrigation department do not have any working knowledge based on output-centric framework like river restoration, hence whatever restoration is done gets undone in three years. At district levels one first needs to make a detailed database of local rivers, nallas and streams of the larger river basin, and demarcate their routes with the help of revenue officials and irrigation departments. But the problem of contamination of rivers and waterbodies has no ready or easily available solutions. For motivating stakeholders even a single restoration of waterbody at the local level can encourage them to strive to become MLAs, MPs by such acts. In general one needs a long-term constructive and creative engagement with stakeholders. But since no long-term deeper engagement currently exists to bring about behavioural change among the people, local communities need some ad hoc short-term benefits to begin with.

STAKEHOLDERS NEED

to agree on a uniform valuation of water. Hence there is need for scientific water accounting for each sector and identification of water stresses

A5.4 RECOMMENDATIONS

The following recommendations are distilled from the above discussions:

1. The three components to achieve the ideal state of highest holistic value of rivers are "river health" as principal component, "river monitoring" as enabling component, and "circular economy" as engagement of principal components.
2. Given the limited understanding of river processes and societal perceptions and needs, a flexible approach needs to be adopted combining scientific understanding of rivers with local and regional needs as well as institutional strengths to address the problem.
3. The primary target should be to improve the economic ecosystem services of rivers, for which we need a comprehensive basin accounting framework that bring together all competing interests rather than fragmented priorities.
4. The adopted framework must be competent to address different concerns including ecosystem services and the economic interests of government, consumers and stakeholders.
5. Stakeholders need to agree on a uniform valuation of water. Hence there is need for scientific water accounting for each sector and identification of water stresses.
6. All factors affecting rivers need to be included and connected through causal diagrams.
7. For river restoration at district levels one first needs to make a detailed database of local rivers, nallas and streams of the larger river basin, and demarcate their routes. But the problem of contamination of rivers and waterbodies has no easily available solution.
8. In general a long-term constructive and creative engagement with stakeholders is needed to bring about behavioural change among the people. But in its absence local communities need ad hoc short-term benefits to begin with.
9. Financial and social incentives as well as awareness programs are needed to make the plan implementable.

TRACK B

DAY 1:
Thursday, December 09, 2021
16:00 –17:45 hrs

MODE:
Virtual

CHAIR:
Rozy Agarwal [ED (Finance), NMCG]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATOR:
Sanmit Ahuja [Expert, cGanga, IIT Kanpur]

PANELISTS:
SC Vashisht [Chief Engineer, Delhi Jal Board]
Ajit Salvi [Deputy Chief Engineer, MCGM]
Ghanshyam Dwivedi [UP Jal Nigam]
Rajneesh Chopra [Global Head, VA Tech Wabag]
Uday Kelkar [MD and CEO, NJS]
Sanjay Guleria [NJ]

Economics and Financing of Sludge Management

As the deployment of number of sewage treatment plants in the country increases, so will the quantity of sludge produced. Although sludge handling should become an integral part of wastewater treatment facility, there are however thousands of STPs in the country that do not have sludge treatment on-site.

- For older facilities how does the retrofit model work in the case and how will these get financed.
- With increase in urbanisation, how will the cities cope up with increase in sludge quantity. Do they need to set up dedicated sludge treatment centres. If so, what are the requisite conditions under which they will be financed.

KEY POINTS RAISED

1. With increasing number of sewage treatment plants (STPs) being built in the country, the problem of sludge generation is increasing rapidly. In the Ganga basin alone 158 STP projects have been sanctioned across 97 towns, of which more than 50 are already completed. The problem of sludge management will come much faster than people are anticipating. Majority of the STPs in Ganga basin are to come on stream in the next 2-3 years.

Until now sludge handling has not been specified in tender documents, and the deemed responsibility is passed on to the contractors constructing and operating the STP. That is a major oversight since handling sludge requires both capital investment and expenditure for operations that are different from handling the wastewater streams. It is therefore not uncommon that the sludge ends up in river systems, in landfills or used for agricultural purposes without pathogen removal.

Economics and Financing of Sludge Management

2. In order to set up proper sludge management processes, it is also important to understand the extent of possibilities. There are a number of possibilities on how sludge can be used to extract resources or processed to generate other materials. These are:

- Use as Soil-enhancer for agricultural/land-application use.
- Used for energy recovery through biogas generation or enhancing (dried) sludge as a biomass through torrefaction for use in furnaces in thermal power plants or industries such as cement manufacturing.
- In its inert form it can be used for construction material.

For each of these uses there are a number of considerations, particularly whether the material meets the specifications, standards and if can be delivered with consistency at price points which the market will absorb.

THERE IS LACK OF DATA

on heavy metals and emerging contaminants such as micro-plastics emerging in sludge streams. Creation of these data-sets is of huge importance for establishment of sludge treatment centre

3. The municipalities when considering which option to take, however, have far many more considerations to take into account. These are:

- Characteristics of sludge being generated including composition and quantity.
- Whether there is enough biogas potential in the sludge or not.
- Whether there is a presence of heavy metals in sludge due to industrial effluents getting mixed in the wastewater stream.
- How much land would the sludge treatment centres require, and if the required area is available or not.
- If agricultural uses were possible, then is there enough storage for dried matter or not, and whether there are enough agricultural users in the vicinity who will take away the soil-enhancer.
- Whether the sludge treatment plant will be an integral part of the wastewater line or a separate sludge line will be required.
- What are the total life-cycle costs of sludge treatment and how will these be funded.
- Whether a PPP model is possible or not and to what extent.
- How to retrofit sludge operations in older plants, or should the cities move towards a new.
- For agricultural uses the most common understanding (or misunderstanding) is that once dewatered and with pathogen removal, the sludge can be used for soil-enhancing purposes.
- There is lack of data on heavy metals and emerging contaminants such as micro-plastics emerging in sludge streams. Creation of these data-sets is of huge importance for establishment of sludge treatment centres.

The most important part of the sludge management operations that there is no one size fits all plan for any city. Each city will require a different master-plan as it has to take into account various factors as highlighted in the points above. However, there are only a handful of choices that any city has when deciding which sludge treatment model framework is best suited for them.

4. KEY POINTS RAISED

1. **For instance, cities that have heavy metals presence in their sludge streams, will already have a limited set of choices on what they can do with their sludge.**
2. **Those who have small capacity plants, will have limited potential for biogas generation.**
3. **Those who have limited availability of land in the city boundaries, will have only select set of technologies that can deliver in sludge volume reduction.**
4. **Those who do not have any agricultural off-take available, will find it difficult to make the sale of soil-enhancer/ conditioner to farmers a commercially viable operation.**
5. **Which treatment standard should the city adopt – Class A/B/C, is more a function of the best environmental way to dispose/handle the sludge and then move towards classification.**

Economics and Financing of Sludge Management

5. It has become abundantly clear that financing sludge operations through a PPP format will require advanced financial and economic structuring:

a. For use in agricultural purposes, the operations will require to tap into some of the fertilizer subsidies offered to farmers.

b. For use of biogas, there maybe a need to mix additional biodegradable waste along with sludge that enhances the biogas generation potential that increases the economic viability.

c. All sludge operations must tap into global funding available for greenhouse gas emission reductions. This will require special structures to enable international funding to be channelled into the projects.

d. If the revenue streams from commercial operations is not sufficient, then there needs to be a provision for a Viability Gap Funding (VGF) to make the projects financially viable.

e. Other forms of funding such as "green/sludge bonds" should be explored to help municipalities finance the projects.

f. Markets for the output from sludge operations need to be created. These will also lead to livelihood creation.

g. Creating of markets for off-take of sludge is also a possibility that must be explored.

h. Sludge treatment can also be funded under the hybrid-annuity-model (HAM) framework.

IF THE REVENUE STREAMS
from commercial operations is not sufficient, then there needs to be a provision for a Viability Gap Funding (VGF) to make the projects financially viable

KEY POINTS RAISED

PERSPECTIVES FROM CITIES

Cities such as Mumbai are only yet treating liquid waste and have not even started development of sludge although it has plans to introduce class A level treatment. It has discharge standards for wastewater but none for sludge – and is therefore just following the US EPA standards. Its problems get further compounded as there is limitation of land.

Delhi on the other hand finds that there are no adequate takers for class A biosolids, and also prescribes creation for both standards and markets for biosolids, otherwise it is left with no choice but to move towards post digestion incineration, which has its own emissions and cost related challenges. Its experience with digesters is also not very good as it finds that more than 50% of the places, the digesters are not functional.

Economics and Financing of Sustainable Agriculture

DAY 2:
Friday, December 10, 2021
16:00 –17:45 hrs

MODE:
Virtual

CHAIR:
Rozy Agarwal [ED (Finance), NMCG]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATOR:
Sanmit Ahuja [Expert Member, cGanga, IIT Kanpur]

PANELISTS:
RV Ramakrishna [GM, National Bank for Agriculture and Rural Development (NABARD)]
CB Singh [Regional In-Charge (UP, Uttarakhand, Bihar), APEDA, Ministry of Commerce and Industry, Govt. of India]
Sunil Kumar [COO, Agrijunction]
Ganesh Kulkarni [Technical Lead, Mebifarm]
Srini Sundaram [CEO, Agvesto, UK]
Shiva Subramanian [Sustainability Bonds Specialist]
Ashok Kumar Meda [Co-Founder & Director, Krishi Kalpa Foundation]
Howard Barrie [Partner, Dentons]
Rajiv Mittal [CEO, Wabag]
Neeraj Gupta [IFC]

There is a significant correlation between agriculture and water quantity/ quality in the river systems. Agricultural sector in northern India uses far more water than global averages in areas with similar conditions. This is largely to do with prevailing irrigation practices, such as type of crops, eg rice that use large volumes of water; dual cropping system that increases the demand on the system; inefficient irrigation practices. Changing attitudes and behaviours within the farming community is not easy, therefore disruptive innovation that creates a new generation of farmers is a model that will enable shifting of the landscape and attitudes of incumbent farmers.

- How can technology innovation bring about disruption in the agricultural sector?
- What impact do water-efficient solutions have on the overall water balance of the country/region?

IN INDIA THE
agriculture sector makes only 18 per cent contribution to the GDP of the nation but more than 50 per cent of the national workforce is directly or indirectly employed in the rural sector

BACKGROUND

1. Farming is the world's largest employment generator with more than 1bn people employed in it and it utilises 50 per cent of the world's inhabitable land for growing food. By 2050 the world will add another 2bn people who have to be fed. Thus food security and bringing sustainable agricultural practices to the world are as important as addressing the climate change issue.
2. In India the agriculture sector makes only 18 per cent contribution to the GDP of the nation but more than 50 per cent of the national workforce is directly or indirectly employed in the rural sector. The agri/rural economy of the country offers a large potential, but major programmes with high technological content need to be rolled out to develop the farming sector.
3. The sector has its unique challenges as 85 per cent of the farmers in India are small and marginal farmers with average landholding at 1 hectare. This scale of farming is not very productive.
4. The agriculture sector is also the biggest employer in the Ganga basin and mainstay of the economy, but it is also a major consumer of water in the region as well as a polluter of the river basin as a result of agricultural run offs.

Economics and Financing of Sustainable Agriculture

5. Attempts at getting farmers to take treated wastewater for irrigation purposes have had a mixed review as there are concerns of heavy metals getting into the food stream as well as financial pressures on the municipality to start generating revenues from wastewater stream, which is difficult to secure in the farming sector.
6. The transition to alternative cropping, single-cropping or organic agriculture is not easy as farmers will first see a dip in their income, and therefore are hesitant to move to sustainable farming practices. But there are economic models that are available that can help usher in much needed changes to the farming sector.
7. It is important for farming sector to appreciate and respect the sustainability of rivers as without rivers the farming sector will cease to exist. To move towards organic farming may be environmentally friendly but it has its economic barriers. Agri economists state that by moving towards organic farming will result in dip in yield that will exacerbate food security issues. That is perhaps the reason why only 4.3mn hectares out of a total cultivation area of 155mn hectares is under organic farming.
8. Quick wins can be achieved by incentivising the farmers to transition to modern agricultural practices that also have better water use efficiency by using precision irrigation systems,

THE TRANSITION TO alternative cropping, single-cropping or organic agriculture is not easy as farmers will first see a dip in their income, and therefore are hesitant to move to sustainable farming practices

help regenerate top-soil, generate higher yield and produce much higher quality crops that fetch premium prices in the market.

9. Focus should also be on holistic economic development around the river systems. The honourable Prime Minister introduced the framework of Arth Ganga which introduces a river centric sustainable development approach.
10. Certain studies have already been conducted in districts Bulandshahar and Balia and pilot initiatives using the Arth Ganga framework are being planned.

A. ROLE OF TECHNOLOGY IN BRINGING FARMERS FORWARD

1. Technology will play a very crucial role in transforming the rural economy of India. Today farmers enjoy easy digital access to information such as weather and market prices that allow them to make critical decisions.
2. In India data is cheaper than atta (flour). Therefore technology must be used to enhance farm sector productivity and in doing so India must have the aspiration to become the kitchen of the world.
3. Digital market places such as Agri-junction and others are mushrooming across the country that are not only reducing farmer input costs but also giving them access to technology and knowhow. The farmers bear the brunt of economic inefficiencies whereby they buy products at retail prices but sell produce at wholesale prices. Therefore, organised farmer groups such as FPOs and other aggregates bring in procurement efficiencies. These must be encouraged.
4. The young farmers are much more technology savvy and ready to adopt modern technologies. They need access to training, techniques, technologies and markets.
5. Technologies such as membrane farming and hydroponics can help shift the food security imbalance as well as accelerating the goal of nutritional feeding. It can help utilise large swathes of barren land that can become productive and bringing greater economic development to rural India. For instance, the state of Uttar Pradesh alone has 11 lakh (1.1 million) hectare of land that is barren which can be utilised for establishing climate controlled greenhouses that utilise precision farming.
6. Membrane farming also delivers very high nutritional quality produce, reduces water consumption by more than 80%, eliminates agricultural farm run-offs, creates a barrier for viruses and bacteria to come in contact with roots, increases yield and thereby potential for increasing farmer's income. The farmer can start earning Rs 80,0000 – 1,00,000 per month per acre income from utilising the membrane farming technology.

The more pertinent point is the use of barren land. In India most farmers have very small land holdings in the order of 1 hectare and buying agricultural land is very expensive for them. This format of farming allows them to acquire/ lease barren land which is very affordable thus enabling more and more farmers to access high income generating farming technology.

Economics and Financing of Sustainable Agriculture

7. Use of data analytics will increase farm productivity. The use of drones, artificial intelligence and machine learning is bringing forth new data insights that were earlier not available to farmers and farm scientists.
8. Technology also increases the social empowerment and inclusion. The use of technology is enabling more and more women farmers to join the farming workforce.

B.ROLE OF INDIAN AGRI FINANCING INSTITUTIONS TO SUPPORT GROWTH OF SUSTAINABLE FARMING

1. Indian government has set up a number of financial institutions and products to support the farming community. Of these NABARD (National Bank for Agriculture and Rural Development) and APEDA (Agricultural and Processed Food Products Export Development Authority) are two fairly active ones playing a crucial role.
2. Whilst NABARD is a wholesale bank, that funds other Retail bank to lend to farmers, APEDA supports projects and capacity building for to enable greater exports of farm produce.
3. NABARD's approach is to support development of rural prosperity in a sustainable and equitable manner. It offers a number of financial products across four main categories:
   - Wholesale bank
   - Lend for rural infrastructure – agricultural marketing and economy
   - Lend to state governments
   - Development – 50% of the staff involved in developmental activities.
4. NABARD has made a number of notable interventions including but not limited to:
   - Over 2.5mn hectares of watershed development in areas that were non-productive.
   - Supported over 500 thousand tribal families to embrace sustainable agriculture and horticulture.
   - Developed soil regeneration programme – called Jeeva (life).
   - Supports a large number of microfinance and non-banking financial institutions to onward lend to FPOs.
   - Developed farmer aggregation platforms to help farmers get procurement efficiencies.
   - Established a venture fund to invest in startups through 7 incubators in the country.
   - 10k FPOs to be promoted in next 5 years so economies of scale are applied to small farmers.
5. APEDA on the hand supports farmers and food processing companies to export their output to various countries across the Gulf, South East Asia, Europe and the Americas. It is also the nodal secretariat for export of organic produce and has established 32 certification bodies across the nation.

NABARD IS A

wholesale bank, that funds other Retail bank to lend to farmers, APEDA supports projects and capacity building for to enable greater exports of farm produce

Economics and Financing of Sustainable Agriculture

6. Other emerging facilities include the Agri Infrastructure fund that has a corpus of Rs 1 lakh crore (appx USD 13bn) that finances infrastructure development, post harvest development by providing loans of upto Rs 2 crore (appx USD 250,000) that are guaranteed and also gives an interest subvention.

OTHER POINTS RAISED:

7. Why retail banks are not taking high credit risk?

It is incorrect to say that retail banks are not taking credit risk. In the last financial year alone nearly Rs 15,000 crores (appx USD 2bn) of farm production. Nearly 140 million farmers have taken loans at highly subsidised rate of 7 per cent with an additional incentive of 3 per cent rebate on timely payment. There are number of crop insurance schemes that allow farmers to borrow additional funds.

8. Can farmers get funds for innovative technologies?

Ample support for training and capacity building is available. Many projects for development of watersheds, use of advanced technologies using IOT/AI/ML have been funded. NABARD supports farmers to establish pilot projects, to test new technology, ensuring they are able to adopt technologies. It also supports startups also although initially through incubators.

For advanced scaling up technologies it is proposed to introduce those via FPOs who in turn can make avail of the financing facilities.

9. There is ample potential for horticulture export as well as in cereal and dairy sector. Recently India started to export butter made of buffalo milk to New Zealand which in itself is the largest dairy exporter in the world. This was a remarkable achievement. There is much potential to be explored for boosting exports of products from the Himalayan belt such as scented rice.

C. INNOVATIVE FINANCIAL INSTRUMENTS TO SCALE UP SUSTAINABLE AGRICULTURE

1. With a strong demand for projects with high ESG score, sustainable agriculture sector is perfectly poised to tap into global capital pool particularly via the capital markets.
2. Tapping into capital markets via bonds is the easiest way to seek capital. But that has its nuances:

- The uses of proceeds have to be very clearly defined with adequate asset and cash flow security covers in place.
- The produce must be insured to give additional security cover to the investors.
- If these conditions are met then there are hundreds of billions of dollars available.
- Funds can be made available in local currency as there are a number of Emerging Market investors who already have exposure to the Indian market and Rupee as a currency.

