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

सत्यमेव जयते
Government of India

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

TWIN SUMMITS

8th India Water Impact Summit [IWIS] 2023

Valuing Water | Transforming Ganga

Development vis-à-vis Land, Water and Rivers

&

1st Climate Investments and Technology Impact Summit [CITIS] 2023

Climate Impact = Deep Technology + Robust Policy + Innovative Finance

November 22-24, 2023
Dr Ambedkar International Centre (DAIC)
New Delhi

ABOUT THE ORGANISERS

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

National Mission for Clean Ganga (NMCG)

NMCG is the implementation wing of National Ganga Council which was setup in October 2016 under the River Ganga Authority order 2016. Initially NMCG was registered as a society on 12th August 2011 under the Societies Registration Act 1860. It acted as implementation arm of National Ganga River Basin Authority (NGRBA) which was constituted under the provisions of the Environment (Protection) Act (EPA) 1986. NGRBA has since been dissolved with effect from the 7th October 2016, consequent to constitution of National Council for Rejuvenation, Protection and Management of River Ganga (referred to as National Ganga Council). NMCG is under the aegis of Ministry of Jal Shakti, Government of India.
www.nmcg.in

cGanga

Centre for Ganga River Basin Management and Studies (cGanga)

cGanga is a think tank and a center of excellence formed under the aegis of NMCG, and one of its stated objectives is to make India a world leader in river and water science. The center is headquartered at IIT Kanpur and has representation from most leading science and technological institutes of the country. cGanga's mandate is to serve as think-tank in implementation and dynamic evolution of Ganga River Basin Management Plan (GRBMP) prepared by the Consortium of 7 IITs. In addition to this it is also responsible for introducing new technologies and innovations as well as novel policy, governance and financial solutions for the water sector in India.
www.cganga.org

SUPPORTING PARTNERS

The organisers are grateful to all supporting partners for their contribution in making this event possible.

samarth ganga
FOUNDATION

Samarth Ganga Foundation is a new entity and a strategic collaborator to cGanga. Designed as an "applied innovation and impact" think-tank, the non-profit entity specialises in developing solutions with high economic impact. SGF is supporting cGanga to advocate the solution across the nation to various urban local bodies.

bharatia

The Bharat Technology & Impact Accelerator (BHARA**TIA**) specialises in technology commercialisation by bringing disruptive innovation from around the world to India. BHARATIA is a SGF initiative.

India Water Leaders' Council

The India Water Leaders' Council is composed of senior representation from various stakeholders of the water industry ecosystem in India. The IWLC meets once per quarter to discuss and debate critical issues and how to address those. IWLC stands firmly behind the decentralised wastewater treatment.

8th

India Water Impact Summit [IWIS] 2023

Valuing Water | Transforming Ganga

Development vis-à-vis Land, Water and Rivers

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1st

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GLIMPSES OF PAST SUMMITS

7th IWIS 2022: The convergence of 5Ps: People, Policies, Plans, Programmes and Projects

6th IWIS 2021: River Resources Allocation: Planning and Management at the Regional Level.

5th IWIS 2020: Comprehensive Analysis and Holistic Management of Local Rivers and Waterbodies: Arth Ganga: River Conservation Synchronized Development.

4th IWIS 2019: Realizing Vision Ganga Through Jal Jeevan Mission.

3rd IWIS 2018: Showcasing and Enhancing Impact of National and International Efforts on Ganga River Restoration and Conservation.

2nd IWIS 2017: Exploring Potential of Stipulations Made in Ganga River Basin Management Plan - 2015.

1st IWIS 2012: Water Innovation in India.

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सत्यमेव जयते

सड़क परिवहन एवं राज्यमार्ग मंत्री
भारत सरकार

Minister for Road Transport and Highways
Government of India

MESSAGE

It gives me immense pleasure to know that the 8th India Water Impact Summit and the 1st Climate Investments and Technology Impact Summit (IWIS-CITIS-2023) organized jointly by Centre for Ganga River Basin Management and Studies (cGanga), National Mission for Clean Ganga (NMCG), Niti Aayog and G20 India Secretariat in New Delhi on "*Development vis-a-vis Land, Water and Rivers*" are being held together in New Delhi in during November 22-24, 2023. Given the wide scope of its agenda, I expect the Summit to give us a unique opportunity to view India's steady progress in multiple fields as our economy rapidly overtakes that of many developed countries in recent years.

Today, our country is not only one of the largest world economies, it is also a torchbearer in sustainable development in many ways — our transitioning to green energy, major agricultural advancements, improved educational and healthcare standards, conservation of rivers, water bodies, forests, and wildlife, infrastructure development, and a technological innovation paradigm that are the cynosure of the rest of the world. Among these, My Ministry has made rapid progress in developing our transport infrastructure through a vast network of high-grade roads and bridges, ports and jetties, inland waterways, and much more. Simultaneously, my Ministry has kept in focus the safety and preservation of our ecological assets and cultural and archaeological heritages that are part and parcel of our government's conservation efforts.

I have noted with interest that IWIS-CITIS-2023 will consider many intersections of our land, water and rivers in the context of social and climatic changes such as lifestyle, policy issues, sludge management, reuse / recycling of wastewater, innovations in technology and business, climate investments in the water sector, and a global coalition for river science and management. I wish the joint organisers of IWIS-CITIS-2023 every success for the Summits and look forward to the outcomes.