3. The main categories of the bonds and loan markets are:

- Green bonds
- Social bonds
- Sustainability bonds
- Sustainability linked bonds

4. How to make these funds available to a local farmer?

The funding cannot be directly availed by the farmers as bonds are institutional products. So either large corporates or banks as via media can issue the bonds and raise capital.

Another model is to develop pass through SPVs which have a guarantee wrapper around them. These instruments can be sponsored by large FPOs or a group of FPOs pooling their project together as the investors need scale and size.

5. Climate resilience insurance is another financial product that could be utilised by farmers. Bespoke risk transfer programmes eg floods, crop failure, insect attack etc, designed for specific use cases can be developed and offered to farmers that in turn lead to availability of capital.
6. Forestry and Agro-financing is another financial product that can bring capital to farmers and rural managers who manage large swathes of lands, wetlands, forests via the carbon financing schemes.
7. There much funding available for supply-chain financing but there are challenges on how to deliver funding to the farmer. Blended finance offers the best route in the short and medium term that can bring government financing alongside with and commercial financing.

AGRI INFRASTRUCTURE

fund that has a corpus of Rs 1 lakh crore (appx USD13bn) that finances infrastructuredevelopment, post harvest development by providing loans of upto Rs 2 crore (appx USD 250,000) that are guaranteed and also gives an interest subvention

Economics and Financing of Water Recycling, Circular Economy and Water Trading Market

DAY 3:
Saturday, December,11, 2021
16:00-17:45 hrs

MODE:
Virtual

CHAIR:
Ashok Kumar [ED (Projects), NMCG}]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATOR:
Sanmit Ahuja [Expert Member, cGanga, IIT Kanpur]

PANELISTS:
Indra Mitra [Cambi]
Sumouleendra Ghosh [KPMG]
Ken Jones [Exo Cubic Solutions, UK]
Brajesh Dubey [Professor, IIT Kharagpur]
Ajit Salvi [Deputy Engineer, MCGM]
K Rajkumar [Director, Indian Rubber Manufacturing Research Institute (IRMRA)]

For the water market to become more robust, it is important to establish not only the pricing but an efficient trading market.

- What are the necessary conditions to establish wastewater trading schemes?
- Who will the pricing and trades be regulated?

For the circular economy to enter mainstream, there must be a clear set of policy regulations, establishment of supply chain that make the economic feasibility stack up, implementation of technologies that will process and/ or enable efficient material recovery and digital platforms that enable the entire value chain.

- What have been the impediments to scale-up circular economy in India?
- What are the different enabling conditions that are needed for different types of waste categories: e.g. plastics, food-waste, farm waste, tyres, construction waste, etc.

A. BACKGROUND – RECYCLE AND REUSE OF WASTEWATER

1. The business case for recycling and reuse of wastewater is simple, and that is there are significant costs to transporting fresh water from long distances to a city which on an average is atleast over 50kms for cities in India. These costs are typically borne by different departments making it very difficult to fully reconcile these costs. However, should those costs be added up, they would make transporting fresh water far more expensive the supplying recycled water locally.
2. Reuse and Recycle for the purpose of restoring and conserving water bodies is also equally important. Although draining wastewater into natural water bodies will eventually lead to eutrophication and aquatic growth, but that must be taken for granted and harvesting of water plants be integrated into the overall process. This approach will help reduce water transport costs and the city will eventually build its own water supply resource and the local water eco-system is maintained. Once the city has closed the water loop, only supplementary water should be imported/ transported from long distances.
3. Relating this to climate change – water bodies and wetlands are major carbon sinks and the Indian climatic conditions are such that we will have aquatic growth in all months. Colder countries only have aquatic growth for limited months due to climate and

READED WATER
use is also seen as financial sustainability instrument for STPs to generate are venue stream for municipality. For example, in Mathura 20MLD of waste water will be sold to Indian Oil Corporations refinery

Economics and Financing of Water Recycling, Circular Economy and Water Trading Market

lack of sunlight. No matter how much amount of nutrients we remove, we will still have aquatic growth in our water bodies. So, it is necessary to accept and incorporate in our system design and deal with the aquatic growth which can be harvested for energy purposes or sequestration of carbon.

4. Where water is scarce, and people are ready to pay, there the focus should be on recycle and reuse. But for areas where water is abundant, water should be treated to discharge standards only as there will no market.
5. The Government already has a mandatory policy for thermal power plants to use wastewater if it is located within 50kms of a STP. Although the number of projects utilising this model is few, but the country has already made a start. For instance, in Kanpur 40MLD treated water is to be taken to a thermal power station and the same for Ghaziabad where 200MLD of treated water is to be supplied to a thermal power plant. The projects are, however, facing pricing resistance from power plant operators as.
6. The Government is working on a framework for treated water reuse and the policy is in its last stages of consultation. Treated water use is also seen as financial sustainability instrument for STPs to generate a revenue stream for municipality. For example, in Mathura 20MLD of waste water will be sold to Indian Oil Corporation's refinery.
7. The Government has also given a recycle-reuse target of 20 per cent to municipalities across the country.
8. The use of wastewater in the agri sector has a mixed response. Proponents say that water supply to farmers is available 24x7 and is at no cost. However, those against it remain sceptical in that many contaminants will enter the food stream, and by giving wastewater free to farmers, we are only moving away from the solution of creating an effective water market.
9. Wastewater in agri is difficult to make a sustainable operations.
10. Multi-purpose objectives of water bodies will make the circular economy possible.

REACTIONS FROM THE PANEL

1. The mindset of people is such that they do not like their principal water supply to come from wastewater resource. This mindset will take time to overcome, but explanation in a transparent manner and showcasing the true costs associated with transporting fresh water will make people think twice.
2. To encourage recycle and reuse, certain municipalities such as Mumbai, are building decentralised wastewater treatment plants, thereby reducing transportation costs. The city also has a recycle-reuse target of more than 50 per cent since it transports water from as far as 150kms, and for it to build new STPs it would have to locate those atleast 200kms away.
3. Mumbai would like to supply wastewater to industries that require large quantities of process water. For instance, it supplies wastewater to a textile industry which finds that their cost of process water when they treat it is lower than what it is when procuring it from the municipality. However, the process requires large number of industrial offtakers in the proximity/ vicinity which is not the case in Mumbai. Therefore it has shifted to supplying wastewater for gardening purposes to Governor's bungalow and also looking to supplying it to other large

Economics and Financing of Water Recycling, Circular Economy and Water Trading Market

communities such as the Defence forces accommodation.

4. The Government has made stringent discharge requirements of BOD < 10/20, TSS < 5 and E.Coli levels below detectable limit. If the water is being treated to such a level (secondary), then why not put it to use for good purposes rather than just discharging. The municipalities should consider taking this water quality to tertiary level and supplying to consumers. If they don't do so, and discharge it into the drains or river systems, then that entire cost is a sunk cost. However, environmental advocates will also support this process as the city is creating its water resource.
5. It was noted that in developed nations the tariff included both fresh water supply and wastewater treatment cost. The fresh water component is only 1/3rd of the tariff and the rest 2/3rd is entirely for wastewater treatment. That is not the case in India where fresh water is supplied at highly subsidised rates.
6. In order to bring in efficient water markets, it is first necessary for all stakeholder groups to understand and appreciate the true value of water, what its total lifecycle costs (source to tap) and then decide on how to price it.
7. Pricing and valuation are core to economics of water. In cities people are paying as much as Rs. 1000 to buy a cubic metre of water from tanker suppliers but have aversion to paying water supply bills.
8. Where Government is nudging industries to buy water some progress is made, but by and large that approach has not worked as it requires government intervention for the transaction to come about.
9. Certain cities have much higher targets such as Surat which is aiming to be a zero liquid discharge city in the next few years.
10. Successful implementation of wastewater treading schemes are possible within the country.

THIS MODEL HAS
worked very well in the energy sector. The producers can concentrate on efficient operations of the plant and not worry about how and where they will sell treated water. It would be WTCs role to then identify customers and develop the market

PRICING AND
valuation are core to economics of water. In cities people are paying as much as Rs. 1000 to buy a cubic metre of water from tanker suppliers but have aversion to paying water supply bills

They would very much like how the carbon credit markets work on a cap-and-trade model. It would require a regulatory support to set water quality and quantity targets for bulk water users. Then those who consume less, get issued credits, which can then be sold to those who are excessive users or polluters. The model can be implemented initially in industrial parks where a lot process water is required.

11. Local area water markets are necessary to develop an effective water recycle and reuse regime. The markets would identify the bulk buyers and sellers in each region and then establish a trading scheme within the counterparties.
12. This could be scaled up by establishing a "Water Trading Corporation (WTC)" that would issue "Water Purchase Agreements (WPA)" to treatment operators. This model has worked very well in the energy sector. The producers can concentrate on efficient operations of the plant and not worry about how and where they will sell treated water. It would be WTC's role to then identify customers and develop the market. WTC would initially need to have government support, but once it starts trading effectively, capital market investors can bring more finances to increase its trading capacity. Establishment of a WTC can massively expand the wastewater market in India. More PPP projects of BOOT/HAM formats can come up rapidly if such a credit-worthy buyer of water was available.
13. In addressing the wastewater market, we need to look at the entire ecosystem including sludge, carbon footprint of processing and transporting water. For instance, the tertiary treatment is done using RO membranes which generate a lot of reject and are also very energy intensive. We need to start incentivising decarbonisation of wastewater systems and industry as well.
14. Water and Sludge bonds are very good financing instruments to lower the long-term financing cost of wastewater treatment processes.
15. The world's first water futures market has come up in the United States.

Economics and Financing of Water Recycling, Circular Economy and Water Trading Market

B. BACKGROUND - CIRCULAR ECONOMY IN SOLID WASTE

1. As a nation India is failing to address the waste problem for a number of reasons. Taking a one size fits all approach to designing waste management solution. Each city and town in India has unique characteristics of segregation, choice of processing and influencing citizen behaviour.
2. Segregation is a critical issue in India. Mixed waste forces municipalities to divert waste to landfill or to incinerate. Both are environmentally harmful and fairly expensive propositions.
3. Segregation at source requires change of citizen behaviour, which is easier said than done.

4. If biodegradable waste is easily sorted and separated, then it can be composted or processed for biogas generation.
5. For other waste streams such as plastics, paper etc. are already sorted out at household level or ragpickers collect most recyclables.
6. Funding waste collection and processing in India has also been a problem. Globally there is a high gate-fee/ tipping-fee available to waste processors, which is not the case in India.

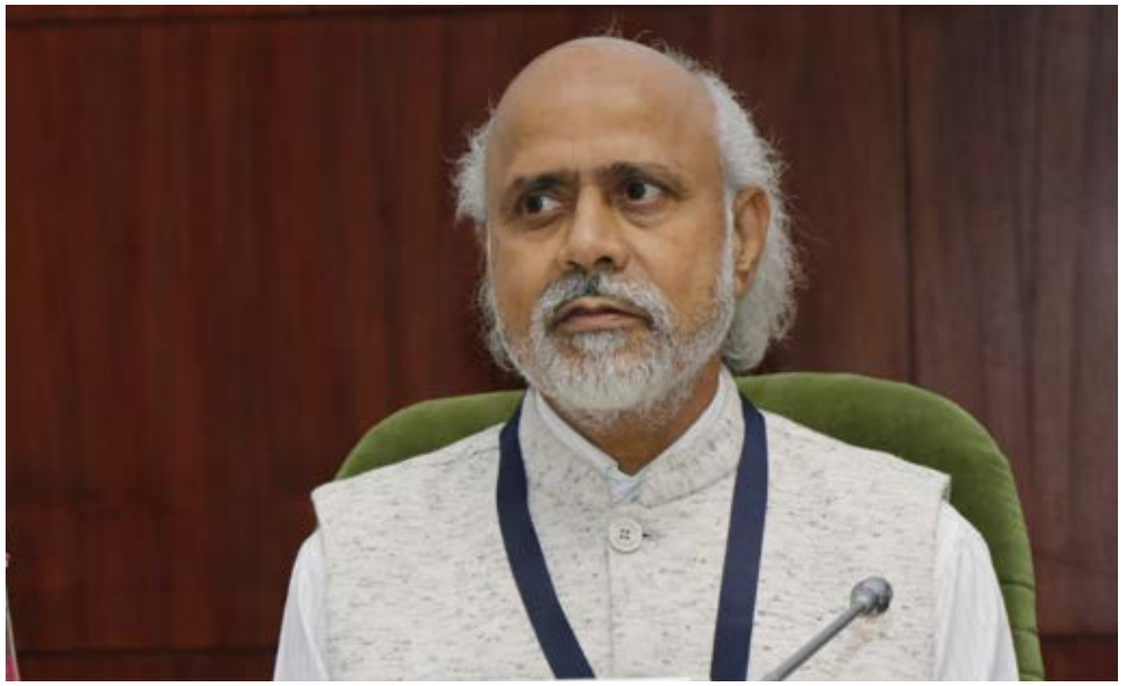
REACTIONS FROM THE PANEL

1. For resource recovery, waste has to be kept clean, which is such an oxymoron. This means that keep waste segregated and free of cross contamination allows downstream processing to happen easily. In India significant majority of the waste is wet waste which must be kept separate from the dry waste. If the waste streams get mixed up then processing becomes very a very difficult or expensive proposition.
2. Most waste to energy plants in India have not worked since the calorific value of waste being low and high proportion of wet waste in the waste-streams.
3. The design of waste management solutions for cities and towns are based on a set of assumptions that are unsubstantiated and devoid of much needed data.
4. Segregation at household level will take decades as even in the developed countries that is a key issue. There are instances where if collection is down twice in a day then the morning waste is largely wet waste and the evening collection is largely dry waste. Additionally, the informal sector also participates in segregating the waste as they extract most if not all recyclables from the waste streams.
5. Technologies for processing the waste is not an issue at all, so long as the waste streams are homogenous.
6. There is a consensus that effort should be put to segregate wet-food waste that can help generate compost or biogas through anaerobic digestion, and the dry waste can go to a number of strategic material recycling facilities (MRFs) where they can be diverted to their respective processing centres.
7. The notion that waste is wealth needs to be debunked. Waste is an environmental liability and the cost to dispose off in an environmentally friendly way has to be adequately priced and resources. One should not try to look for revenue models that don't exist.

OTHER POINTS:

- Development of a citywide waste lifecycle planning tool is essential.
- What gate-fee to be paid to operators is a function of how much fee is collected by the municipality from each household.
- The economics of waste will depend on what technology choices a municipality takes on.
- Valorisation without the right understanding of waste composition. Plants have not worked because incineration has been applied in an indiscriminate manner.
- The nation should put forth a few successful pilots eg, getting all food market waste to bio-processing centres and then build on from there.

Economics and Financing of Water Recycling, Circular Economy and Water Trading Market



CASE STUDY – END OF LIFE TYRE RECYCLING

1. Globally there is a decent market for all types of tyres particularly truck and lorry tyres. But car tyres are a big problem
2. The ultra high pressure water (UHPW) jet technology uses fresh water to strip the rubber off the steel matrix. In the conventional process you take the whole tyre and grind it down. If you tear a sheet of newspaper you will not be able to separate paper from ink, and much like that tyres will have steel bits stuck or embedded in rubber when shredded. Quality of material is reduced.
3. Circular economy looks at how a material moves from finished raw state to used and then back to finished raw state. Eg steel goes round and round in circle 40-50 years. By removing the rubber completely from steel – each element can go back into its own value chains.
4. The goal is to put rubber particles back into tyre manufacturing.
5. This process can produce particle sizes that haven't been seen before. Typical sizes are about 150 micron. This technology delivers particle sizes of 30-40 microns.
6. Rubber is a very big sector – especially driven by petrochemicals. It has a lot of high calorific value materials are used. Natural and synthetic rubbers are mixed together. Tyres are dumped after end of life.

7. Carcass that is inbuilt has a lot of value – dumped in environment and landfills. Some are burnt through pyrolysis process which has been banned.
8. Parts of rubber is recycled by reclaim rubber companies. Part of circular economy is in place.
9. Crumb rubber uses grinding technologies which is energy intensive. Some use it as TDF.
10. The value of Indian rubber industry is Rs. 90,000 crores and of that the value of Indian tyre industry is 60,000 crores.
11. Once tyres are getting dumped, it is wastage of energy and resources.
12. Trials have been done of the UHPW technology and materials analysed in the laboratory. Materials are not contaminated with any fibres or metals which is very encouraging.
13. Tyre industries can use the technology to address their environmental responsibility.
14. There is a big demand-supply gap – 4.5 lakh tonnes of natural rubber shortage in India.
15. If the country is able to circulate raw materials, UHPW material has high tensile strength, some natural rubber shortage can be met through reclaimed.
16. It has strong environmental credentials as well. For making one tonne of carbon black – equal amount of CO_2 is emitted. Carbon black is made by cracking crude oil. If we are able to reclaim carbon black then we use double carbon credit.
17. The technology produces a very clean green rubber and the water used in it is recycled.
18. It has a huge potential to develop a new tyre recycling industry in India.

Ganga Hydrogen Forum

DAY 4:
Monday, December 13, 2021
16:00 –17:45 hrs

MODE:
Virtual

CHAIR:
Rozy Agarwal [ED (Finance), NMCG]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATORS:
Sanmit Ahuja [Expert, cGanga, IIT Kanpur]

PANELISTS:
Rajan Varshney [Deputy General Manager, NTPC]
Vinay Maheshwari [President, JBM Group]
Rajneesh Chopra [VA Tech Wabag]
Liran Dor [CTO, Boson Energy, Luxembourg]
Mark Tonkin [CEO, Hope Resources, UK]
Chris Toureau [Hope Resources]
Rakesh Jha [Director, Fichtner Consulting and Engineers]
Ashish Mathur [Board Member, Tulip Compressions]

The programme launches in providing a "generation platform" to accelerate development of the hydrogen economy using municipal solid waste to hydrogen, sewage gas to hydrogen, hydropower to hydrogen and other forms of green hydrogen. In the following decades India could require 40MT of hydrogen generation per annum. This programme will help support the National Hydrogen Mission.

BACKGROUND

1. Whilst generating hydrogen from renewable sources (solar and wind) is fairly well understood, the generation of hydrogen from waste or using hydro power is another dimension that must also be explored.

2. Hydrogen is a very important component for India's decarbonisation journey. The PM has announced the hydrogen mission earlier in the year and the policy document is under consultation. Performance linked incentive schemes for manufacturing electrolysers and fuel cells in India is also under consultation.