16 November 2023

Nitin Gadkari

सत्यमेव जयते

जल शक्ति मंत्री
भारत सरकार

Minister for Jal Shakti
Government of India

MESSAGE

I am heartened to learn that the twin Summits – the 8th India Water Impact Summit and the 1st Climate Investments and Technology Impact Summit (IWIS-CITIS- 2023) – are being organized in November 2023 by the joint efforts of National Mission for Clean Ganga (NMCG), Centre for Ganga River Basin Management and Studies (cGanga), and Niti Aayog for national and global experts, key stakeholders, technology innovators and investors to probe *"Development vis-a-vis Land, Water and Rivers"* in depth. It is particularly notable that the Summit is being held under the aegis of India's G20 presidency.

At this historical juncture when we have begun to make giant strides in transforming India into a developed country, unforeseen problems have arisen from the world at large – devastating pandemics, internecine conflicts and, of course, the vagaries of rapid climate change leading to increased natural catastrophes. It is remarkable that we have faced these problems with fortitude until now, and remain committed to improving the lives of our billion-plus population at all costs and make us "Atmanirbhar" in all respects. We have made remarkable progress in such people-centric programmes as *Swachh Bharat* and *Jal Jeevan Mission* that have been lauded all over the world. Simultaneously, our government has also focussed on reviving and conserving our water resources and aquatic ecosystems with exemplary programmes for rivers, wetlands, coastlands and aquatic biodiversity along with other terrestrial resources such as forests, wildlife and soils.

I am pleased to note that IWIS-CITIS-2023 will consider both land and water resources together along with lifestyle aspects, sludge management, reuse/recycle of wastewater, technological & business innovations, policy interventions, climate-related investments in the water sector, and establishing a global coalition for river science and management. I am also delighted to learn that IIT Kanpur and National River Conservation Directorate has proposed to set up centres for preparing river basin management plans for Mahanadi, Narmada, Godavari, Krishna, Cauvery and Periyar at 11 Institutes similar to that of cGanga. I wish the organisers of IWIS-CITIS-2023 every success in this venture, and hope that it gives us valuable inputs to shaping our future governmental actions.

16 November 2023

Gajendra Singh Shekhawat

सत्यमेव जयते

जल शक्ति एवं खाद्य प्रसंस्करण
उद्योग राज्य मंत्री
भारत सरकार

Minister of State for Jal Shakti
and Food Processing Industries
Government of India

MESSAGE

It gives me great pleasure to know that the twin Summits 8th India Water Impact Summit and First Climate Investments and Technology Impact Summit (IWIS- CITIS-2023) are being held in November this year jointly organised by the National Mission for Clean Ganga (NMCG), Centre for Ganga River Basin Management and Studies (cGanga), Niti Aayog, and notably the G20 India Secretariat to deliberate on "*Development vis-a-vis Land, Water and Rivers*" by national and foreign experts, stakeholders, government representatives, technology providers and financiers.

Over the last nine years we have made tremendous progress in forging a common strategy of development with environmental sustainability in India. Thus, while we have made astounding progress in technology, manufacturing, agricultural, health and many other sectors resulting in rapid improvement in the wellbeing and livelihoods of our citizens, we have also improved the conditions of many of our rivers, lakes, wetlands, coastal areas, mangroves, forests and other natural resources through a people-centric and future-ready vision. A lot of our efforts are now also involved in the design and putting in place measures to combat and ameliorate the likely climate change impacts. For this, we definitely need the active involvement of all stakeholders and experts to chalk out a path of minimum risk and maximum benefit in the water sector as also in other areas of natural resource management.

I am extremely pleased that IWIS-CITIS-2023 will deliberate upon land, water and rivers, sludge management, water recycling/ reuse, lifestyle aspects, technology innovations, climate financing for water sector, and global alliance for river science and management. I wish the organisers of IWIS-CITIS-2023 very successful summits, and await their outcomes.

17 November 2023

Prahlad Singh Patel

सत्यमेव जयते

जल शक्ति एवं जनजातीय कार्य राज्य मंत्री
भारत सरकार

Minister of State for Jal Shakti & Tribal Affairs
Government of India

MESSAGE

I am glad to know that the 8th India Water Impact Summit and the 1st Climate Investments and Technology Impact Summit (IWIS-CITIS-2023) are being organized by the National Mission for Clean Ganga (NMCG), Centre for Ganga River Basin Management and Studies (cGanga), Niti Aayog and G20 India Secretariat to facilitate the brainstorming of ideas by national and international experts, stakeholders, administrators, technology developers and investors on "Development vis-a-vis Land, Water and Rivers". The co-organization of the Summits by G20 India Secretariat this year is especially welcomed.

India has undergone many fundamental changes for the better in the past nine years ever since the Government of India opened the gates of governance to all stakeholders, resulting in a vibrant exchange of ideas and enthusiastic participation of the whole country in nation-building. The Ministry of Jal Shakti, too, has been actively in the forefront of this drive with a knowledge-based reshaping of our water resource management. On the one hand we have learnt to evaluate our water resources in much greater detail, and on the other hand we have balanced supply against demands much more reliably. These measures may take time to percolate down to state, town and village levels, but our progress has been tremendous so far, with crores of Indian villagers benefitting from our "Har Ghar Jal" programme for instance. Likewise, the Hybrid Annuity mode of STP projects adopted by NMCG has resulted in very satisfactory results that have also been acknowledge by the whole world.

It interest me greatly that IWIS-CITIS-2023 will consider many interactive aspects of land, water and rivers in Twin Summits under one cover, besides technological and business innovations, climate investments in the water sector, and pursuing a global coalition for river science and management in line with Hon'ble Prime Minister's message to the world of "वसुधैव कुटुम्बकम्". I wish the organisers of IWIS-CITIS-2023 all success, and look forward to the recommendations.