LARGE COMPANIES
such as Reliance Group, Adani Group, Jindal, L&T, Arcelor Mittal, NTPC, GAIL, IOCL and others have all announced their hydrogen plans. Many will be consumers of hydrogen whilst others are planning producing hydrogen

3. Large companies such as Reliance Group, Adani Group, Jindal, L&T, Arcelor Mittal, NTPC, GAIL, IOCL and others have all announced their hydrogen plans. Many will be consumers of hydrogen whilst others are planning producing hydrogen.

4. The waste products of producing hydrogen are just water and heat. Hydrogen is an energy carrier and does not generate carbon when utilised.

5. There are several ways through which hydrogen is being produced. The most prominent ones are: grey hydrogen that is produced from steam methane reforming but releases a lot of CO_2 in the atmosphere (it is estimated that 1 tonne of hydrogen produced using SMR technique produces 10 tonnes of CO_2); green hydrogen that is produced through electrolysis with electricity supply from renewable sources such as solar and wind; and blue hydrogen which is when hydrogen is produced from gas or other hydrocarbons but CO_2 is captured and sequestered into storage facilities.

Ganga Hydrogen Forum

Note: Many of the points summarised below are based on the anticipated announcement of India's hydrogen policy as of December 2021. The hydrogen policy has since then been announced.

REACTIONS FROM THE PANEL

6. 18 per cent of India's energy requirement is electricity but the green-house gas emissions from these sources is 33 per cent. India has an ambitious target of producing 500GW of renewables by 2030, but these sources are intermittent and variable. However, to make electricity dispatchable at any time at the quantity required, a stabilised source base-load energy is required. Hydrogen can fulfil that gap as it can be stored when energy is surplus and supplied when demand peaks it can be used to supply power via fuel cells.

7. The most important aspects of hydrogen are divided in four parts: source of electricity through which hydrogen is produced, point of production; transporting hydrogen through a network and point of consumption.

8. The starting point for building any new economy one has to look at the end-market and work backwards from there. Hydrogen can be a major energy provider to heavy transportation industry, steel, cement, petroleum refining and fertilizer industry sectors. So the development of hydrogen economy will be based on where and how the hydrogen is utilised.

9. Indian companies have made statements that India has the potential to produce cheapest green hydrogen in the world at USD 1 per kg by 2030. This is made possible as India has the cheapest renewable energy tariffs in the world. Electricity cost makes up for nearly 70 per ecnt of the cost of hydrogen. Secondly, by then India will also become a major manufacturer of electrolyzers, thereby reducing the capital cost of the plant.

10. However, the distances between point of production and consumption is a major challenge. In the assessment of levelized cost of hydrogen (LCOH), one has to look at levelized cost of hydrogen delivered (LCOHD). That is the most important figure that consumers will view. Although the cost of transporting hydrogen is lower than the cost of transmitting electricity over long distances, until a hydrogen network is established, the government in order to incentivise hydrogen production should look at giving subsidies in transmission of green power for hydrogen production.

11. Green hydrogen is presently costing 3x that of grey hydrogen. If we scale up green hydrogen, which is the target then the goal of USD 1 per kg can be achieved compared to a current global price of USD 8-10 per kg. It is a function of power price. Since India has abundant and cheap renewable power, the aim to produce cheapest hydrogen is also realistic.

12. Hydrogen can also play a crucial role in stabilizing peak power as it can be stored for long term. An export market can also be developed around hydrogen as it can be stored in ammonia form.

13. The transportation sector contributes nearly 15 per cent of GHG emissions and these can be cut down through hydrogen mobility. In EV transportation, batteries are used, but they have low energy intensity and a carry a lot of weight in the battery itself. In heavy transportation, batteries cannot be successful – because of distance and weight carrying requirement limit the use of batteries in heavy equipment.

14. Hydrogen can also be fired into gas-turbines, and we can generate electricity and heat. Or we can store hydrogen in ammonia. Ammonia turbines are also available, and some coal plants are being replaced

IN THE ASSESSMENT

of levelized cost of hydrogen (LCOH), one has to look at levelized cost of hydrogen delivered (LCOHD). That is the most important figure that consumers will view

Ganga Hydrogen Forum

with ammonia turbines. Even blending hydrogen can be done to reduce carbon intensity of power.

15. Hydrogen can also be used in glass production as well as in making vegetable ghee from oils.

16. To enable efficient transport of hydrogen, national storage hubs have to be created. Airports can be made hydrogen hubs, ports can be made hydrogen hubs, for export of hydrogen.

17. Waste to hydrogen holds massive potential in the country. Waste tyres, plastics, biomaterial, mixed waste, cow dung and dairy waste can all be used to make hydrogen. It is estimated that 1 tonne of waste (depending on waste stream) can produce 100-150kgs of hydrogen. This can power 1000kms of bus journey. Since India's waste to energy sector has largely failed to deliver, because of composition of waste, utilising waste for producing hydrogen provides a whole new opportunity to transform the ailing sector.

18. Blending of hydrogen – hythane (hydrogen blended with methane) can rapidly enable hydrogen offtake in the transport sector. Upto 18 per cent blending of hydrogen with CNG possible.

19. Hydrogen can also be used for diesel generator backup. And if CO_2 captured then hydrogen can also be used to produce green methanol.

20. For waste to hydrogen certification of hydrogen will be quite important. This needs to be incentivised as producing hydrogen from waste and biomass is a very stable source.

21. Decentralised hydrogen framework needs to be created. Issue of hydrogen is not in the production but in distribution and getting it to consumers. How is it distributed and used is the most critical part.

22. Since most waste-to-energy plants are within city limits, they can become not only points of production but also points of consumption by creating hydrogen filling stations.

23. Sewage Treatment Plants generate methane which can also be used to generate hydrogen, but the energy losses in conversion must be taken into account.

24. But wastewater can be used to generate not only hydrogen but also oxygen. Since the most expensive and energy intensive part of the wastewater-treatment facility is aeration, producing of oxygen from electrolyzing wastewater can be a tremendous value add. It can bring the overall cost of hydrogen down.

25. The sludges produced in STPs can also be used to produce hydrogen. It is estimated that 1 tonne of dry sludge can produce 50kgs of hydrogen.

26. Hydrogen as a technology scales up easily as most plants are modular in nature. Scaling up only requires stacking electrolyzers in an array.

27. The hydrogen policy should look at:
a. Performance linked incentive scheme.
b. Fiscal incentive by providing tax credits.
c. Financial incentive such as guaranteed offtake price.
d. Subsidies on transmission of green power.
e. Linking renewable purchase obligations of states and large polluters.

28. Other points:
a. Co-locating hydrogen is the only interim model until such time the hydrogen hubs come up.
b. Hydrogen can also be produced on rooftop using solar panels.




TRACK C

DAY 1:
Thursday, December 09, 2021
16:00 – 17:45 hrs

CHAIR:
M Jawed [Professor, IIT Guwahati]

CO-CHAIR:
DP Mathuria [ED (Technical), NMCG]

MODERATOR:
Sundeep Singh Chauhan [Expert, cGanga]

PANELIST:
S Shrihari [NITK Surathkal]
B Sikka, Senior Consultant [NMCG]
Pawan K Labhasetwar [Chief Scientist & Head, NEERI, Nagpur]
AK Gupta [Professor, IIT Kharagpur]
Sachin S Gunthe [Professor, IIT Madras]
Ashootosh Mandpe [Assistant Professor, IIT Indore]
Indumathi M Nambi [Professor, IIT Madras]
MM Ghangrekar [Professor, IIT Kharagpur]
M Mansoor Ahammed [Professor, SVNIT Surat]
Sudha Goel [Associate Professor, IIT Kharagpur]

SESSION CHAIR


M Jawed


DP Mathuria


Sundeep Singh Chauhan

PANELISTS


S Shrihari


B Sikka


Pawan K Labhasetwar


AK Gupta


Sachin S Gunthe


Ashootosh Mandpe


Indumathi M Nambi


MM Ghangrekar


M Mansoor Ahammed


Sudha Goel

Technology & Innovation Showcase

SOURCE
Renewable Water from the Sky

Source Global (USA) – Drinking Water using Hygroscopic Panels

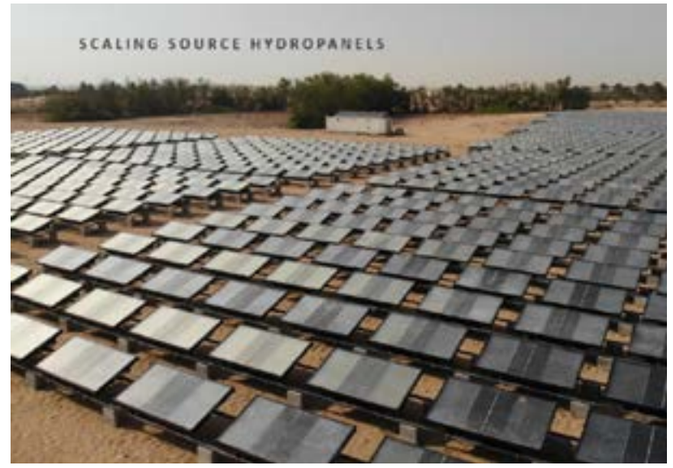
Sound technology and supported by leading VC and Bill Gates. ETV can look at the economics, robustness in Indian conditions and intent to manufacture in India.

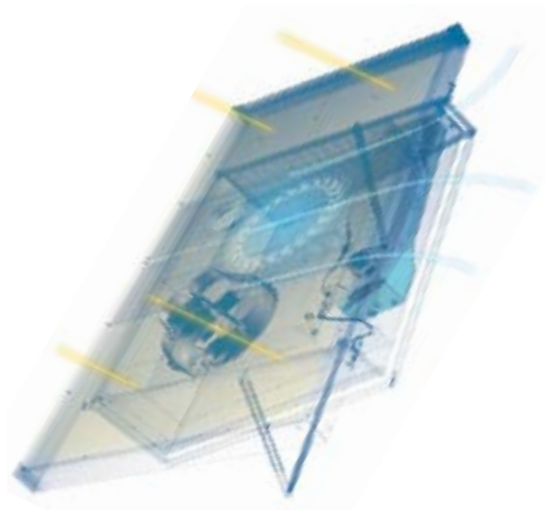
Manu Karan, Vice President, Business Development, Middle East & South Asia, Source Global, USA

Source Global is funded by Bill Gates and Blackrock and is based in Scottsdale Arizona. Claims to provide sustainable drinking water in 52 countries around the world. They claim to be the largest Air Water Generation (AWG) company in the world. No conventional power is used. Source hydropanels are zero carbon footprint devices using only sunlight and has zero wasteful discharge. In contrast, RO wastes 4 litres for every litre of drinking water it produces. They are suitable for serving 5 litres of water/day/person for cooking and drinking purposes. It can work in relative humidity as low as 10%. Magnesium and calcium is added to make the water palatable. It is low maintenance and best suited for remote communities in islands, hill areas, forests, mining etc. The devices are deployed in 9 states in India. Sounds like a working technology and relevant to meet every aspect of water stress mitigation. The cost varies from 10 paise to 100 paise per litre.

SOURCE HYDROPANELS

- Zero Carbon Footprint Pure Drinking water from sunlight + air
- Self-contained, elegant design
- No input electricity or water source required, Zero wasteful discharge
- Can be mounted on roof or on ground





HOW DOES SOURCE WORK?

1. SOURCE Hydropanels contain a patented Hygroscopic material which attracts moisture from the air
2. The attracted moisture is heated using solar thermal energy. The hot moisture condenses into pure water (distilled / de-mineralized) on contact with cooler ambient temperature air
3. The pure water is mineralized with magnesium & calcium by the mineralization cartridge to achieve an ideal taste profile
4. The condensed water is pumped out of the panel using a small pump powered by the Solar PV + battery built into the panel

VALUE PROPOSITIONS FOR COMMUNITIES

PURITY, WELLNESS & TASTE
SOURCE water is the purest and healthiest form of drinking water as minerals get added in the perfect ratio. It also without any contaminants that are usually present in ground water.

ON SITE, AT HOME
SOURCE water is available on top anywhere there is sun. Can be installed on roof or unused piece of land. Instead of traveling to the water source, it is brought home.

INCREASED WATER AVAILABILITY
Drinking water generated from their air adds to the existing water availability at site. Using SOURCE and avoids the usage of RO Filtration Plants which use 4 litres of fresh water to produce 1 litre of clean drinking water.

RESILIENCE
Resilient against drought, contamination, natural disasters and drop in water table. Perpetual captive source of stable quantity of drinking water for communities.

LOW MAINTENANCE
Apart from periodic cleaning of panels & replacements of filters, operations can be managed long term by the communities in which they are placed.

Technology & Innovation Showcase

Smart - Ops WaterDR Technology Suite (UK) – Floating Water Systems

Proof of concept has already been demonstrated. However, exact treatment mechanism involved in containerized systems including its scalability has to be understood in indoor presentation before considering these technologies for ETV.

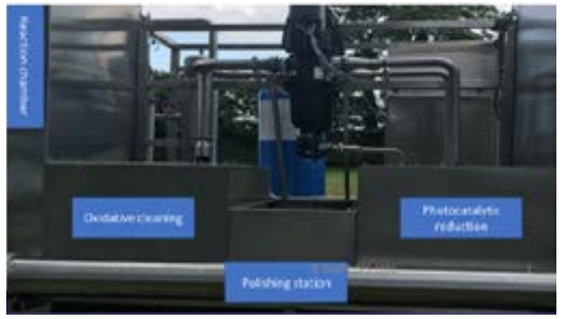
Minesh Patel, Managing Director, Smart Ops Ltd, UK

The company works with a nice mission statement: "To ensure all future generations of life on this planet have the same opportunities and standard of living we have today, by providing the most advanced yet acceptable technologies that we can profitably develop and implement to have an impact on a global scale". It claims to provide containerized solutions. The water floating treatment system pulls water from up to 10 m depth below the surface into reaction chamber where liquid is aerated / treated and then pumped out across surface of the water. They also have a proprietary fractionating / bioreactor technologies which claims to remove 95% of suspended solids from polluted water including microplastics. They have also developed continuous online monitoring of river & lagoon through iCloud monitoring using sensor arrays. They have demonstrated industrial wastewater treatment including treatment of municipal wastewater. Already working in Ganga basin with interception of drains and treatment of intercepted flows. Questions were asked about N and P and nitrification / denitrification.

Low energy usage 6-10kW | **Low Capex and Opex cost** | **Treats 1.5 million litres of water per day** | **Impacts 50 million litres of water due to microflora improvement**

QWUBE™ a forty foot container treating heavily polluted and coloured industrial water from food factories.

Bioreactor and separator aids in growing up naturally present beneficial bacteria and removes suspended solids, faecal material and microplastics.



Smaller water treatment system for smaller industrial outlets with less polluted water.

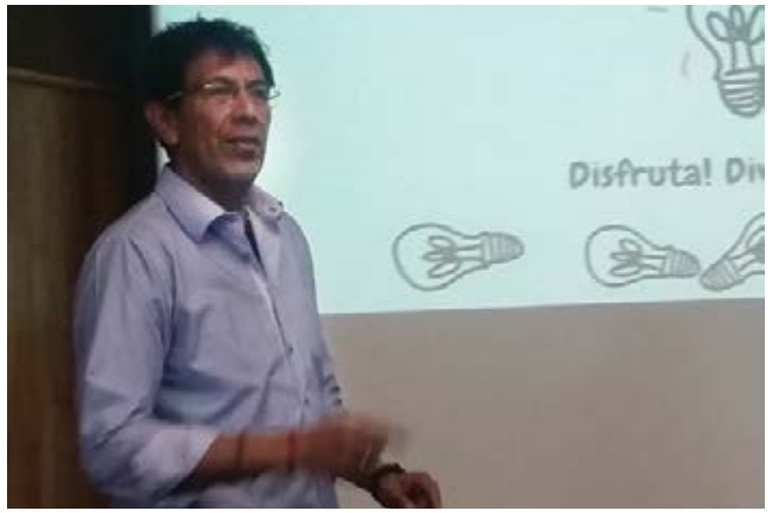
Pilot executed in Ganga river system.

Wastewater sample | 30 sec | 60 sec | 90 sec

Technology & Innovation Showcase

Lyndon Water (UK) – Naturally Occurring Process to Separate Wastewater into Clean Water Suitable for Agricultural Use and Create a Highly Usable Protein

This is a well-tested technology and already have some working units in the country. Hence, this technology need not be considered for ETV.

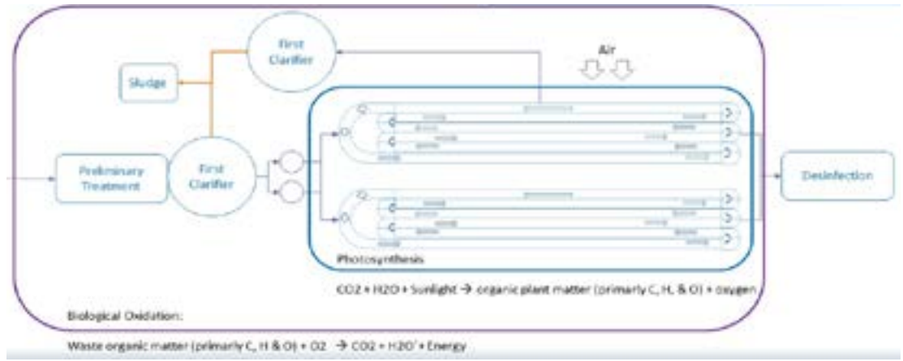


Alfonso Gonzalez Orduno, Technical Director, Lyndon Water, UK

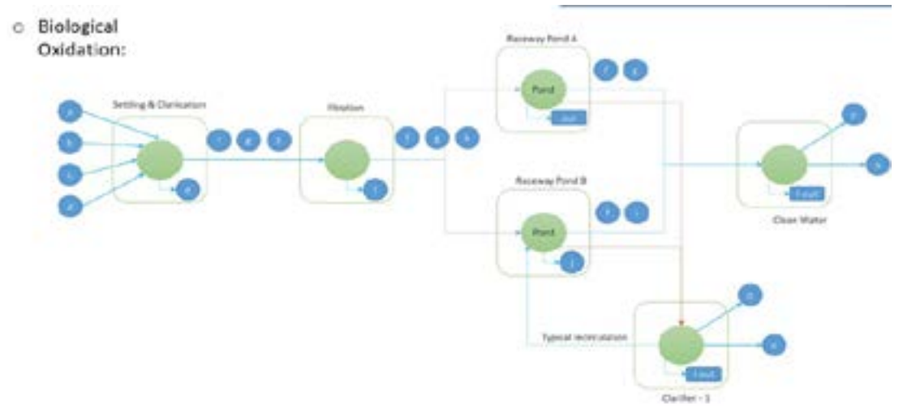
The presentation was on the use of duckweed-lagoon system to clean wastewater. They have shown modelling based design approach for lagoon for the treatment of domestic wastewater through biological oxidation process. One of the valuable end-product of this process is growth of duckweed – rich in protein. The technology allows it to work in local conditions but it requires huge land-parcel. The technology appeared to very similar to constructed wetlands as commented by Prof Gupta.

ALTERNATIVE SUPPLY OF CLEAN WATER: (A-D) PROCESS FLOW CHART

(A)



(B)



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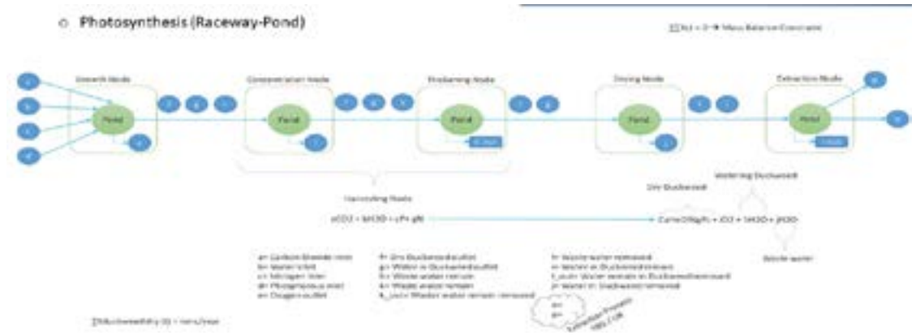
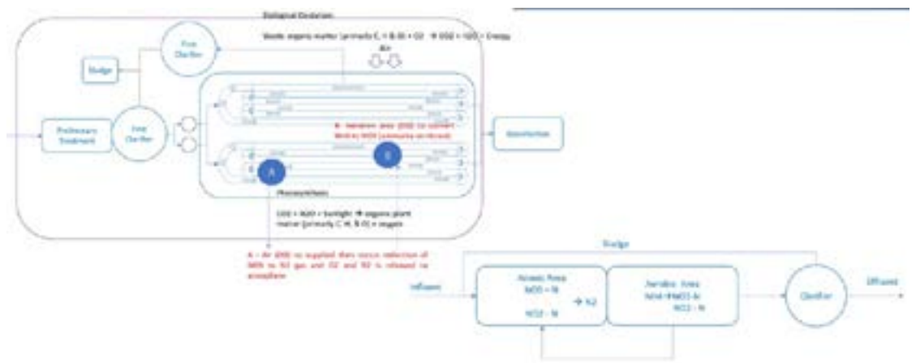


(D)



Technology & Innovation Showcase

pani
AI Operator Coach™
existing hardware, existing people, existing data.

PANI Energy (Canada) – Cloud based Machine Learning to Optimise Wastewater Treatment Plants

AI, IoT, ML solutions are now being used extensively in water sector. It provides efficiency, helps compliance, saves energy and aids in optimal operations. Promising technology to showcase and support through ETV process. The company is encouraged to establish their technology under Indian context in one or two selected water and wastewater treatment plants to refine their data acquisition process.

Devesh Bharadwaj, Founder and CEO, Pani Energy, Canada

PANI Energy has started from a Canadian University as an AI operator. Their AI technology is purpose built for treatment of industrial water & wastewater, desalination as well as municipal water & wastewater. With the deployment of AI, it has seemingly achieved successes in reduction in operating costs of treatment and aiding in preventive maintenance. This technology has won disruptive technologies award from Global Water Intelligence. Case studies have been showcased with data. The product AI Coach is a cloud-based ML solution. Ticks Industry 4.0 and helps save energy and ultimately carbon footprint. However, most of the data is acquired through online using sensors and it has limitation with respect to data to be estimated through laboratory analysis.

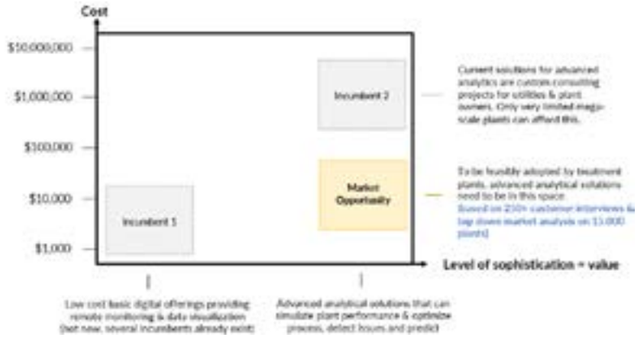
PANI'S AI COACH™ SOLVES THESE CHALLENGES AT THE SOURCE

- ☑ Up to a 20% reduction in OPEX
- ☑ Up to a 20% reduction in CAPEX for upgrades
- ☑ Elimination of unplanned / unforeseen downtime
- ☑ Increased compliance with regulatory frameworks and the elimination of fines
- ☑ All with a low up-front cost, short time to value, and an affordable recurring fee

WATER PLANTS ARE DIFFICULT TO MANAGE AND NEED HELP

Sub-optimal plant operations	Poor maintenance scheduling & unplanned downtime	Sub-optimal compliance & associated fines
loosing thousands of dollars per day	*Unable to meet factory's production targets*	*One fine can cost up to $0.25M dollars & millions in lost production*

WATER SECTOR IS THIRSTY FOR AN ECONOMICAL AI SOLUTION



HOW IT WORKS

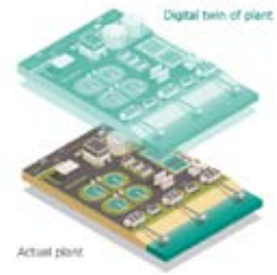
AI TECHNOLOGY IS PURPOSE BUILT FOR TREATMENT

Industrial Water & Wastewater

Desalination

Municipal Water & Wastewater

A DIGITAL TWIN FOR THE PLANT



Technology & Innovation Showcase

Forward Water (Canada) – Forward Osmosis

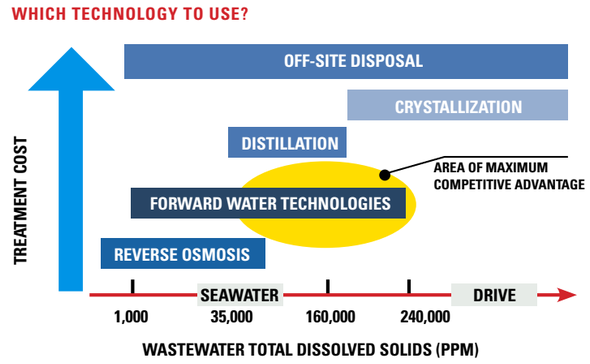
It is an emerging area and worth experimenting / piloting through ETV process for highly polluted mine water discharge and industrial waste. Low energy use is a positive but the boundaries need to be understood. FO is likely to be adopted for future use.

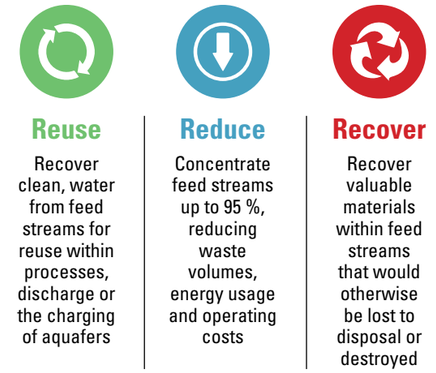
Alan Birrell, FWT, Canada

Forward Osmosis (FO) is now working as a proven technology for various applications. This particular technology was spun out of Queens University in Canada. Waste treatment is about, "Burn, Bury or Boil". Intractable pollutants from textiles, electronics, oil & gas, mining, etc. have created difficult to survive situation in many parts of the world. Heavy metals and polar compounds are difficult to remove. FO cost effectiveness kicks in for effluents having TDS ≥ 20000 mg / L.

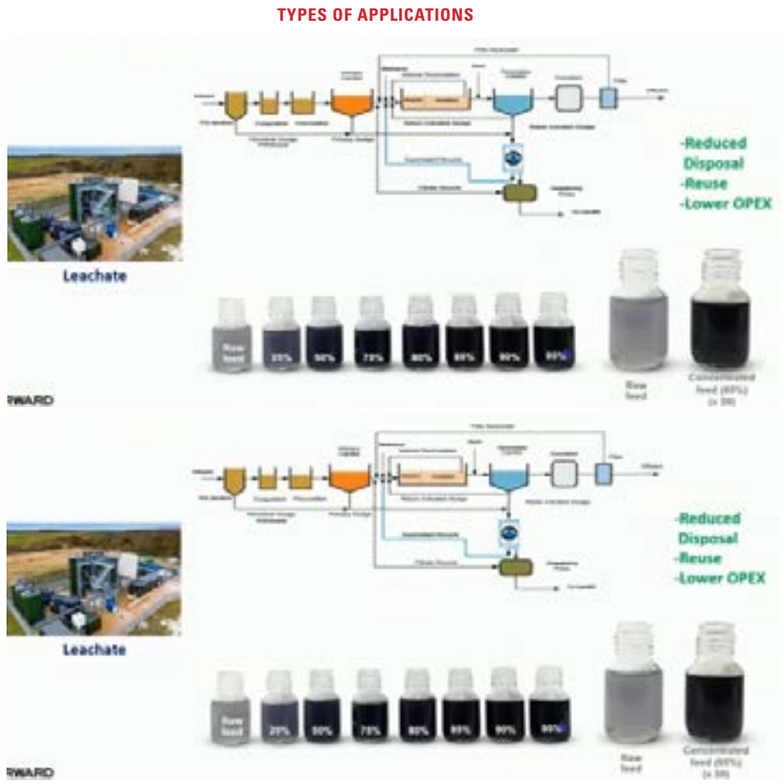
Grant Thornley, VP Engineering Sales

It supports the circular economy and the 3 R's – Reduce, Reuse, Recycle. An example was given of a project in US. The cost of burying waste was $ 2.92 million; Cost of boiling was $ 1.3 million and Cost of FO use in terms of electrical costs was just $ 87600. The technology is being used for Lithium brine and mine water leachates. FO is not a pressure driven system like RO. It uses osmotic diffusion across membranes and defines this as osmotic pull. FO can be used in continuous operation or in a batch mode.





THE (3) R's OF FORWARD OSMOSIS



Technology & Innovation Showcase

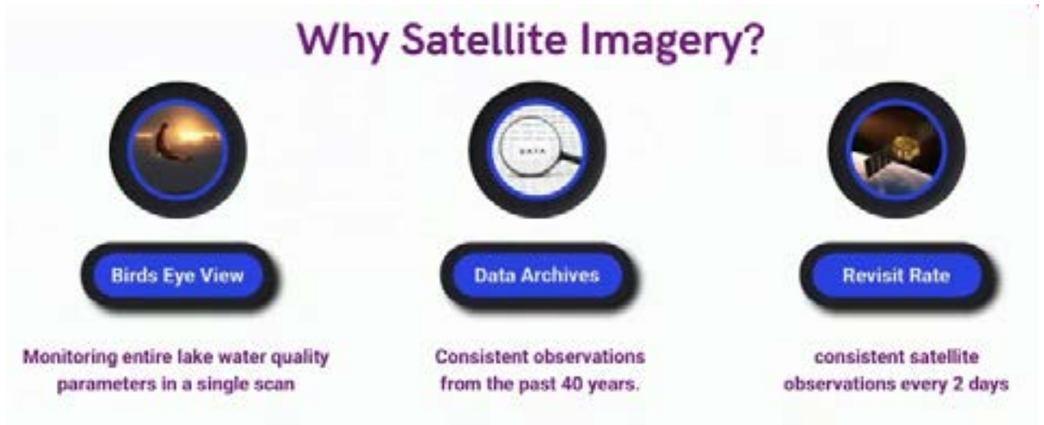
OCEO Water (India) – Lake Water Quality Monitoring from Space

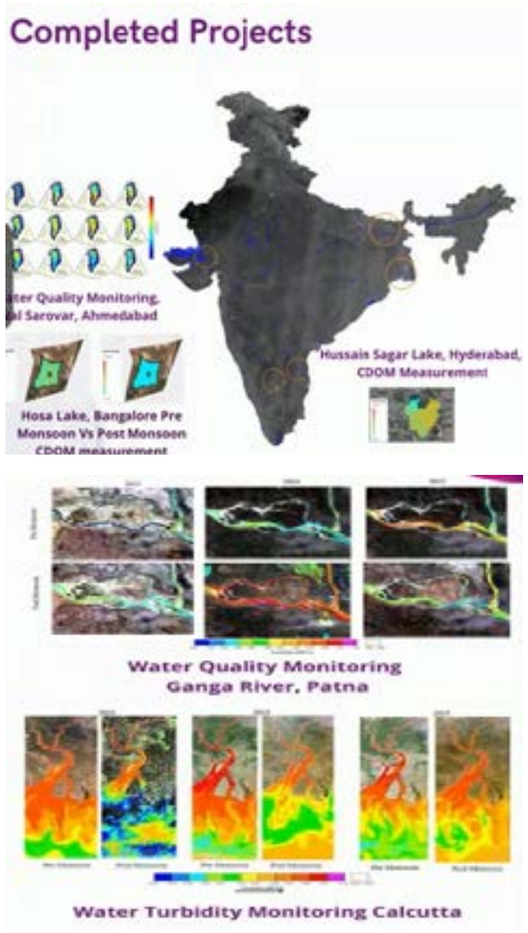
The capabilities look good. More case studies needed for proof of concept. Huge implications as a standalone technology and as an augmenting force of other measuring devices. Dovetails with 4 IR. May be encourage through ETV process.

Vikram Gulecha, Founder, Oceo Water, India

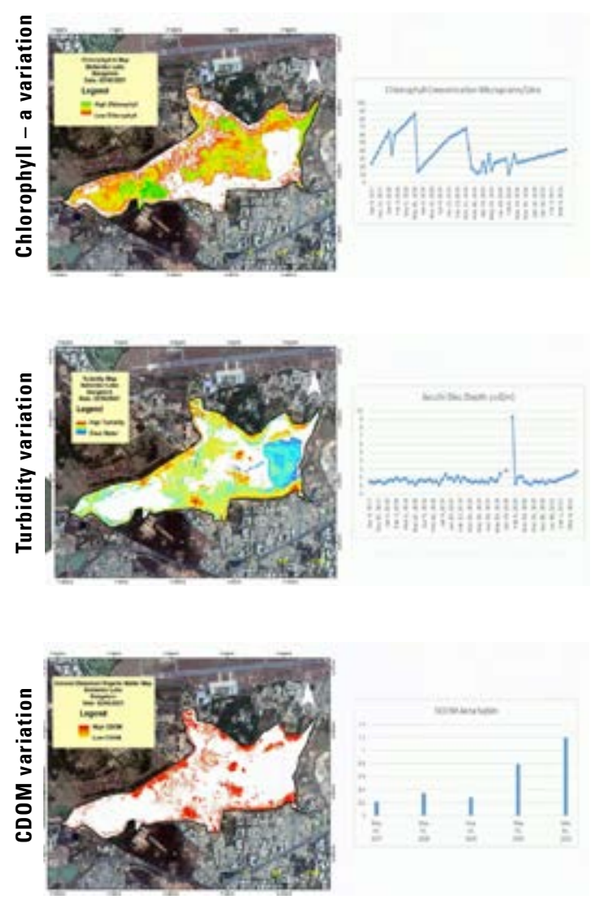
OCEO uses satellites to acquire some of the water quality parameters of water bodies. The team is based in Bangalore and are using remote sensing data and high-resolution pictures of earth. Measuring water quality through remote sensing is a new venture and is becoming sharper and accurate. The data is both open source and paid. Claiming developing ability to measure BOD / COD from remote sensing data. The panel wanted details of this capability. Currently companies across the globe measure movement of algae, flotsam etc. It can see a few meters below the surface and have a spatial resolution of 10 meters. A case study of Hussiansagar Lake in Hyderabad and Bellandur Lake, Bangalore were presented. The technology is also being used to measure water leakages in underground pipelines at 2-3 metre depth. It augments ground penetrating radars capabilities.

LAKE AND POND WATER QUALITY MONITORING FROM SATELLITE OBSERVATIONS





CASE STUDY BELLANDER LAKE,BANGALORE



Technology & Innovation Showcase

SATSENSE

SatSense (India) – Water Resources Assessment using Satellite Remote Sensing

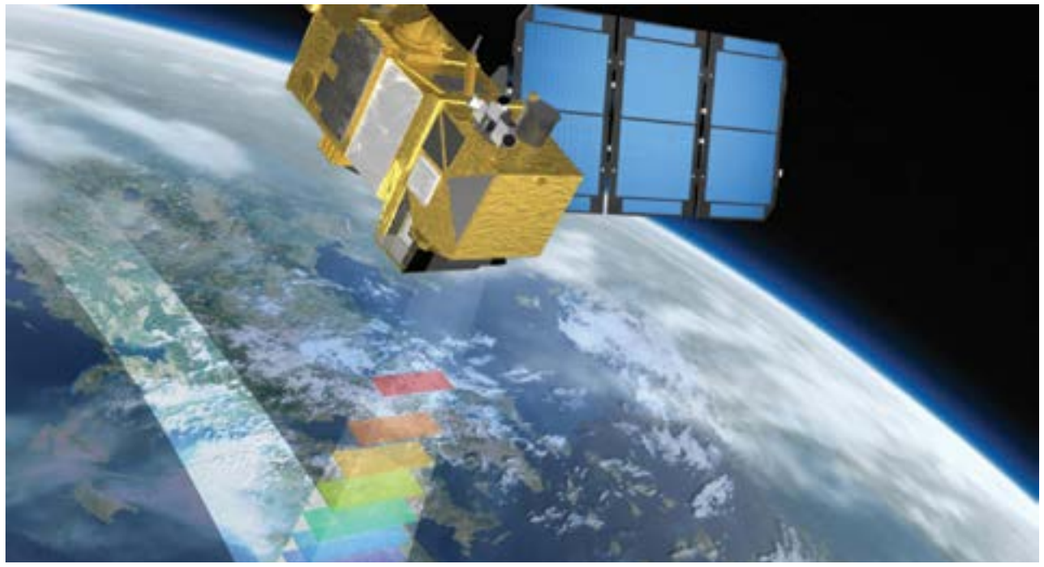
The technology and methodology used is state of the art and it will keep improving in future as higher resolution and sensor data analytics become vogue. Eyes in the sky will help in monitoring real time and eliminate falsification and tardy performance of assets on ground. These technologies are here to stay and are part of 4IR. The company may be invited for an indoor presentation to understand the exact process of data acquisition from the treatment plants before taking a final call on ETV.