18 November 2023

Bishweswar Tudu

सत्यमेव जयते

जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
भारत सरकार

Ministry of Jal Shakti Department of Water Resources River Development & Ganga Rejuvenation
Government of India

MESSAGE

I am very pleased to learn that the 8th India Water Impact Summit and the 1st Climate Investments and Technology Impact Summit (IWIS-CITIS-2023) are being organized together jointly by National Mission for Clean Ganga (NMCG), Centre for Ganga River Basin Management and Studies (cGanga), Niti Aayog and G20 India Secretariat in New Delhi for many national and international experts, government leaders, administrators, technological innovators, business representatives, and investors to discuss many aspects on many aspects on the theme of "*Development vis-a-vis Land, Water and Rivers*".

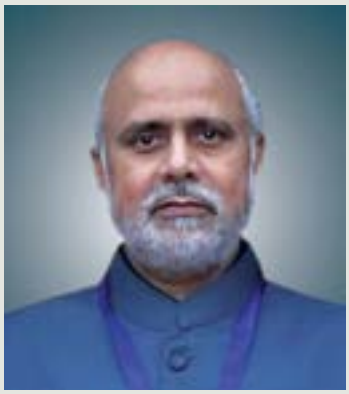
Our country has been growing rapidly in recent times with many spectacular achievements on this earth and in space to our credit. Working with multiple stakeholders, academics and committees, our government's efforts have helped Indians to achieve tremendous improvement in their lives with systemic improvements in agriculture and irrigation, water resources development, rejuvenation and conservation of rivers and water bodies, forests and land management, and other foundational steps. Our ministry is also successfully handling the Namami Gange Mission, which has found a place in the first ten UN World Restoration Flagship programmes.

I am happy to note that IWIS-CITIS-2023 will deliberate upon land and water resources and rivers considering STP sludge management, reuse/ recycle of wastewater, lifestyle aspects, innovative technologies and business models, policy issues, climate-related investments, and a global coalition for river science and management. I wish the dedicated organisers of IWIS-CITIS-2023 all success in their endeavour.

21 November 2023

Debashree Mukherjee

PREFACE



VINOD TARE
Emeritus Fellow & Founding Head
Centre Ganga River Basin Management & Studies (cGanga), IIT Kanpur

G ASOK KUMAR
Director General
National Mission for Clean Ganga (NMCG)
Ministry of Jal Shakti, GoI

On behalf of the Centre for Ganga River Basin Management and Studies (cGanga) led by IIT Kanpur, National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti (Govt. of India), and NITI Aayog, we warmly welcome all participants from India and abroad to the twin summits, 8th India Water Impact Summit (IWIS-2023) and the 1st Climate Investment and Technology Innovation Summit (CITIS 2023).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 strategic comprehensive Ganga River Basin Management Plan (GRBMP-2015) was developed by a consortium of 7 IITs, which is being further evolved by cGanga led by IIT Kanpur. 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 Dhara and Nirmal Dhara, and maintaining its geomorphological and ecological integrity. Integrated River Basin Management (IRBM) approach is followed in Namami Gange with multi-sectoral and multiagency interventions such as: (i) for pollution abatement (Nirmal Ganga), (ii) for improving river flows (Aviral Ganga) and ecology, (iii) to strengthen people's river connect (Jan Ganga), and (iv) to facilitate diversified research, scientific mapping, and evidence-based policy formulation (Gyan Ganga). India Water Impact Summit, which was started as a one-time event a decade ago, has now become an annual event organized jointly by NMCG and cGanga. In the 7th Edition of IWIS, NITI Aayog extended its support in organizing the event. In the 8th edition we are further delighted that the twin summits are included in the G20 India events.

At the outset, a brief overview of the past seven Summits is outlined here to throw light on the background to the theme of the present IWIS. The first 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 ideas and suggestions that emerged from these four Summits led us to seek comprehensive means to integrate river conservation into India's developmental path in the 5th IWIS (IWIS-2020) from the perspective of Arth Ganga, an ancient Indian concept. IWIS-2020 also intensified efforts to financially strengthen water

The eighth Summit,

focuses on land, water and rivers – their interdependence as healthy systems of nature, that is Samarth Ganga and Productive Land considered together in the context of the national initiative on Lifestyle for Environment.

management and river conservation in India through synergy between planners, executors, financiers, investors and regulatory bodies. A more focused assessment was attempted in the 6th IWIS (IWIS-2021) to evaluate the different types of river resources, their usefulness for ecosystem services for human benefit, and the adverse effects of over-extraction and misuse of these resources on the ecosystem services. This exploration was aimed to help chalk out feasible pathways for sustainable river resource planning and management over the long term to meet the concerns of diverse stakeholders and to aid planners, policymakers and financiers. In order to resolve the issue of divergent impacts of different activities carried out by different agencies and governments for developmental or social purposes, the convergence of five P's, namely, People, Policies, Plans, Programmes and Projects, were considered crucial in the "Samarth Ganga" framework to achieve Sustainable Development Goals (SDGs). Thus, the thrust of deliberations in the 7th IWIS (IWIS-2022) was to understand, elaborate, delineate potential causes of divergence, and formulate strategies for convergence through collation of views expressed in the Summit.

In the eighth Summit, the focus is on land, water and rivers – their interdependence as healthy systems of nature, that is Samarth Ganga and Productive Land considered together in the context of the national initiative on Lifestyle for Environment. The first issue to be considered is Lifestyle for Land Productivity and Sludge Management, wherein the changing status of agricultural lands under intensive agriculture and how to ensure their sustained health and fertility are to be examined along with the efficient management of large quantities of sludge generated from India's Sewage Treatment Plants (STPs). In the second major issue to be addressed in the Summit, key aspects of Lifestyle for Rivers are to be probed along with the recycle/ reuse of wastewater. The recycle/ reuse of wastewater has been a long-attempted endeavour in the India, and the creation of a Water Market may be the best way to promote cost-efficient recycle/ reuse. Hence ways and means of creating a Water Market need to be chalked out.

Financial resources and technological experimentation, and business innovations are essential for sustained efforts in land and river management, especially in the context of climate change challenges. This year's IWIS is coupled with a twin Summits – the Climate Investment and Technology Impact Summit (CITIS). CITIS is streamlined to bind potential investors with technology providers after review and testing of new technologies and innovative business models, implementation of proven new technologies, adopting suitable financing mechanisms, and collaborating within multiple sectors such as energy, agriculture, urban management, transport, and infrastructure development that are intricately linked with climate, air, land, rivers and water management. Thus, the first CITIS this year will present new technologies and applications being developed worldwide that can significantly improve India's river and land management scenario.

Finally, we wish to thank our strategic partners, panellists, speakers, staff and volunteers who have worked hard and contributed enthusiastically to make this Summit a success. We hope that you find IWIS-CITIS-2023 to be as constructive and exciting as the previous seven Summits. We look forward to your valued participation.

TWIN SUMMITS AT A GLANCE

Day 1: Wednesday 22 November 2023

Time	India Water Impact Summit (IWIS)	Climate Investments & Technology Impact Summit (CITIS)
1000 – 1130		Special Session: River City Alliance **Venue: Conference Hall 1** CITIS 1: ETV/Tech presentations - 1 **Venue: Conference Hall 3**
1130 – 1200	**Tea/Coffee Break**	
1200 – 1400	**Inaugural Session** **Venue: Bhim Hall**	
1400 – 1500	**Lunch**	
1500 – 1630	IWIS 1: Samarth Ganga & Productive Land - I **Venue: Bhim Hall**	CITIS 2: ETV/Tech presentations - 2 **Venue: Conference Hall 3**
1630 – 1700	**Tea/Coffee Break**	
1700 – 1830	IWIS 2: Lifestyle for & Economics of Rivers - I **Venue: Bhim Hall**	CITIS 3: ETV/Tech presentations - 3 **Venue: Conference Hall 3**
1830 – 1900	**High Tea**	

Day 2: Thursday 23 November 2023

Time	India Water Impact Summit (IWIS)	Climate Investments & Technology Impact Summit (CITIS)
0930 – 1100	**CITIS Plenary** **Venue: Bhim Hall**	
1100 – 1130	**Tea/Coffee Break**	
1130 – 1300	IWIS 3: Samarth Ganga & Productive Land - II **Venue: Bhim Hall**	CITIS 4: Investing in Water **Venue: Conference Hall 1**
1300 – 1400	**Lunch**	
1400 – 1530	IWIS 4: Lifestyle for & Economics of Rivers - II **Venue: Bhim Hall**	CITIS 5: Investing in Energy **Venue: Conference Hall 1**
1530 – 1600	**Tea/Coffee Break**	
1600 – 1730	IWIS 5: Digital Tools for River Basin Management **Venue: Bhim Hall**	CITIS 6: Investing in Waste **Venue: Conference Hall 1**
1930 – 2230	**Dinner**	

Day 3: Friday 24 November 2023

Time	India Water Impact Summit (IWIS)	Climate Investments & Technology Impact Summit (CITIS)
0930 – 1100	IWIS 6: Inducting Samarth Ganga Concept in Preparing Basin Plans for Six Major Rivers of India - I **Venue: Bhim Hall**	CITIS 7: Investing in Food & Agri **Venue: Conference Hall 1**
1100 – 1130	**Tea/Coffee Break**	
1130 – 1300	IWIS 7: Inducting Samarth Ganga Concept in Preparing Basin Plans for Six Major Rivers of India - II **Venue: Bhim Hall**	CITIS 8: Investing in Transport **Venue: Conference Hall 1**
1300 – 1400	**Lunch**	
1400 – 1530	**CITIS Valedictory** **Venue: Bhim Hall**	
1530 – 1600	**Tea/Coffee Break**	
1600 – 1730	**IWIS Valedictory** **Venue: Bhim Hall**	
END OF 8th IWIS and 1st CITIS		

LIST OF MEMBER INSTITUTES-cGANGA, IIT KANPUR

Indian Institute of Technology Madras

Indian Institute of Technology Delhi

Indian Institute of Technology Hyderabad

Indian Institute of Technology Indore

Indian Institute of Technology Palakkad

Indian Institute of Technology (ISM) Dhanbad

Indian Institute of Technology, Ropar

Indian Institute of Technology Jodhpur

Indian Institute of Technology Roorkee

Indian Institute of Technology Gandhinagar

National Institute of Technology, Calicut

National Institute of Technology, Agartala

National Institute of Technology, Arunachal Pradesh

National Institute of Technology, Andhra Pradesh

National Institute of Technology, Trichy

National Institute of Technology, Jalandhar

National Institute of Technology, Silchar

National Institute of Technology, Raipur

Motilal Nehru National Institute of Technology (MNNIT), Allahabad

National Institute of Technology, Uttarakhand

National Institute of Technology, Sikkim

National Institute of Technology, Rourkela

National Institute of Hydrology, Roorkee

National Institute of Technology, Warangal

Visvesvaraya National Institute of Technology, Nagpur

Indian Institute of Science Education and Research, Kolkata

Indian Institute of Science Education and Research, Tirupati

Indian Institute of Management Lucknow

Faculty of Engineering & Architecture (M.B.M. Engineering College) Jai Narain Vyas University Jodhpur