Pranav Pasari, Head, Technology, Satsense, India

SatSense uses multi-spectral imagery from space borne sensors to evaluate quality parameters of surface waters. It uses remote sensing technology (satellite earth observation) & geospatial analytics to provide business & governance solutions. Water Quality Assessment initiative was funded and supported by European Space Agency. In India, commercial projects have been successful executed for TSUSL (India's largest private water utility) and a large manufacturer of Sewage Treatment Plants. Pilots conducted for several government organizations in India, such as: Ministry of Housing & Urban Affairs, GOI; Jharkhand State Pollution Control Board; Kerala State Pollution Control Board; Tamil Nadu State Pollution Control Board and Siliguri Jalpaiguri Development Authority. Pilots have also been conducted for storage and run-of-river hydropower projects, successfully measuring sediment concentrations in rivers and reservoirs.

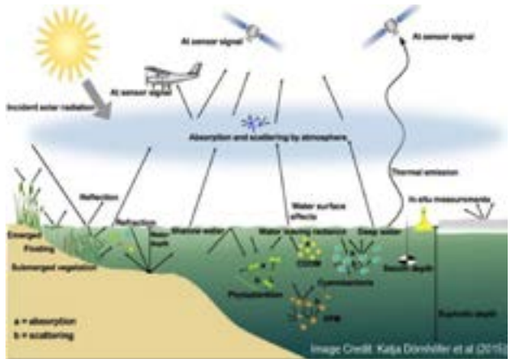
Several factors obtained from satellite data can be collectively evaluated to screen potential sites for building STPs.

SATELLITE BASED WATER QUALITY ASSESSMENT



Multi-spectral imagery from space borne sensors are used to evaluate quality parameters of surface waters.

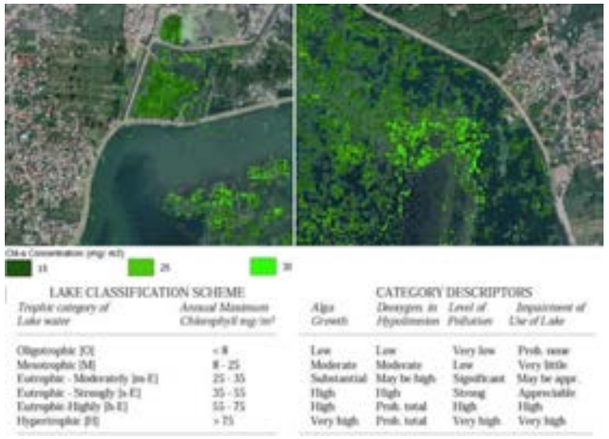
TECHNOLOGY: SATELLITE BASED WATER QUALITY ASSESSMENT



In surface waters, several substances contribute to the optical spectral signature. A bio-optical radiative transfer model & neural network are used to convert water leaving reflectance to derive water quality parameters.

SCHEMATIC: SATELLITE BASED WATER QUALITY ASSESSMENT

WASTEWATER APPLICATION: MEASURING EUTROPHICATION



LAKE CLASSIFICATION SCHEME

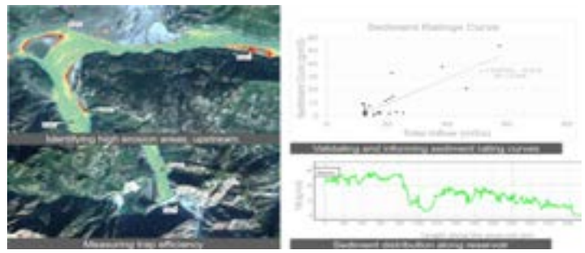
Trophic category of Lake water	Annual Maximum Chlorophyll mg/m³
Oligotrophic [O]	< 8
Mesotrophic [M]	8 - 25
Eutrophic - Moderately [m-E]	25 - 35
Eutrophic - Strongly [s-E]	35 - 55
Eutrophic-Highly [h-E]	55 - 75
Hypereutrophic [H]	> 75

CATEGORY DESCRIPTORS

Algae Growth	Deoxygen in Hypolimnion	Level of Pollution	Impairment of Use of Lake
Low	Low	Very low	Prob. none
Moderate	Moderate	Low	Very little
Substantial	May be high	Significant	May be appr.
High	High	Strong	Appreciable
High	Prob. total	High	High
Very high	Prob. total	Very high	Very high

Chlorophyll-a concentrations (mg/m³) are measured in lakes and ponds to determine the Trophic category of the water. This can be done by comparing with values prescribed by the OECD Lake Classification Scheme, shown on the right.

SEDIMENT ASSESSMENT: OUTPUTS



Technology & Innovation Showcase

University of Tel Aviv (Israel) – Water Resource Management

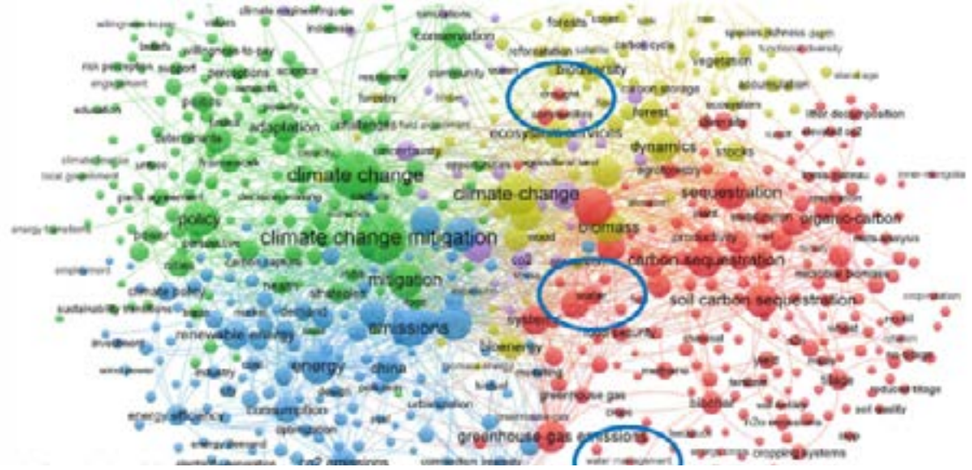
New bio-remediation technologies are being used but their efficacy at large scale is yet to be ascertained. However, any methodology that helps in pollution mitigation is welcome. Use of AI in water section is established with experiment data, sensitivity and comparison with conventional methods, which places the proof of concept on sound footing. More such applications should be encouraged to measure other water quality related parameters.

Hadas Mamane, Professor, Tel Aviv University

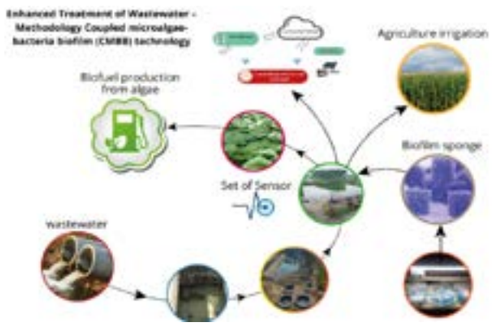
Climate change is forcing farmers to use wastewater from municipality and industrial effluents. This has serious health implications across the globe but rather acute in a country like India because of dense population and decreasing per capita availability of water. Globally, less than 10% of collected wastewater receives any form of treatment. 65% of downstream-irrigated croplands (90 million acres, mostly in China, India, Pakistan, Mexico, and Iran) were highly dependent on urban wastewater flows. The University of Tel Aviv has developed microalgae based wastewater treatment ponds to tackle problem of sewage treatment. In conventional wastewater treatment of 1000 m^3, approximately 117 kg of O_2 is required whereas microalgae produce more oxygen than they require. A case study carried out in Punjab using microalgae was illustrated in the presentation. For the growth of microalgae and its retention in the pond treatment system, the University of Tel Aviv has designed special carriers / media. Bioremediation of wastewater was shown with data. Future works aim to (a) evaluate the effect of treated wastewater on soil properties or to water bodies, (b) develop low cost solar operated IoT based electrochemical sensor system and network for carbon and nitrogen monitoring, detection and monitoring of algal toxins and (c) algal based biofuel production and parametric optimization followed by evaluation of biofuel properties. In addition, application of AI in water sector was also presented showing measurement accuracy, sensitivity and precision. The results seem to be good on all parameters.

WASTEWATER TREATMENT OF ALGAE SEWAGE PONDS IN RURAL INDIA, PUNJAB

Bibliometric analysis of research on climate change mitigation



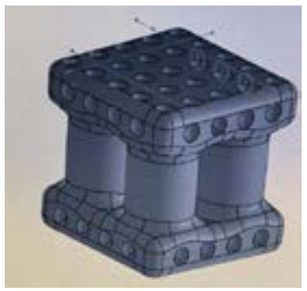
OVERALL SCHEME

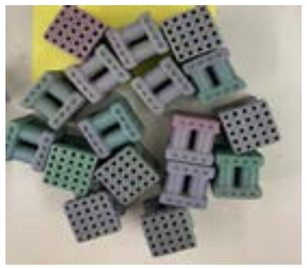


RESULTS OF PILOT SCALE EXPERIMENTATION (100 LITERS)

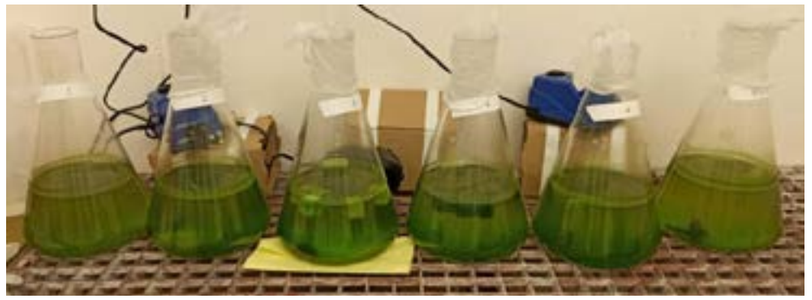
Parameters	Initial reading	Values observed after 3days of Treatment	Values observed after 5days of Treatment	Values observed after 7days of Treatment	Values observed after 12days of Treatment	PPCB Standards (Discharge for treated water for irrigation)
COD mg/L	188	142	118	92	68	<150mg/l
BOD (5days) mg/L	90	74	55	48	36	<100mg/l
TDS ppm	434	473	498	522	558	< 1200ppm
TSS mg/L	18	15.8	13.2	11.8	9.9	< 40mg/l
pH	7.82	8.05	8.39	8.74	8.9	5.5 to 9.5
Nitrates	12mg/l	10.7mg/l	7.2mg/l	6.5mg/l	5.6 mg/l	< 40mg/l
Total Phosphates	8.8mg/l	-	5.7mg/l	4.2mg/l	3.4 mg/l	< 10mg/l
Fecal Coliform	$3.54x10^6$ /100ml	-	-	-	$0.12x10^3$ /100ml	$<2.30x10^3$ /100ml
E.coli	$2.67x10^6$ cfu/100ml	-	-	-	$0.28x10^3$ cfu/100ml	$< 10^3$ cfu/100ml

CARRIER: P CUBE





A NATURAL REMEDIATION USING BIODEGRADABLES CARRIERS



Technology & Innovation Showcase

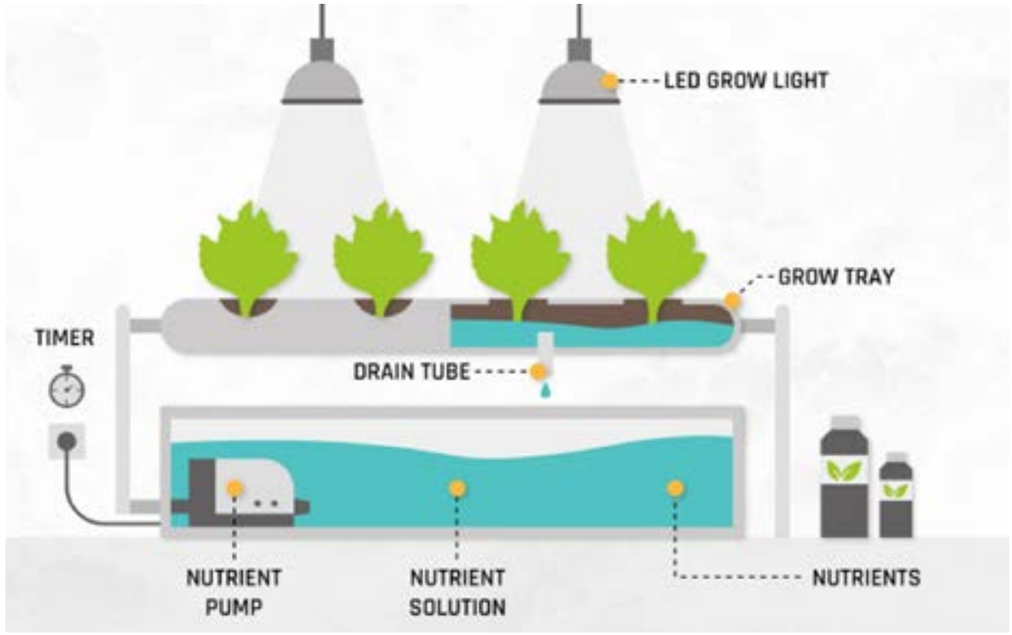
ZEH Ltd (Hungary) – Rainwater Use and Hydroponic Crop Production System

Rainwater harvesting is not new to India and several designs are available. Hydroponics is picking up in India and the design etc. needs to be understood in the context of crops, area, geo climatic conditions, economics etc. India is now water scare with poor soils. Hydroponics can play a vital role in productivity and optimal use of nutrients without soil. The company can be encouraged to put demonstration systems at selected sites / location as part of ETV.

Bertalan Kovacs, ZEH Ltd, Hungary

The company Zero Energy House limited is an SME in Hungary. More than 10 years of experience in the plastics industry in design, production and professional installation. The presentation was focused on Rainwater use and Hydroponic crop production system. Harvested rainwater is being used in households for toilet flushing, washing of dishes / clothes and showering after passing through mechanical filters, special UV lamp and dry booster pump. Design of a shower reservoir allows people to collect rainwater, monitors rain forecasts, uses existing water in order to have capacity for storage of large amounts of rainfall in future, ensures water protection. The presentation also focused on hydrophonics – growing plants (usually crops) without soil using a nutrient solution. However, the innovation was self-supporting panels for multi-level vertical crop production, having movable levels, maximum space utilization (up to 5-6 m^2 peak size of each panel). This type of system may be used where available space is small, having poor soil structure, requiring excessive use of fertilizer and contaminated soils. The system has the advantage of accelerated growth and higher average yield as well as the movable panel could be taken to the place of harvest.

RAINWATER USE AND HYDROPONIC CROP PRODUCTION SYSTEM



WHEN SHOULD YOU USE IT?
- The available space is small
- Poor soil structure
- Excessive use of fertillizer
- Contaminated soil

WHY USE IT?
- Less pests
- Fewer plants protection tasks
- Protection from extreme weather
- Nearly 100% marketability
- Less live work
- Optimal use of space
- There are no seasonal omissions
- Greater efficiency
- Accelerated growth
- Higher average yield
- Mobile panel
- The tray can be taken to the place of harvest
- The cost of the finished product can be reduced
- To gather information

WHAT DO WE OFFER?
- New, innovative solution with self-supporting panels
- Our goal is to replace the old tubular crop production
- Current method
- Multi-level, vertical crop production
- Movable levels
- Maximum space utilization
- Up to 5-6 m^2 peak size (each panel)
- Rotomolding
- Research and development stage

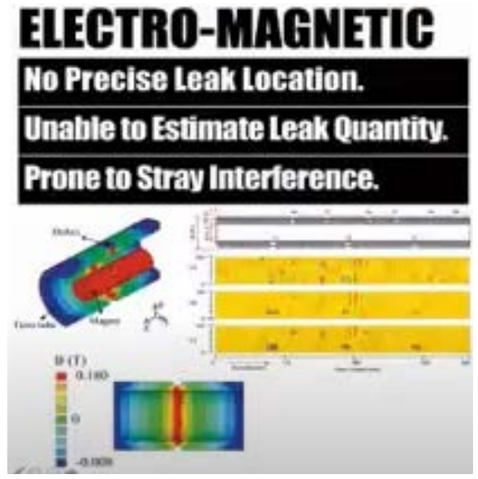
Technology & Innovation Showcase

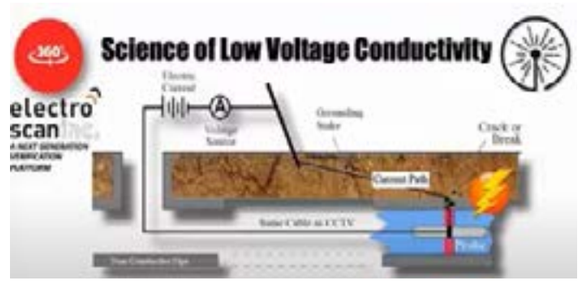
Electro Scan (USA) – Inspecting Pressurised Pipes for Leaks

The technology appears to be well established abroad. However, for Indian situation, the same may be considered for ETV after having a detailed indoor presentation from the company including cost implication of its use.

Chuck Hansen, Chairman & CEO, Electro Scan Inc, USA

Electro Scan has presented briefly the concept of leak detection in pressurised underground pipe networks. The system not only detects the leaks but also gives information on size of hole(s) and its location on the pipe without disturbing running water under pressure. In most of the urban water distribution network, very high water losses have been reported and therefore, use of such a technology may come handy in carrying out effective remedial action to save on water.





Technology & Innovation Showcase

Exo-Cubic Solutions (UK) – Ultra High Pressure Jet based Tyre Recycling

Recycling is part of 3Rs and supports the environment and reduces pollution of land, water and air. The ETV support may be continued.

Ken Jones, CEO & Founder, Exo-Cubic Solutions, UK

Exo-Cubic Solutions made a brief presentation on the ultra-high water pressure jet based tyre recycling and then highlighted their progress of past years under ETV. They had two demonstrations to tyre industry people and the concerned Ministries of Government of India. Presently, the company is partnering with cGanga, IIT Kanpur as technology partner. To a pointed question regarding centralized or decentralized system of recycling, Mr Jones suggested to go for decentralized system. Under the decentralized system, recycling units can be erected at the tyre dump sites and valuable rubber, steel is recovered through recycling process and then couriered to the destination units of use. This will generate more local employments.