CSIR-National Environmental Engineering Research Institute

Babasaheb Bhimrao Ambedkar University Lucknow

Wildlife Institute of India Dehradun

Indian Institute of Science, Bangalore

Gokhale Institute of Politics and Economics, Pune

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GH2 Green Hydrogen Organisation

IIC IMPACT INVESTORS COUNCIL

the climate party

India Water Leaders' Council

"River Cities Alliance: A Global Step Forward (GRCA)"

1st CITIS Summit, 22nd November 2023, DAIC, New Delhi

Since 2019, the National Mission for Clean Ganga (NMCG), under the Ministry of Jal Shakti and the National Institute of Urban Affairs (NIUA), under the Ministry of Housing and Urban Affairs have been working on a joint initiative to propagate river-sensitive development in our cities. This is in response to the Hon'ble Prime Minister's clarion call for new thinking in river cities, in the 1st Meeting of the National Ganga Council (NGC) in December 2019. Subsequently, the River Cities Alliance (RCA) was launched on 25th November 2021, by the Hon'ble Minister of Jal Shakti, as a dedicated platform for 30 river cities in India to ideate, discuss and exchange information for sustainable management of urban rivers. Within one and half year of its launch, the number of Alliance member cities increased from 31 to 143 across the country.

The success of the RCA in addressing the challenges of urban river management in India has gradually paved the way for constituting a global city-led movement focused on sustainable management of urban rivers. India is therefore in a position to act as a **"Global Bridge between developed & developing nations for sustainable management of urban rivers"**. Considering the anticipated impact of climate change & rapid urbanization on the quality and sustainability of urban life, a dedicated alliance of national governments and their respective river cities is proposed to be launched during the COP28 in Dubai.

In this regard, a session **"River Cities Alliance- A Global Step Forward (GRCA)"** is being organized on 22nd November 2023, during 1st CITIS Summit, DAIC, New Delhi.

AGENDA

Details	Time	Details
10:30 AM-10:35 AM	5 mins	Welcome and Introduction - ED (P) NMCG
10:35 AM-10:40 AM	5 mins	Overview of RCA – Urban Lead, NMCG
10:40 AM-10:50 AM	10 mins	Keynote Address - DG NMCG
10:50 AM-11:00 AM	10 mins	Special Address- JS MEA
11:00 AM-11:25 AM	25 mins	Roundtable Discussion with International Countries Participating at COP 28 – Moderator NIUA
11:25 AM-11:30 AM	5 mins	Closing Remarks - Deputy Secretary NMCG

8TH IWIS & 1ST CITIS - SUMMIT 2023

Development vis-à-vis Land, Water and Rivers

Since the 4th IWIS in 2019 the focus has been on exploring 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 ideas and suggestions that emerged from these four Summits led to seek comprehensive means to integrate river conservation into India's developmental path in the 5th IWIS (IWIS-2020) from the perspective of Arth Ganga, an ancient Indian concept. 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. A more focused assessment was attempted in the 6th IWIS (IWIS-2021) to evaluate the different types of river resources, their usefulness for ecosystem services for human benefit, and the adverse effects of over-extraction and misuse of these resources on the ecosystem services. This exploration was aimed to chalk out feasible pathways for sustainable river resource planning and management over the long term to meet the concerns of diverse stakeholders and to aid planners, policymakers and financiers. In order to resolve the issue of divergent impacts of different activities carried out by different agencies and governments for developmental or social purposes, the convergence of five P's, namely, People, Policies, Plans, Programmes and Projects, were considered crucial in the "Samarth Ganga" framework to achieve Sustainable Development Goals (SDGs). Thus, the thrust of deliberations in the 7th IWIS (IWIS-2022) was to understand, elaborate, delineate potential causes of divergence, and formulate strategies for convergence through collation of views expressed in the Summit.

The 8th India Water Impact Summit (IWIS) will present an exhibition of past achievements of IWIS and hold intensive expert discussions on the main theme of "Samarth Ganga" in the context of the ongoing national initiative of Lifestyle for Environment. Within that it will focus on "Productive Land" (highlighting the inter-dependability of Land and Rivers), and "Lifestyle for Rivers". IWIS will also launch a "Global Coalition for River Science and Management", which would provide a platform for hosting the best practices around management, tools and techniques for understanding, monitoring and managing different aspects of river systems around the world.

The 8th IWIS showcases

past achievements, discusses "Samarth Ganga" in the context of ongoing National initiative of Lifestyle for Environment emphasizing "Productive Land" and "Lifestyle for Rivers." It launches a "Global Coalition for River Science and Management" to share best practices worldwide around the world.

1. Theme I: Samarth Ganga and Productive Land

There are several problems of river systems that have origin from the terrestrial part such as excessive flow and deposition of sediments resulting in chocking and/or reduction in carrying capacity that can be better resolved if catchment area (land, vegetation, forest cover, etc.) is managed properly. Also, water abstractions from the river systems (rivers, ponds, reservoirs, wetlands, subsurface/aquifer waters, etc.) could be appropriately regulated by efficiently managing water requirements for achieving desired land productivity (food, fiber, etc.). Likewise, river systems can receive water evenly despite uneven distribution of rainfall by managing surface and sub-surface flows by maintaining appropriate land use and land cover. Therefore, it is important to develop understanding on interdependence of land and water systems and manage lifestyle as well as human interventions in land and water systems. The two sessions on this theme namely, Samarth Ganga and Productive Land I & II, are aimed at deliberating some dimensions of this grand challenge.

1.1 Desertification and Land Degradation:

Land degradation is an issue of increasing global concern. It threatens not only the productivity of land but also water quality, human health and the fundamentals of ecosystems on which all life depend. It has also close connection with other major global issues, particularly climate change and biodiversity. It has been estimated that globally around 24 billion tons of fertile soil and 27,000 bio-species are lost each year. While land degradation is acutely felt in the world's arid lands, some 80 per cent is actually occurring outside these areas. For this reason, there is an urgent need to halt and reverse land degradation for ensuring food, water and environment security as well improving living conditions of population residing in such areas. Desertification, along with climate change and the loss of biodiversity were identified as the greatest challenges to sustainable development during the 1992 Rio Earth Summit which paved the way for the conceptualization and formulation of the United Nations Convention to Combat Desertification (UNCCD). The Convention's 195 parties, including India, work together to improve the living conditions for people in drylands, maintain and restore land and soil productivity and mitigate the effects of drought.

Despite erratic rainfall, balancing river water involves regulating surface and sub-surface flows via land management. Understanding the land-water interdependence is vital. Lifestyle adjustments and prudent human interventions in land-water systems are crucial for sustainable management.

The most significant process of desertification/ land degradation in the country is Water Erosion (increased to 11.01% in 2018-19 from 10.98% in 2011-13 and 10.83% in 2003-05). The second most significant process is Vegetation Degradation (9.15% in 2018-19, 8.91% in 2011-13 and 8.60% in 2003-05). Area under desertification (arid, semi-arid and dry sub-humid regions of the country) during 2018-19 was estimated to be 83.69 million ha area whereas, during 2011-13 was estimated to be 82.64 mha; and, during 2003-05 it was estimated to be 81.48 mha. Thus, there is a cumulative increase of 1.05 million ha area under desertification from timeframe 2011-13 to 2018-19. The increase in area under desertification from 2003-05 to 2011-13 is 1.16 million ha. The most significant process of desertification in arid region is observed to be wind erosion, and in semi-arid and dry sub-humid regions vegetation degradation and water erosion dominates (SAC, 2016).

Desertification is the continuous degradation of land under the influence of natural and anthropological causes in arid, semi-arid and dry-sub humid conditions. Desertification affects two third countries of the world and one third of the earth's surface, on which one billion people live (one seventh of world's population). The processes of desertification and land degradation are observed to have accelerated during recent years. As per United Nations Convention for Combating Desertification (UNCCD), Desertification is defined as "land degradation in arid, semiarid and dry sub-humid areas resulting from various factors including climatic variations and human activities"

Human-induced vegetation loss

quickens soil degradation, fostering desertification. Soil lacking vegetation cover faces heightened erosion by wind and water, causing organic matter loss and reduced fertility. Diminished water retention and nutrients intensify pressure on vegetation survival.

(UNCCD, 1994). Here "land" means the terrestrial bio-productive system and "land degradation" means reduction or loss of biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) Soil erosion caused by wind and/or water; (ii) Deterioration of the physical, chemical and biological or economic properties of soil; (iii) Long term loss of natural vegetation, etc. (UNCCD, 1994).

Processes of Desertification/ Land Degradation
Vegetation degradation:
Vegetation degradation is observed mainly as deforestation / forest-blanks / shifting cultivation and degradation in grazing / grassland as well as in scrubland. At places, agriculture is observed within forest lands, this has also been classified under vegetation degradation within forest area. Vegetation is an important factor in the protection of soil and soil fertility as well as the rate at which surface runoff and percolation occurs resulting in significant impact on groundwater recharge and soil erosion. Destruction of vegetation, most often by human activities accelerates soil degradation leading to desertification. When soil loses vegetation cover, it becomes more susceptible to wind and water erosion. Removal of top soil by water or wind erosion results in loss of organic material leading to decrease in soil aggregation and stability, and hence soil fertility. The water-holding capacity and the nutrient content of the soil are reduced when organic material is lost, which is an additional strain on vegetation survival.

Productivity of land depends on adequate water and nutrient uptake from the soil. Thus, besides soil moisture, soil fertility depends on the adequacy of nutrients in forms that are easily available for plant uptake. This, in turn, depends not only on the presence of nutrients in the soil, but also on soil biodiversity, especially microbes (like bacteria and fungi, but also micro-fauna) and invertebrates (like earthworms), that recycle and process the nutrients appropriately from organic matter and help stabilize soil structures (cGanga and NMCG, 2015).

Forest soils have efficient nutrient recycling by virtue of their rich and optimized soil biodiversity. This enables the growth and sustenance of vegetation without any external supply of nutrients (except what little may accrue from airborne particles and runoff/ groundwater from upland sources minus what is lost through outflows). But cultivated soils have much poorer nutrient recycling capacity due to progressive nutrient depletion through plant growth and their harvesting as well as due to significant loss of topsoil and nutrient washout (leaching) from tilled farmlands. Hence, traditionally, farmlands would have to be left fallow for one or two years to recover their fertility after every few years of cultivation unless the nutrients could be replenished through periodic flooding.