THE BENEFITS

1-step Process: All In-feed tyre materials are transferred via conveyors to UHPW for single stage processing – in high volume

100% Recycling: All tyres are 100% recycled, 100% clean and 100% separated

0% Waste: All materials are recovered with nothing diverted to landfill

100% Clean: The output materials of premium quality are ready for direct use in industries

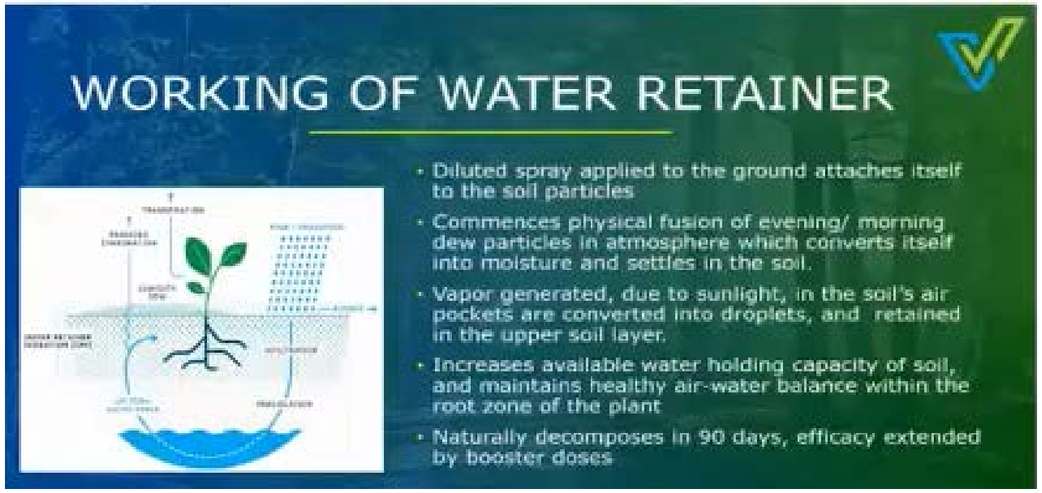
Technology & Innovation Showcase

Water Retainer, Valoric Venture (Hungary) – Soil Water Retention

It is a water retaining material probably having organic in nature. They are trying to establish their credentials by working closely with ICAR and other agricultural universities. It appears to be fully supported by Hungarian principles as well as Hungarian Embassy in India. However, the company has been requested to provide a few published literature. Also, costing details are needed and therefore a more detailed indoor presentation is required before recommending the same for ETV.

Vinay Verma, Managing Director, Valoric Venture, Hungary

The presentation detailed water distress scenario across the country. Erratic weather has made soils very dry and overdrawing water has made the situation dire in most places. The water retention material as developed by the company is used when the soil is prepared. It has a life of 90 days at the field level. This technology has been supported by FAO. This technology has also been used in tea gardens. Presently, the company is working in close association with a few agricultural universities and ICAR in India and more data may be available in near future. Dr Jawed asked about the material used. It was not disclosed citing patent issues. They are insisting on water saving more than the material being used. Approximately 10 litre of the water retaining material is applied over an hectare of land. This material encourages formation of dews from moist air whereas the water retaining material ultimately decomposes in the soil. The company has shown willingness to install production units in India.



Technology & Innovation Showcase

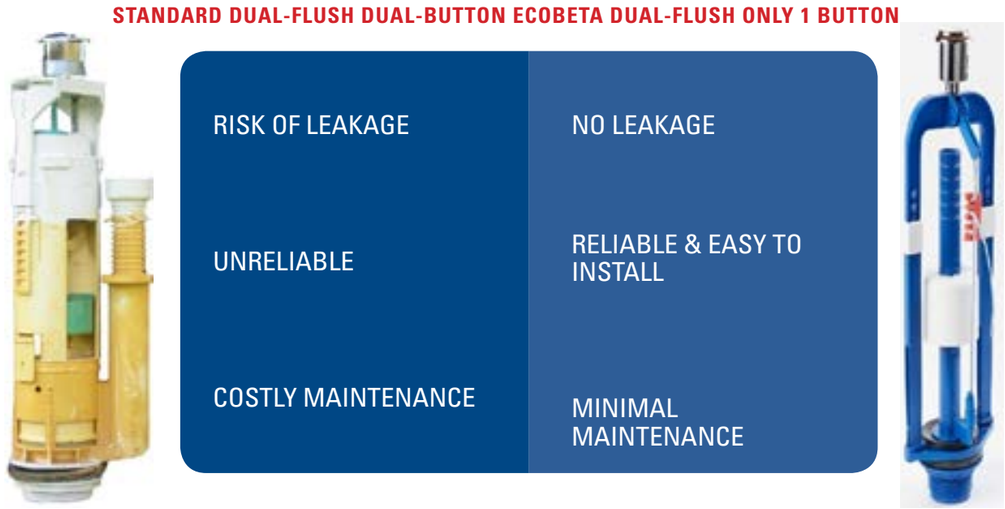
ecoBETA (Denmark) – Water Use Reduction Systems for Toilet Flushes, Taps and Showers

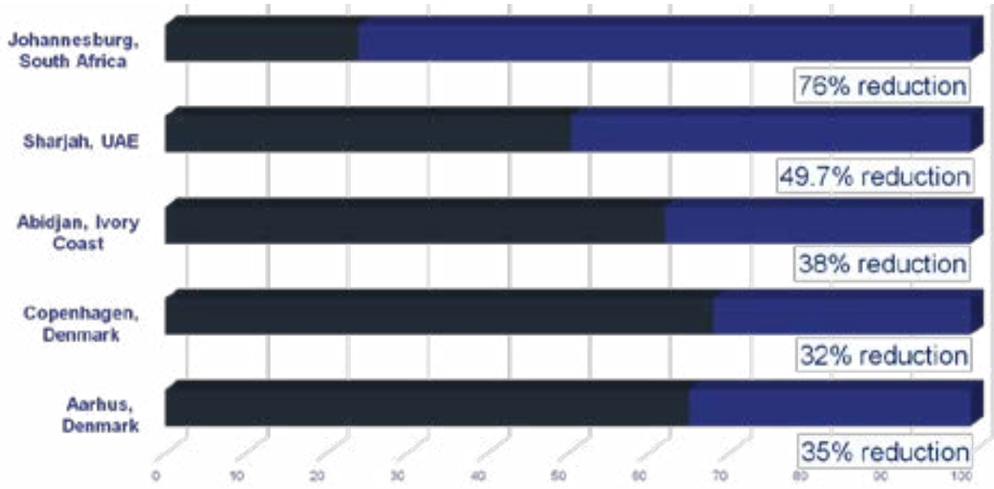
One innovation can make so much difference. Ability to sell the concept and the product shall define success. Since the product is already in the market, it does not require ETV from cGanga end.

Viraal Balsari, ecoBETA, Denmark

ecoBETA are into reducing per capita water consumption. The company arm is housed in Mumbai. The company mission statement is – "We believe that it is cheaper and more sustainable to save water rather than generate and transport it", especially given supply constraints across the globe. The presentation included data on water saving in Africa, Denmark and 18 other countries. Mr Balsari explained the designed cistern buttons for the flush, including ecoBETA dual flush button.

Our solution to reduce water stress is low cost compared to the foregoing. **ecoBETA preserves current supply capacities** and hence, is more suitable from a public financing perspective





Technology & Innovation Showcase

BioXgreen (India) – Bioremediation of Open Water Bodies including Drains – Beyond Conventional Approach for Effective Treatment of Wastewater

This is a very promising methodology to address some intractable waste water remediation challenges. An alternate use of natural bacteria and ability to meet outlet parameters are shown nicely in case studies of ongoing projects. This holds huge promise for the future and need support at every level. They are able to treat open drains, water bodies, industrial effluents. ETV may back more pilots for other solutions and perhaps keep an eye on this excellent bio remediation company.

Anil Pillai, Vice President, BioXgreen, India

Arvind Sharma, Founder and Managing Director, BioXgreen Technology Pvt Ltd

One of the key issues faced are runoffs from urban sewage systems, industrial wastewater, rural septic tanks which leads to pollution of natural water bodies such as ponds, lakes and rivers. BioXgreen provides bioremediation solutions for natural water bodies, open drains, ponds, lakes and rivers. They have claimed to reduce BOD < 30 mg/L, COD < 150 mg/L, TSS < 100 mg/L, nitrogen < 10 mg/L and phosphorus. For industrial ETPs and CETPS, they have developed bespoke pure culture microbial consortium for difficult to degrade complex organic compounds present in effluents generated from agrochemical, pharmaceutical, pigment industries, chemical industries, petrochemical industries, textiles & tanneries, and others. The case studies with data have also been presented indicating clear proof of concept successfully achieving the results. They also spoke about bio augmentation with addition of bespoke solution of specially designed highly potent consortia of pure microbial cultures (a robust unique blend of aerobic & facultative bacteria) to degrade and mineralize the organic fraction in the wastewater.

Biofilm formation on FAB media before and after using BXG bio-culture at 29 MLD STP at Salori, Allahabad (receiving 45 to 55 MLD Sewage), Uttar Pradesh, India

Bioxgreen Provides Bio-remediation solutions for:

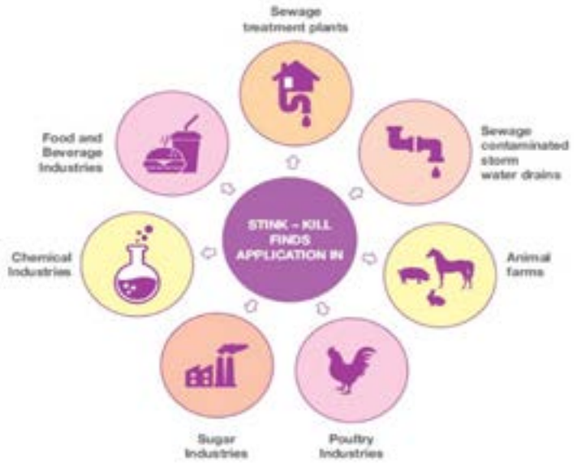
NATURAL WATER BODIES

- Open drains
- Ponds
- Lakes
- Rivers
- Reduction of
- BOD < 30 mg/L (if required we can also reduce it to 10 mg/L
- COD < 150 mg/L
- TSS < 100 mg/L
- Nitrogen < 10 mg/L
- Phosphorus

BROWN FIELD SEWAGE TREATMENT PLANTS

- To achieve the new norms
- BOD < 10 mg/L
- COD < 50 mg/L
- Total Nitrogen < 10 mg/L

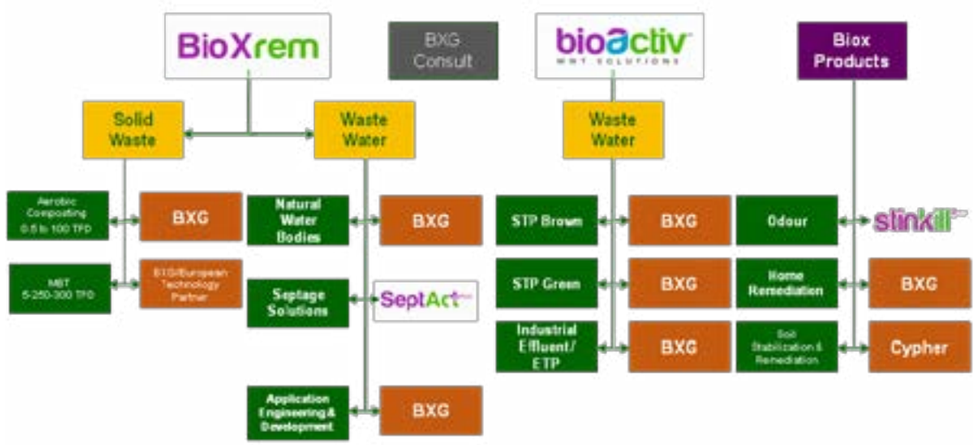
THE BOD, COD AND TSS LEVELS INDICATED FOR NATURAL WATER BODIES ARE AS PER NMCG's



BIOXGREEN'S PRODUCT

- BioxRem for waste water treatment
- SeptAct for septic tank and fecal sludge management
- StinKill for odor control

WASTE MANAGEMENT- TECHNOLOGY SOLUTION



Technology & Innovation Showcase

Mebifarm (Japan) – Membrane Farming Systems

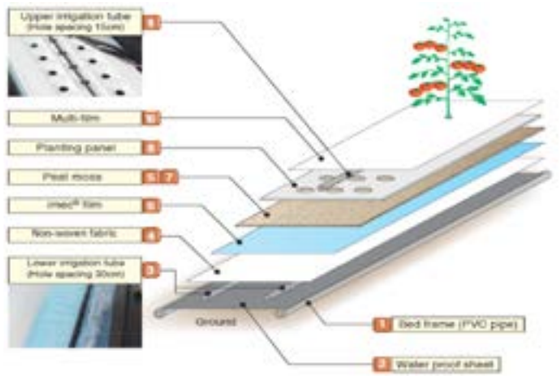
This is a promising technology already being piloted successfully in India. ETV is aware and cGanga has to monitor the progress. Membranes are presently manufactured in Japan but may be manufactured in India once volumes are established.

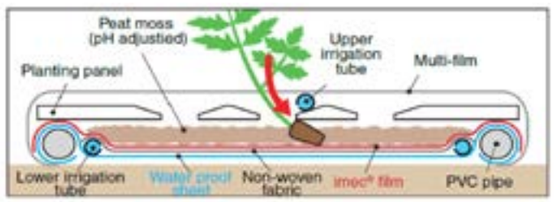
Ganesh Kulkarni, Technical Director, Mebifarm, Japan

The hydro-membrane farming systems comprises of hydro-membrane, the water and nutrient feeding system. This system has been claimed to be economical and simple to set up and operate. Hydro-membrane has numerous nano-sized pores which allow only water and nutrients such as ions, amino acids and sugar to pass while it restricts viruses and microbes. They have setup a sample project of 1000 m^2, using membrane technology near Pune. The project uses Hitech climate-controlled Greenhouse and membrane-based technology. Presently this technology is under the process of ETV.

MEMBRANE TECHNOLOGY

Pilot at Mulshi, Pune





TECHNOLOGY BENEFITS

- Very less water required
- Very high nutrition value
- Better yield
- Require minimum fertilizers
- Minimum chance to disease
- Eco friendly, residue free

BACKGROUND

IWIS 2021 was held virtually. In Technology showcase sessions, 15 companies made presentations over five days. A group of 13 panellists included, the Chair: Prof M Jawed (IIT Guwahati), Co-Chair: Mr DP Mathuria (NMCG), Moderator: Sundeep S Chauhan (cGanga), Dr B Sikka (NMCG), Prof V K Tyagi (IIT Roorkee), Dr Pawan Kumar Labhasetwar (NEERI Nagpur), Prof AK Gupta (IIT Kharagpur), Prof Indumathi M Nambi (IIT Madras), Prof MM Ghangrekar (IIT Kharagpur), Prof M Mansoor Ahmad (SVNIT Surat), Dr Ashootosh S Mandpe (IIT Indore), Prof S Shrihari (NIT Suratkal), Prof Sachin S Gunthe (IIT Madras) facilitated the discussions and Q&A.

The major emphasis in Tract C Session included assessing technologies that are novel, has relevance to India, shown past record of deployment and success, number of SDGs they have addressed or likely to address, interest in adopting “Make in India”, has cost effectiveness and alignment with climate change adaptation and mitigation. The synopsis is based on notes taken during presentations as well as clarifications provided during Q&A by panelist.

TRACK D

India-Norway Collaboration

DAY 1:
Thursday, December 09, 2021
18:00-19:00 hrs

MODE:
Virtual

CHAIR:
DP Mathuria [Executive Director – Technical, NMCG]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATORS:
Sanmit Ahuja [Expert Member, cGanga]

PANELISTS:
Rajesh Kumar [Uttar Pradesh Jal Nigam]
Ole Henaes [Innovation Norway]
Line Blytt [Norwaste]
Henrik Wiig [Oslo Metropolitan University]
Harlad Kleiven [Cambi]

Recently cGanga signed a MOU with NIBIO (Norway) to develop a sludge management framework. The collaboration is now expanding to assess sludge masterplan for various cities and to deploy demonstration sludge management projects. Additionally, partnership around hydrogen and marine pollution will also be discussed in detail.

VIEWS AND COMMENTS FROM THE PANEL

1. India and Norway are strategic partners with deep relationships in various areas of mutual interest. The Government of Norway established a 2030 vision for its partnership with India that includes the following areas: democracy and rural development, oceans, energy, climate and environment, research and global health.

2. As Indians cherish their rivers as it enables livelihood for hundreds of millions, Norway cherishes its oceans as it depends on it for its energy, food and transport needs.

3. In the climate and environment space, there is a lot of emphasis on circular economy. Norway is also working with India in removal of plastics from oceans. The Government of Norway has established the Ocean panel through which it is addressing ocean health, wealth, equity, finance and knowledge.

4. Norway's National Institute for Bioeconomy Research (NIBIO) signed a collaboration agreement with cGanga (IIT-Kanpur) to develop a framework for sludge management in India. The study looks at global best practices on sludge management with a view to help India develop its own policy, guidelines and regulations. It also looks at various technological choices and processes that various countries are following.

5. In sludge management the most comprehensive framework is that from the USA and the European Union. Sludge has three components: water, gas and biosolids. Resource recovery of all three components is possible and should be incentivised to reduce or even eliminate the amount of sludge reaching landfills and water bodies. The recovered water can be recycled and reused or discharged into water bodies after treatment.

6. The gas recovered can be used in transport or other energy applications that have introduced biogas as the energy form, and finally the biosolids can be treated to remove pathogens and then applied to land as soil enhancer

India-Norway Collaboration

or fertilizers. There is a lot of phosphorous and nitrogen in sludge which when recovered then it can be a good source of nutrients.

7. Sludge management is a function of proposed end-use of biosolids, the transport distances between sewage treatment plants and the overall Value chain analysis of the sludge being generated that will help each city to design its sludge management policy. The cities will have to evaluate the cost of treatment, transportation and what markets offer in terms of resources recovered.

8. There are various ways to treat sludge – pasteurisation, digesting at high temperatures and pre-treatment like THP. Which technology is used very much depends on what the cities goals and objectives are.

9. India cannot have categorisation based on size of the cities, but more so based on the size of the plants, its proximities to markets, the economic incentives offered for the various output products. A one size fits all strategy will not work in India. For instance, both Mumbai and Delhi are large cities, but will have to take very different approach to sludge. One such parameter is proximity to agricultural markets.

10. Across the Ganga basin, most towns have been densified with the requisite number of sewage treatment plants, but acceleration of the development of regulatory framework on sludge is the need of the hour. In India the sewerage network that was developed is mostly of interception and diversion, which means that many drains are open in nature.

11. Indian cities will also have to look at toxicity of sludge particularly where there are industrial treatment processes are taking place in the city. These waste streams when mixed with sludge streams may introduce heavy metals and other unwanted elements into the food chain if the final application of treated sludge is for fertilizer use.