Chemical fertilizers applied in modern agriculture overcome the above problem, but they disrupt the nutrient balance of soils by selectively increasing the availability

of macronutrients such as N (or N, P & K) while many other macro- and micro-nutrients essential for plant growth get rapidly depleted from the soil, thereby dwindling soil fertility over crop cycles. This loss of soil fertility also results in significant adverse impact on soil microbes, which further reduces the ability of plants to absorb water and nutrients from the soil. Thus, soil fertility depends largely on the level of Soil Organic Matter (SOM) or Soil Organic Carbon (cGanga and NMCG, 2015), which is an indicator of the adequacy not only of organic carbon (required by soil biota but not by plants) but also on various essential nutrients required by plants and soil organisms, since organic compounds from plant and animal sources include a varied mix of various essential nutrients. Thus, composted plant/ animal residues and animal dung are known to promote high long-term agricultural productivity. SOM also enables better bonding between soil particles, thereby minimising the loss of soil particles, nutrients and water (soil moisture) through erosion and leaching that otherwise pollute nearby aquatic ecosystems with high soil and nutrient inputs.

The closest approximation to maintaining soil fertility and nutrient adequacy in agricultural fields to that in forest soils is when the agricultural fields: (i) remain relatively undisturbed from mechanical ploughing ("no tillage" or "minimum tillage"), (ii) is adequately supplied with organic matter through mulching (which also prevents topsoil erosion and evaporation), and (iii) by adopting crop diversification (or crop rotation) as in mixed forests.

Crop residues left in fields in small landholdings are generally much less since they are harvested through manual labour, leaving very short stalks that are often ploughed into the soil for the next cropping season. Other post-harvest crop residues serve to provide animal fodder, domestic fuel, composted manure, and sundry other purposes. Mechanical harvesting of crops leaves large amounts of plant material behind in the fields. For rapid removal of the plant stalks before the next crop season, they are often burnt in situ, leading to significant air and water pollution over vast regions.

1.2 Crop Residue Management and Rivers

The inter-dependability of Land and Rivers occurs in multiple ways involving physical, chemical and biological aspects. They include material transfers from one to the other involving energy, chemical and biological changes that may enrich or impoverish land ecosystems and waterbodies in different ways depending on the nature, quantities and rates of material movement. Hence both land use and water use have concomitant effects on land and waterbodies.

Anthropogenic land use, primarily in agriculture, significantly alters soil ecosystems through tillage, irrigation, and fertilizers. While agriculture consumes substantial water, urban activities pose a greater risk to water quality, with wastewater laden with pollutants discharged into waterbodies.

Geographically, anthropogenic land use is most significant for agricultural purposes, which often involves extensive tillage, irrigation, and fertilizer application, all of which significantly alters the soil ecosystem. On the other hand, while water consumption is also very high in agriculture and has its major impact on waterbodies, water quality deterioration occurs more significantly in urban uses, whence the wastewater generated by households and urban institutions is loaded with organic and inorganic pollutants that is usually discharged after treatment into nearby rivers and waterbodies with the potential risk of fouling the waterbodies. These adverse phenomena need to be mitigated both through institutional and lifestyle measures.

Soil health is an envelop term that may be broadly conceptualized in terms of biological productivity to support plant growth (Brevik, 2009) or generally as "the capacity of a soil to function, within ecosystem and land use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant and animal health" (Doran et al.,1994; Doran and Zeiss, 2000). Soil health is generally indicated by physical, chemical and biological indicators, as presented in **Table 1.**

Table 1. Commonly used Indicators of Soil Health (Brevik, 2009)

Physical Indicators	Chemical Indicators	Biological Indicators
Texture	pH	Microbial biomass
Bulk density	Organic matter	Earthworm populations
Penetration resistance	Total carbon	Nematode populations
Aggregate stability	Total nitrogen	Arthropod populations
Water holding capacity	Cation exchange capacity	Mycorrihizal fungi
Infiltration rate	Major and minor nutrients	Respiration rate
Depth to hardpan	Electrical conductivity	Soil enzyme activities
Depth to water table	Heavy metals and other plant toxins	Pollutant detoxification
Porosity		Decomposition rate
Erosive potential		
Aeration		

Physically, soil texture is a basic attribute that partly determines the other physical properties, viz. Figure 1

Figure 1. Soil Texture Depending on Percentages of Sand, Silt and Clay (Source: USDA Natural Resource Conservation Service).

Chemical properties of soil are related to properties that directly affect plant nutrition. Plants need an adequate supply of nutrients to grow and repro¬duce. There are at least 17 nutrient elements that most plants need for productive growth and development namely, carbon, oxygen, hydrogen, nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, zinc, manganese, boron, copper, chlorine, iron, nickel, and molybdenum (cGanga and NMCG, 2015), of which at least 13 are very important, viz.

Nitrogen: Improves growth, grain and fruit development and leaf quality
Phosphorus: Promotes blooming and root growth
Potassium: Improves fruit quality, disease resistance and drought tolerance
Sulfur: Essential for chloroplast formation
Calcium: Aids nutrient transport within the plant
Magnesium: Activates growth enzymes, essential for chlorophyll formation
Iron: Essential for chlorophyll formation
Manganese: Essential for photosynthesis and nitrogen metabolism
Boron: Essential for fruit and seed development
Copper: Aids photosynthesis and reproductive development
Zinc: Regulates plant growth and sugar metabolism

The biological component of soils is very complex as it depends on a vast range of physical and chemical factors, with bacteria and fungi playing a key role in breaking down complex organics for nutrient uptake by plants. In a nutshell it is best visualized by the Soil Food Web as shown in **Figure 2**.