12. Most plants in India are of aerobic nature and most of the energy in the system has already been lost.

13. In India fertilizer sector gets large government subsidies, and these have to be channelled to the soil enhancer generated via sludge to make it economically viable.

14. Sludge lines should be handled separately and could also be seen as standalone projects. Whatever solution India uses, the one approach that should be dissuaded is that of incineration.

15. cGanga will expand its cooperation Norway in the areas of hydrogen, plastics recycling and sustainable agriculture.

NORWAY'S

NIBIO signed a collaboration agreement with cGanga (IIT-Kanpur) to develop a framework for sludge management in India. The study looks at global best practices on sludge management with a view to help India develop its own policy, guidelines and regulations

India-EU Collaboration

DAY 2:
Friday, December 10, 2021
18:00-19:00 hrs

MODE:
Virtual

CHAIR:
Rajiv Ranjan Mishra [Director General, NMCG]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATORS:
Sanmit Ahuja [Expert Member, cGanga]

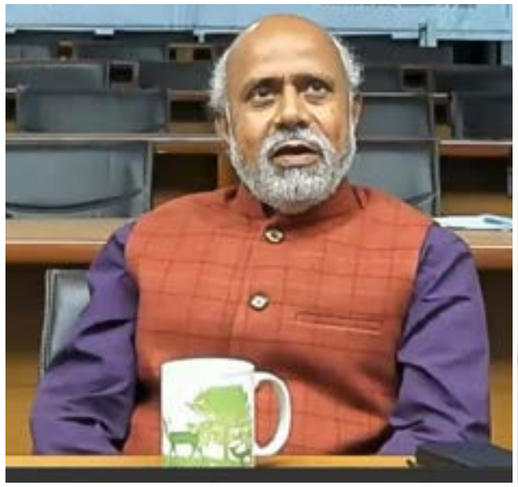
PANELISTS:
H.E. Ugo Astuto [EU Ambassador to India]
Stephan Grabherr [Deputy Head of Mission, Embassy of Germany, New Delhi]
D P Mathuria [Executive Director – Technical, NMCG]
Antónia Kováts [Head of International Office, UPS]
Habil Boglárka Koller [Vice-rector International Affairs, UPS]
Tibor Bíró [Dean, Faculty of Water Science, UPS]
Jakob Williams Ørberg [Innovation Centre, Denmark]
Heike Zatterstrom [Boson Energy]
Aditya Sharma [President, Indian Business Chambers Luxembourg]
Daniel Scholten [Innicca Capital]

EU and its member nations are engaged with India on multiple facets of managing water resources including but not limited to river basin planning, circular economy principles, data and information systems, energy, sustainable transportation and many others. This session will highlight the multi-faceted partnership with EU around water.

VIEWS AND COMMENTS FROM THE PANEL

1. EU has been a great friend of India in sustainable development in the areas of policy and regulation, technology transfer, operations and financing.
2. The IPCC report encourages better management of water cycles. In the EU 11% of population and 70% of the territory is already under water stresses. The biodiversity loss has to be slowed down and reversed under all circumstances. In the coming years Governments around the world are setting aside almost Euro 10 trillions to combat climate change. But great care has to be taken that this investment is fit for purpose keeping in mind the future of sustainable living. EU wants to reach a net-zero target by 2050 with biodiversity at the heart and water management will be the bedrock of this.
3. Water quantity is as important as its quality. EU and India already have a partnership in this area called the India-EU Water partnership which has many EU member states as partners to India. Supported and managed by GIZ (Germany), the IEWP now enters its second phase. In phase 1 it helped develop a river basin management approach for Tapi and this will be extended to the Ramganga basin in the coming years.
4. Collaboration underpins any effort to combat the effects of climate change. In water partnership with the EU, the focus remains on water resource management. The approach has to be looking at the ecosystem of water. India is gaining from the bilateral cooperation of several member states in areas including technology & innovation, policy framework, regulations, circular economy models in water, biodiversity and water financing.
5. Many member nations that are involved in water resource management with India include: Germany, Netherlands, Denmark, Hungary, Luxembourg, Slovenia and many others. Whilst many countries are supporting Indian in development of technological choices, there is need to also

INDIA IS GAINING
from the bilateral cooperation of several member states in areas including technology & innovation, policy framework, regulations, circular economy models in water, biodiversity and water financing



India-EU Collaboration

develop the right business models for applying those technologies in the Indian context.

6. There are many dimensions of water: It can also form a great connector of people if used as a transport channel. Water will also play a central role in formation of green hydrogen.

7. India and Hungary entered a cooperation agreement on sharing knowledge in water with cGanga (IIT-Kanpur) and UPS, Hungary signing a MOU. UPS, a major university in Hungary, will bring significant knowhow to India in the areas of water sciences, water resource management, water treatment, water efficiency and others.

8. India and Denmark entered into a cooperation agreement on sharing knowledge in sustainable development with cGanga (IIT-Kanpur) and Innovation Centre Denmark (ICDK) signing a MOU. The parties will develop partnerships in sustainable energy, circular economy, climate science, green finance and technology and innovation.

9. Alliance of EU India Circular Economy Finance, is a private sector led initiative focused on getting more finance into circular economy technologies and projects in both regions. EU green industry can be a very good partner with India that can make action solutions on the ground.

To drive circularity on the ground, partnerships are important. Technologies coming into India have to make in India to make it fit for India. All stakeholders including policy makers, academia, NGOs and industry have to play their part in managing climate change.

10. For India it is a great potential to establish projects in waste management, nutrient and biomass removal, producing hydrogen from biomass, water bodies as carbon sinks and India can offer a great platform for companies from EU to develop new projects.

11. More and more green finance is becoming available to companies via a range of instruments – venture finance, green bonds, impact bonds etc. However, it is really important to ensure that deserving companies also get access to this finance.

12. The potential of technology transfer from EU to India has not been fully capitalised. Finance will follow companies all the way to India. It shouldn't always the government that pays for this economic cooperation. Private finance also has to support and participate.

13. The Namami Gange programme is a great landing platform for European companies as it offers real life conditions and pilot projects to companies to demonstrate their technology in the Indian market.

14. The Environment Technology Verification (ETV) framework already offers a pathway to international companies coming to India and there are more than 10 companies from EU member nations that are enrolled into the ETV programme.

15. The India EU Water partnership will focus on several common priority areas. Different aspects of water must be explored. The partnership will need to look at entire chain of ecosystem as well as all the actors. The multi-lateral nature of the partnership should support the bilateral collaborations between India and EU member states.

TECHNO-LOGIES
coming into India have to make in India to make it fit for India

India-Australia Collaboration

DAY 4:
Monday, December 13, 2021
09:30 – 10:45 hrs

MODE:
Virtual

CHAIR:
D P Mathuria [Executive Director - Technical, NMCG]

CO-CHAIR:
Rozy Agarwal [Executive Director – Finance, NMCG]
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATORS:
Sanmit Ahuja [Expert Member, cGanga]

PANELISTS:
Tim Fisher [Alluvium, Australia]
Simon Tilleard [Alluvium, Australia]
Anu Kumar [Principal Research Scientist, CSIRO Land and Water, Australia]
Pradeep Khanna [CEO Global Mindset and Executive Director Asia Pac VR/AR Association, Australia]
Salil Goel [Associate Professor, IIT Kanpur]

This session will focus on knowledge sharing and building a partnership around environment management including water trading, emerging contaminants, water governance, water rights, technology & innovation and modes of partnership.

VIEWS AND COMMENTS FROM THE PANEL

1. India and Australia have had long standing partnership in multiple areas whether it is water resource management, river basin development, water and energy, water and emerging contaminants and water stewardship amongst areas.

2. CSIRO and CWC have been continuously engaging on integrated water resource management. Four river basins have been identified to be worked upon under this cooperation. India Australia Water Partnership has taken up various activities including sharing of knowhow from Murray Darling Basin authorities.

3. Contaminants in water bodies is a big challenge with many known and unknown sources of contamination. What is needed the training and capacity building of young water professionals in India. This could be done with knowledge exchanges, introduction of new technologies, understanding bio-analytical tools, accelerated screening tools that help eco-surveillance of contaminants and pathogens.

4. Another area to focus is anti-microbial resistance. As nations increase the use of antibiotics, these will eventually start entering the water streams and enter food chain of both humans and animals. Tracing and managing of these new contaminants is very crucial.

5. India and Australia could partner in strengthening of environment regulators, understanding emerging contaminants and their streams, water quality monitoring, water reforms, reservoir management, irrigation schemes and water quality trading.

6. Many parts of Australia's water management journey are also relevant to that of India. These include how to share water resources efficiently, sustainably and equitably, shaping of cities and communities around water resources such as rivers, addressing climate change through enhanced adaptation and resilience, integrating catchment to coast science, engineering and economics and addressing decline of our natural resources.

CSIRO AND CWC
have been continuously engaging on integrated water resource management. Four river basins have been identified to be worked upon under this cooperation

India-Australia Collaboration

7. Other areas include improving environmental management, transforming water allocation, reforming water pricing and modernising institutional arrangements. Areas that help in creating water information knowledge base are: water metering, water registers, water accounting and monitoring of ground and surface water, demand/ supply trends and water usage pattern.

8. Community and stakeholder management lie at the heart of river basin management. The stakeholders have to play an active role in management of water resources. The communities have to understand their water rights and that it is not a free, endless resource.

9. Australia's water entitlement framework was developed from that of English law where water is owned by the Crown (the State). The entitlement rights in Murray Darling Basin are fully allocated and no new rights can be issued. This is due to massive droughts and variable climate and water resources have to managed effectively.

10. Enabling water markets can be an essential tool to ensure equitable and efficient water resource management. The approaches are by and large accepted universally but countries may be in different stages of implementation.

11. Other elements that need to be leveraged are emerging technologies and technology management. Australian water industry is mostly made up of niche players or utilities whose mandate is largely to look at within Australia. The right model of partnership have to be identified and emerging technologies can be a great connector.

12. Individual Australian entities may not have the wherewithal to enter the Indian market, but a consortium approach is one that will deliver better results.

13. IOT, Digital twins and artificial intelligence is an area where India and Australia have great deal to learn and share from each other. India's National Hydrology programme can also induct many Australian innovations in data and information systems.

14. The mechanisms of India Australia joint working group and cGanga's Environment Technology Verification (ETV) programme offer windows for a seamless collaboration.

ENABLING WATER

markets can be an essential tool to ensure equitableand efficient water resource management

India-UK Collaboration

DAY 4:
Monday, December 13, 2021
18:00 – 19:00 hrs

MODE:
Virtual

CHAIR:
Rajiv Ranjan Mishra [Director General, NMCG]

CO-CHAIR:
Rozy Agarwal [Executive Director – Finance, NMCG]
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATORS:
Sanmit Ahuja [Expert Member, cGanga]

PANELISTS:
Uday Dholakia [Director Smart Ops]
Vijay Goel [Singhania, UK]
Jas Sohl [International Advisor, British Water, UK]
Dhruva Kumar [City of Glasgow College, UK]
Srini Sundaram [Agvesto, UK]
TN Giridhar [Director, SSG Capital, UK]
Jayeis B Sonill [AUM Investments]
Medha Mukherjee [Global Water Intelligence, UK]

Recently cGanga signed a MOU with British Water to create a bridge for UK industry to pair up with its Indian counterparts to build 21st century infrastructure in water and environment sector. The Clean Ganga Exhibition in the UK has also created a phenomenal platform and blueprint for engaging international community including the Indian diaspora to participate in and support the Clean Ganga programme. UK is also becoming a major partner to help India tap into global capital base to finance its green growth agenda. The session will put a spotlight on how the partnership is being put into action.

VIEWS AND COMMENTS FROM THE PANEL

1. UK and India have collaborated for a long time for sustainable development and is a major supporter of the Ganga River rejuvenation programme. The partnership between the two nations is already at a fairly advanced level.

2. The recently concluded Ganga Connect exhibition, that started in Glasgow in the margins of the UN COP 26 meeting, established a significant engagement channel with a range of experts. The exhibition that travelled from Glasgow, Cardiff, Birmingham, Oxford to London has managed to establish network across the UK. Four chapters were launched and announced: Ganga-Scotland, Ganga-Midlands, Ganga-Wales and Ganga-London chapter.

3. UK is also the largest contributor to cGanga's Environment Technology Verification (ETV) programme with 13 technology companies already enrolled and in various stages of launching their solutions in India. Two specific technologies were selected during the trip – Forward Osmosis and Floating water treatment reactors for drains and stagnant waterbodies. These have already been enrolled in the ETV programme.

4. The scientists from across the country came together to establish a consortium for establishing a scientific bridge on sustainable development between the two nations. cGanga will soon be forming a national task force which will then be introduced to their UK counterparts to increase scientific collaborations.

5. There was much energy demonstrated by the youth segment of the Indian diaspora in the UK, who have organised themselves to form the Global Youth for Ganga Forum. The forum shall identify and enrol highly motivated and passionate youth who are working as professional researchers, scientists, climate technology inventors to give them a platform to engage with the policy makers and stakeholders of the Ganga River Basin.

6. The finance community from the UK has come together to form the Ganga Finance Forum and suggested a range of instruments

THE CLEAN GANGA

Exhibition in the UK has also created a phenomenal platform and blueprint for engaging international community including the Indian diaspora to participate in and support the Clean Ganga programme

India-UK Collaboration

INDIA OFFERS A HUGE
potential for issuance of green/ blue bonds and the UK has a lot to offer to India in that regards. A number of professionals from the industry have formed the Water Finance Forum with a strong focus on Ganga

including structured finance, guarantee instruments, credit enhancement structures and green/blue bonds. India offers a huge potential for issuance of green/blue bonds and the UK has a lot to offer to India in that regards. A number of professionals from the industry have formed the Water Finance Forum with a strong focus on Ganga.

7. One of the most positive developments of the Ganga Connect exhibition has been the participation of the Indian diaspora community in the UK. Never before has there been an opportunity for the individuals in the community to learn so much about the river Ganga in a manner that they have never seen before. The community leaders were able to understand how large systemic problems are solved by seeing the exhibition and talking with the visiting scientists and policy makers from India.

8. The convenors of the various chapters of Ganga Connect in the UK have proposed a number of impact projects that will enable to demonstrate real change on the ground.

9. Impact Project 1: Development of a smart canal network that would not only rejuvenate the river basin but also create livelihood of people living around the riverine lands. This is based on the experiences of the Scottish canal systems have put back more than GBP 2bn (appx Rs. 20,000 crores) into the economy. Similar concept can be rolled out in the Ganga canal network. The smart canal systems will reduce flood risk and also act as transport networks to carry people and goods. Sensor based network can automatically control the opening and closing of canals based on water stresses in the system.

10. Impact Project 2: To twin river systems in India with river systems in the UK. This would enable all stakeholders to understand and learn from each other on how environmental assets and biodiversity is being preserved/ developed.

11. Impact Project 3: There has been commitment to endow two research scholars from India to do their PhDs in water resource management in the UK.

12. Impact Project 4: To prepare a number of short educational films on Ganga that can be disseminated globally. It was highlighted that the well known personalities David and Richard Attenborough both hail from Leicester.

13. Impact Project 5: To make the exhibition a permanent setting in the UK and host talks and engagement workshops with communities across the country. This would galvanise the communities as well as spread awareness about biodiversity conservation. The Leicester based Indo British Trade Council had committed to host the exhibition in Leicester City.

14. Impact Project 6: To develop a framework for a USD 1bn water bond issuance including structure, regulatory model, pricing, distribution, use of proceeds certification, insurance, resilience financing, risk management and other aspects.

15. Impact Project 7: Develop a carbon sequestration project through wetlands and marshes in the run upto the COP 27 meeting.

16. Impact Project 8: Develop a hydrogen from waste project using hydrogen for land/ rail/ water/ air transport networks along the Ganga basin.

17. Impact Project 9: Using circular economy principles develop a waste-water trading schemes of circular economy.

18. Impact Project 10: Engage venture finance in both countries to back innovative and disruptive technologies.

India-Japan Collaboration

DAY 5:
Tuesday, December 14, 2021
09:30 – 10:45 hrs

MODE:
Virtual

CHAIR:
DP Mathuria [Executive Director – Technical, NMCG]

CO-CHAIR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]

MODERATORS:
Sanmit Ahuja [Expert Member, cGanga]

PANELISTS:
H.E. Sanjay Kumar Verma [Indian Ambassador to Japan]
Kiyose Kazuhiro [Counsellor (Economic), Embassy of Japan, New Delhi]
Uday Kelkar [NJS Consulting Engineers]
Ali Adnan [Mebifarm]
Nami Ashizawa [Mebiol]

With rapid urbanisation in India, the need for effective management of urban water resources and treatment of wastewater is at an all-time high. The dialogue with Japan will focus on efficient management of urban water and wastewater management.

VIEWS AND COMMENTS FROM THE PANEL

1. Water is a key growth driver and a central pillar for sustainable development. By 2050 over 40% of global population will be under severe stress only to be exacerbated by climate change.

2. One third of India lives in its urban areas and partnership with Japan in urban water management will form a critical part of the cooperation. JICA is already supporting India in areas such as rainwater harvesting, water supply, sewage treatment, ground water management through overseas development assistance. Issued 752bn Yen (46,000 crores) of loans for water projects.

3. Indian and Japan also signed a cooperation in the water area in 2019 in integrated water resource management, flood management and forecasting, cooperation in water quality issues, water cycle management, river basin management, water use efficiency amongst other areas.

4. When Japan started to construct its own water management systems it also faced significant challenges. It overcame of these challenges with a proactive approach to procure technology, strengthening the legal system, committing financial resources and skilling its workforce.

5. After World War II, Japan also had poor sewerage network. The small and medium sized municipalities did not have much capacity. Japan Sewerage Works Agency was developed which took the major role in expanding the sewerage network in Japan. It was an empowered by the national government to be able to roll out infrastructure in a faster way. There is a parallel in India, such as Delhi Metro Rail Corporation. A similar framework can be adopted/ developed for sewerage network.

6. The main funding source in Japan for municipalities was through the issuance of municipal bonds which the national government supported by purchasing it. It of course laid down the guidelines on qualification criteria.

7. In Japan 70% waters are surface waters and 30% are ground waters. To address the issues of contamination of household sewage, Japan developed advanced technologies such as ozonation and

THE MAIN FUNDING source in Japan for municipalities was through the issuance of municipal bonds which the national government supported by purchasing it

India-Japan Collaboration

sand filtration systems. Japan has developed decentralised waste-water system called Johkasou which are now in the process of being introduced to India.

8. India has to lot to gain from Japan to develop and enhance its own urban water management systems. Human resource development through exchange of ideas and professionals. With the right capacity building initiatives, India's talented workforce can play a critical part in development of its infrastructure.

9. Japan and India have a lot to share on renewable energy and the countries should also look to partner in the emerging area of hydrogen.

10. On the global level – India and Japan are convergent on addressing climate change. There three levels where the two nations are partnering:

    a. Technology and Innovation – where the countries are co-innovating to address the unique problems of each country. Once they are innovated, the technologies are tested out which is co-creation, and to replicate or scale up the countries can co-produce the technologies.

    b. Capacity building - new emphasis to transferring knowhow in that the processes should not be academic, but more relevant to needs of the issues prevailing on the ground.

    c. Climate financing for climate justice – to bring greater capital to countries that historically did not contribute to climate pollution.

11. Partnership between Japan and India should be made active at four levels:

    a. Government to Government with numerous cooperation agreement and one on water is imminent.
    b. University and academic institutions, particularly those that are not covered under the cooperation agreements, should also be brought in.
    c. Industry to industry partnership with particular emphasis on getting Japanese companies to understand the commercial models of water sector in India.
    d. Between NGOs who are working in social and environmental institutions.

12. Capacity development cooperation will be a crucial area of partnership addressing legal frameworks in the urban water sector, best practices in implementation, addressing skilling of engineering talent and developing new financial instruments.

13. Given that the water is a state subject, but agencies such as NMCG that play a role of a federal level financier, knowledge provider is a very good model to accelerate water and wastewater infrastructure through the country.

14. JICA is helping support building one of the largest plant of more than 500 MLD and the agency also supported Yamuna Action Plans I and II. It helped support develop a guidance document for recycle and reuse of waste-water.

15. Mumbai is exploring flood management control systems as designed in Japan where excess water is stored underground and then transferred to sea.

16. One of the most advanced technologies that has been introduced from Japan to India is a hydro-membrane technology that enables farmers to grow food on a special membrane and don't need any soil. The technology reduces water consumption by more than 80%, eliminates agricultural run-offs and increases farmer income. The technology has been already successfully implemented in India through cGanga's Environment Technology Verification (ETV) process. The technology implementation cost was massively reduced by partnering with Indian engineers making it commercially viable for Indian environment.

17. The panelists stressed and all vouched for more partnerships in co-innovating, co-creation and co-production to solve global problems in the environment sector.

18. Decentralised infrastructure was highlighted as an area to build capacity in.

CAPACITY DEVELOPMENT

cooperation will be a crucial area of partnership addressing legal frameworks in the urban water sector, best practices in implementation, addressing skilling of engineering talent and developing new financial instruments

TRACK E

Challenges for Policy, Law & Governance for River Resource Allocation Planning

Friday, December 10, 2021
09:30 –10:45 hrs

MODE:
Virtual

MODERATOR:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]
Indrajit Dube [Professor, IIT Kharagpur]

PANELISTS:
Rozy Agarwal [ED (F), NMCG]
Krishna C Rao [Advisor Program Management, WASH Institute]
Sujit Koonan [Professor, Department of Law, Delhi University, New Delhi]
Philippe Cullet [SOAS, University of London, United Kingdom]
Tony George [Professor, OP Jindal Global University]
Srinivas Chokkakula [Centre for Policy Research, New Delhi]
Sharad Lele [ATREE, Bangalore]
Awadhesh Pratap Singh [Senior Advocate & Water Law Expert, Supreme Court of India, India]
Amita Singh [Centre for the Study of Law and Governance, JNU]

E1.1 PROBING THOUGHTS

Quantifiable river resources such as water, sediments, nutrients, biota, energy and the morphological space of rivers are the essential ingredients of various human benefits (or ecosystem services) available from rivers (such as food, water, sand, fiber, nutrients, genetic resources, medicines, flood drainage, drought control, waste assimilation, navigation, recreation, and cultural and spiritual services). However, anthropogenic extraction of river benefits often involves significant reduction or alteration of river resources. Selective resource abstraction from specific river stretches also affects the contribution of other resources and alters the resource balance of rivers. Now, since the leading contenders of river resources are riverine organisms themselves (almost all river resources being vital for their sustenance and growth), the interactive aspects of river resources, and hence of river goods and services, must be taken into account for optimal and sustainable river resource allocation between different contenders – especially river biota and humans – in different river stretches. Hence allocation of river resources for different purposes is best planned on whole river basin scales. However, for large rivers, due to varying human needs in different parts of the basin and the diverse resource dynamics of different stretches, tributaries and sub-tributaries, river resource allocation for large basins can be very complex and challenging. It may be easier to plan river resource allocation for relatively small and low-order streams, eventually combining them for the whole river basin.

The critical problem in such planning, whether on large basin scales or more minor catchment scales, is accessing adequate and reliable data of the river's resources in basin and anthropogenic activities in the basin about these resources.

The second major problem is that of accommodating the interests of small and marginal stakeholders such as riverbank communities and those in subsistence engagements with rivers (such as boatmen, fishers and riverbank farmers) in the resource allocation plan.

Challenges for Policy, Law & Governance for River Resource Allocation Planning

E1.2 KEY QUESTIONS

In the above context, some critical issues to be addressed and resolved for comprehensive river resource planning and basin management are:

1. **Is it possible to access information on river resources in the catchment/ basin from different agencies for centralised administrative planning for River Basin Management? Can it be mandated through policy or law (existing or developing in future)?**
2. **Are the present administrative processes/ policies/ laws sufficiently equipped to manage natural resources (including the needs for different contenders) in river basins/ catchments?**
3. **How does the law perceive the natural boundary of rivers vis-a-vis administrative boundaries, especially in the context of Interstate Rivers?**
4. **What are the inclusive characteristics of existing policy and governance mechanisms to accommodate the interests of small and marginal contenders?**

E1.3 DISCUSSIONS

The principle of Arth Ganga – meaning that river conservation and development have to be seen as two sides of the same coin – is the most suitable premise for the management of Ganga and other rivers of India. In the preparation of GRBMP the legislations operative in the Ganga Basin were mapped and it was found that there is limited understanding of the assets and resources of the basin. Moreover, many of the laws go back to colonial periods, and several laws are at cross-purposes, which makes the implementation of river conservation measures difficult.

River restoration and river basin planning tend to focus on what is in the stream channel. But, by focusing only on surface water the impact of groundwater use resulting in reduced base flows in rivers is ignored. Unfortunately, groundwater has not been incorporated in the hydrological calculations in water dispute tribunals. Moreover, the water act of 1974 was framed virtually entirely around use of water rather than conservation. We need to look beyond anthropocentric use, and hence giving legal personalities to rivers can take regulations forward. We should not move towards river rights as such, because that does not include what goes on around the rivers, it may be water rights instead.

Integrated river basin management is based upon the availability of the sound scientific information. But data needed to adjudicate are seldom adequate. Without such data, judges are incapable to pass correct judgment. The Mahadayi Tribunal could not apportion the waters of river Mahadayi between the states of Maharashtra, Karnataka and Goa equitably because the information was inadequate or unreliable. Judiciary should not decide disputes on the whims and fancies of contending parties, and the law should ensure accountability and transparency of decision meeting. Hence judges also need training on environmental issues, just as industrialists and civil society leaders need to be brought together.

What constitutes good governance of rivers or good River Basin Management must be explicit. For a flowing resource like water, the biggest issue is about fair allocation, how benefits of water are distributed across the landscape, that is, of equity and social justice, and not about sustainability and productive use of water. Hence, democratic governance must be a normative concern. In the water sector

INTEGRATED RIVER basin management is based upon the availability of the sound scientific information. But data needed to adjudicate are seldom adequate

Challenges for Policy, Law & Governance for River Resource Allocation Planning

both centralization and decentralization need to go hand in hand for building the processes of governance, with the integration of bottom up and top down approaches in terms of allocation that goes downwards and the actual management that moves from the bottom up,

Regarding the mismatch between administrative boundaries and natural boundaries, the substantive principles for water regulation cannot be locked within administrative boundaries. Natural boundaries should be respected, especially since disasters and hazards occur only when administrative boundaries intrude upon natural boundaries, whether of forests or of rivers or of other ecosystems. Besides, we also need coordination or cooperation between different administrative units, particularly between different states for interstate rivers. Information exchanges and information assimilation may happen efficiently only if done in a centralized way, which is a subsidiarity principle in law. Thus, when a river originates and ends within the borders of a particular state, then under the Indian Constitution it is the state government which has all rights over the river. But when the river is interstate, then the central government is in charge by virtue of the powers under entry fifty-six. In the Kaveri river dispute the supreme court ruled that interstate river is considered to be national asset, and no particular state can claim full rights over the river waters within its boundary.

E1.4 RECOMMENDATIONS

The following recommendations ensue from the above discussions:

1. The water act of 1974 is framed virtually entirely around use of water rather than conservation. There is a need to look beyond anthropocentric use, and hence giving legal personality to the river can take regulations forward.
2. For a flowing resource like water, what constitutes good governance is fair allocation – how the benefits of water are equitably and justly distributed across the landscape, and not only sustainability or the productive use of water.
3. Democratic governance must be a normative concern in the water sector: both centralization and decentralization need to go hand in hand with integration of bottom-up and top-down methods by allocation that goes downwards and actual management that happens from bottom up.
4. Integrated river basin management is based upon the availability of sound scientific data. But there seldom is enough data to inform judges to ensure that the law can focus primarily on accountability and transparency of decision making.
5. Natural boundaries should be respected, especially since disasters and hazards occur only when administrative boundaries intrude upon natural boundaries, whether of forests or rivers or other ecosystems.
6. When a river originates and ends within a particular state, then the state government has all rights over the river. But when the river is interstate, then the central government has overall rights by virtue of the powers under entry fifty-six.
7. There is need for coordination between different administrative units, particularly between different states for inter-state rivers. Information exchanges and assimilation can be efficient if done in a centralized way – a subsidiarity principle of law.

INFORMATION EXCHANGES

and information assimilation may happen efficiently only if done in a centralized way, which is a subsidiarity principle in law

Holdups in Policy, Law & Governance for River Resource Allocation Plan Implementation

DAY 3:
Saturday, December 11, 2021
09:30 –10:45 hrs

MODE:
Virtual

MODERATORS:
Vinod Tare [Founding Head, cGanga, IIT Kanpur]
Indrajit Dube [Professor, IIT Kharagpur]

PANELISTS:
Rozy Agarwal [ED (F), NMCG]
DP Mathuria [Joint Secretary and Executive Director – Technical, NMCG]
Sujit Koonan [Professor, Department of Law, Delhi University, New Delhi]
Philippe Cullet [SOAS, University of London, United Kingdom]
Tony George [Professor, OP Jindal Global University]
Srinivas Chokkakula [Centre for Policy Research, New Delhi]
Sharad Lele [ATREE, Bangalore]
Awadhesh Pratap Singh [Senior Advocate & Water Law Expert, Supreme Court of India, India]
Amita Singh [Centre for the Study of Law and Governance, JNU, New Delhi]

E2.1 PROBING THOUGHTS

The management of constituents of the river resources is distributed between the lists within the Constitution. Both State Government and the Central Government exercise power over these resources. Historically, several enactments on the management of different river resources promote fragmentation and conflict between administrative agencies in the absence of clear demarcation of administrative policies in the management of river resources. These pose challenges to the holistic planning and governance of river resources in the basin.

Allocation of river resources for different purposes is best planned on whole river basin scales. However, for large rivers, due to varying human needs in other parts of the basin and the diverse resource dynamics of tributaries and sub-tributaries, river resource allocation for large basins may be very complex and challenging. It may be easier to allocate river resources for relatively small and low-order streams, eventually combining them for the whole river basin.

The critical problem in implementing such plans, whether on large basin scales or smaller catchment scales, however, is that the implementation will probably be carried out by existing administrative and implementation agencies that are governed by (i) administrative jurisdictions (e.g. district and state boundaries) and (ii) existing laws and policies that may impact river resources. For instance, river resources are affected by direct anthropogenic interventions and human activities in the basin, such as land use and groundwater abstraction/ recharge, which may be covered under laws unrelated to rivers.

WE NEED TO

enable inter-State cooperation through an adequate political process of consensus-building, following it up with effective governance mechanisms at different scales since planning at the level of River Basins does not necessarily mean having governance mechanisms also on basin scales

E2.3 DISCUSSIONS

Many of the issues involved are State subjects, but River Basin Planning has to be centralized, with actions – i.e. implementation – being done by the States and the knowledge creation in Planning being done by the Centre. Further, knowledge gathering has to be done in a decentralized way, but knowledge may be disseminated in a top-down manner. Hence the question arises as to "How can the administrative and institutional fragmentation (between the States and the Centre) be addressed in managing river resources within the basin?" Is it possible to devise a process of coordination between various institutions/ departments through policies within the existing legal and constitutional framework? Or does it require a fresh legal perspective?

At the outset, it may be noted that Law is not the only weapon for managing India's water resources. As an example, water users associations acting through Panchayati Raj institutions are the basis of success in water resource management in some States. But out of the 29 sections under Article 243 for

E2.2 KEY QUESTIONS

In the above context, some critical issues to be addressed and resolved for comprehensive river resource planning and basin management are:

1. How to address the administrative and institutional fragmentation (between different governments, i.e. of States and Centre) in managing river resources within the basin?
2. Is it possible to promote a process of coordination between institutions (departments etc.) through the policies within the existing legal and constitutional framework?
3. How shall non-stakeholders (e.g. fisherman and riverside communities) participation be integrated within the process of coordination?
4. Will promoting a centralised body (like a Commission) solve administrative and institutional fragmentation issues in the management of river resources within the basin?

Holdups in Policy, Law & Governance for River Resource Allocation Plan Implementation

Panchayati Raj, no Panchayat has been able to work on more that 6 or 7 areas at most. The other 22 or 23 areas have been kept effectively out of bounds for Panchayats, limiting their effectiveness on the ground. For Inter-State rivers, however, there is need for improved co-ordination between States and between States and the Centre. The tension between Articles 87 and 86 of the Constitution needs to be resolved. Right now, the particular powers are being centrally applied through the National Mission for Clean Ganga (NMCG). But there is a need to manage river regional assets within sub-national programs. The other law to enable cooperation is the River Basin Act 1986, which has neither been touched nor amended even once. We therefore need to enable inter-State cooperation through an adequate political process of consensus-building, following it up with effective governance mechanisms at different scales since planning at the level of River Basins does not necessarily mean having governance mechanisms also on basin scales. The functions of different institutions at different levels need to be delineated.

We also need to consider the facilitative role of law. We don't have any alternative to administrative boundaries as far as the operation of law is concerned. The key question here is "How to take care of natural boundaries and related issues within the existing administrative framework?" From a legal perspective, it may be noted that, first, very few studies have been done on the River Boards Act 1950 regarding framing regulations and governance structure by respecting the natural boundary, and secondly, considering the whole financial and political scenario. The new Groundwater Model Bill tries to propose some kind of mechanism where this kind of institutional coordination and sharing from top to bottom as well as bottom to top is possible.

We already have mechanisms for information sharing. As such, there is no legal hindrance to information sharing, rather it's a gap of institutional culture and the associated political culture. The question of coordination considered arises from seeing the problem as fragmentation between states, but the issue of fragmentation is not just of scale, it is also across sectors. The biggest driver of groundwater pumping is agriculture and the related electricity subsidies. So the river water sharing problem is basically due to the government's agricultural policy, and not a water policy. Hence

THE KEY QUESTION

is How to take care of natural boundaries and related issues with in the existing administrative framework?

Holdups in Policy, Law & Governance for River Resource Allocation Plan Implementation

the problem should be reframed as a problem of lack of respect for existing information-sharing and coordination mechanisms, which is a downright lack of accountability to the people. Thus, the plans for Command Area Development and Catchment Area Development in the Ganga basin failed in the 1970s and 1980s because they were centralized and without any accountability mechanism.

There is, however, a lack of water legislations in certain critical areas. Most of the existing legislations are colonial, and they do not consider business management aspects. Article 253 may provide a pathway to bring in new legislation, as was done for the Dam Safety Bill. The Dam Safety Bill introduced in Parliament should now be followed up by other Acts like River Floodplains (or River Space) Restoration Act and Catchment Restoration Act.

ARTICLE 253 MAY

provide a pathway to bring in new legislation, as was done for the Dam Safety Bill. The said Bill introduced in Parliament should be followed up by other Acts like River Floodplains Restoration Act and Catchment Restoration Act

In consideration of the above issues, there is a palpable need for a Charter for a Federation of all institutions which are working on the ground. The Federation's objective might be to establish synergy between themselves with the overarching goal of river conservation. The Charter can also include a framework to incentivize all institutions working on the ground, along with a provision for information-sharing and knowledge-sharing. This Charter can be then translated into a proper legislation. This kind of framework has been advocated by NGT in an earlier order – probably in February 2021 – to create a National River Rejuvenation Mechanism that would include the successful implementation of NGT's many notifications. The main additional task here is to incentivize the schemes penetrating down to the level of districts and ULB's. Alternatively, there may not be any need to create new laws but to give effect to the existing law and institutional revenues instead. Constitutionally mandated institutional space is available under Article 263, where an Inter-State Council can enable Inter-State coordination and empower States to come together to rework their relationships other than pursuing their own water resource agenda.

E2.4 RECOMMENDATIONS

The following recommendations emerge from the above discussions:

1. Law is not the only mechanism or full mechanism to manage water resources. The task also involves: (i) governance mechanisms, (ii) a culture of co-operation between institutions and between institutions and people, and (iii) accountability to people.
2. Village Panchayats should be empowered to act on all 29 sections under Article 243 for for effective decentralized actions through Panchayati Raj.
3. The tension between Articles 87 and 86 of the Constitution needs to be resolved to clearly demarcate the powers and responsibilities of the Centre and the States regarding rivers and water resources.
4. The facilitative role of law should be applied to the framing of regulations and governance structure with institutional coordination considering the natural boundaries of river basins. The new Groundwater Model Bill can be a guiding example.
5. The need for institutional coordination is not only between States and the Centre but also across different sectors such as agriculture, electricity/ energy, etc.
6. Article 253 may provide a pathway to bring in new legislation, as was done for the Dam Safety Bill. The said Bill introduced in Parliament should be followed up by other Acts like River Floodplains (or River Space) Restoration Act and Catchment Restoration Act.
7. An agreed Charter should be devised for a Federation of all institutions working on the ground to establish synergy between the institutions for river conservation purposes. The Charter – including a framework to incentivize all institutions working on the ground and with provision for information-sharing and knowledge-sharing – can be later translated into new legislation. Alternatively, the existing laws and institutional revenues should be given effect using the constitutionally mandated institutional space available for Inter-State coordination such as under Article 263.

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