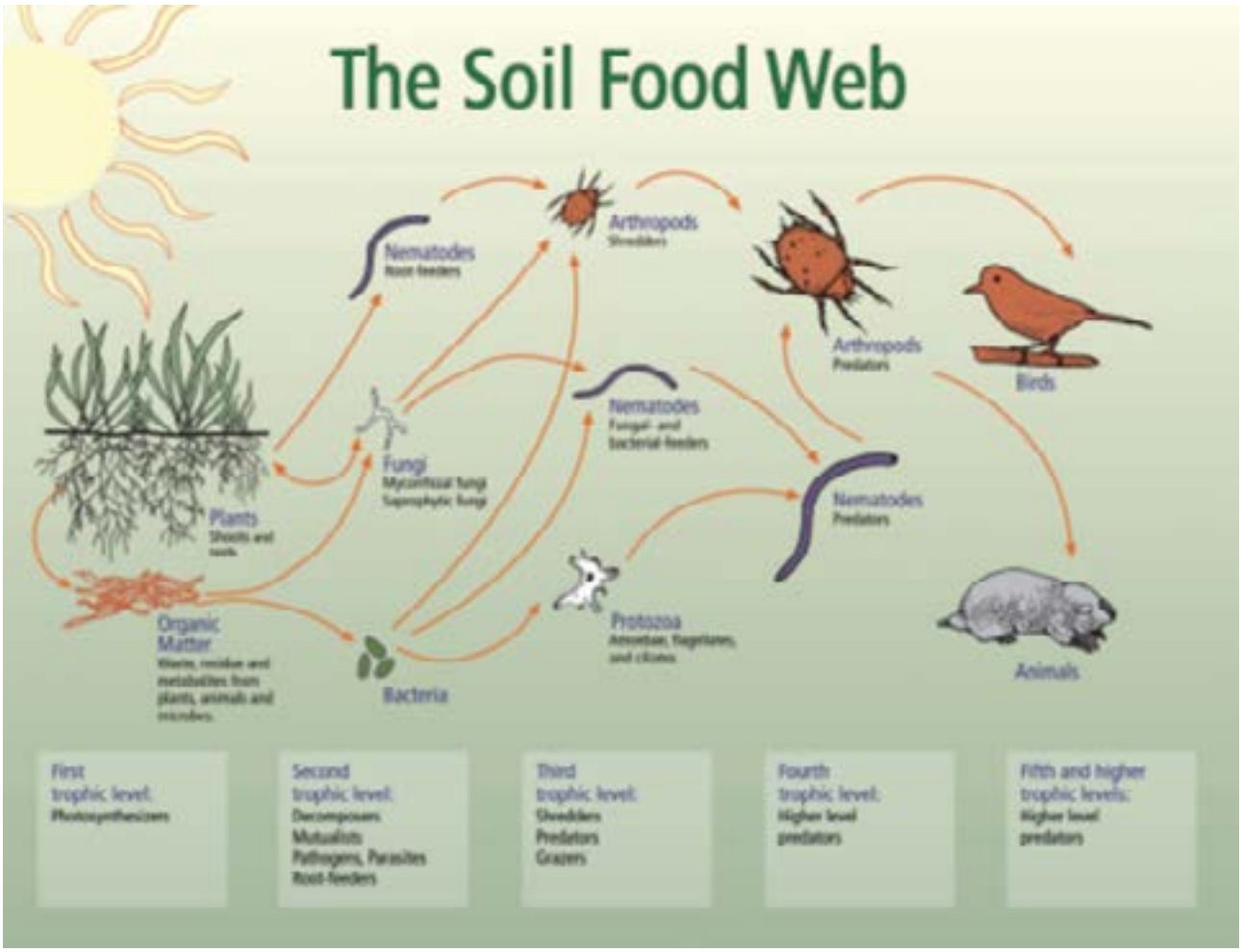

Figure 2. The Soil Food Web Describing the Various Feeding Relationships of the Organisms in the Soil (Source: USDA Natural Resources Conservation Service).

Water erosion, notably sheet erosion within agricultural lands, dominates land degradation in the country, constituting 10.98% of Total Geographical Area (TGA) in recent years. This loss of soil cover arises from rainfall and runoff, intensified by agricultural practices like tillage.

In the above context, it is useful to survey the broad impact of agriculture on India's land. According to SAC, around 96.40 mha area of the country (29.32% of the Total Geographic Area or TGA) was undergoing land degradation during 2011-13, while during 2003-05 the area undergoing desertification or land degradation was 94.53 mha or 28.76% of TGA (SAC, 2016). There is obviously an urgent need to stop and reverse the process of land degradation at various levels to combat desertification and land degradation, for which sustainable management of soil and water resources are required. The most significant process of land degradation in the country was identified by SAC as Water Erosion (10.98% of TGA in 2011-13 and 10.83% in 2003-05), which refers to loss of soil cover mainly due to rainfall and/ or surface runoff water, of which sheet erosion (or rill erosion) occurs mostly within agricultural lands (SAC, 2021) due to the loosening of soil by tillage and other agricultural interventions. The loose topsoil is easily eroded by rain and runoff, carrying away valuable minerals, organic carbon and other nutrients with them. The loss of soil organic carbon (SOC) also reduces the water holding capacity and microbial population of sandy and loamy soils, as shown in **Figure 3**.

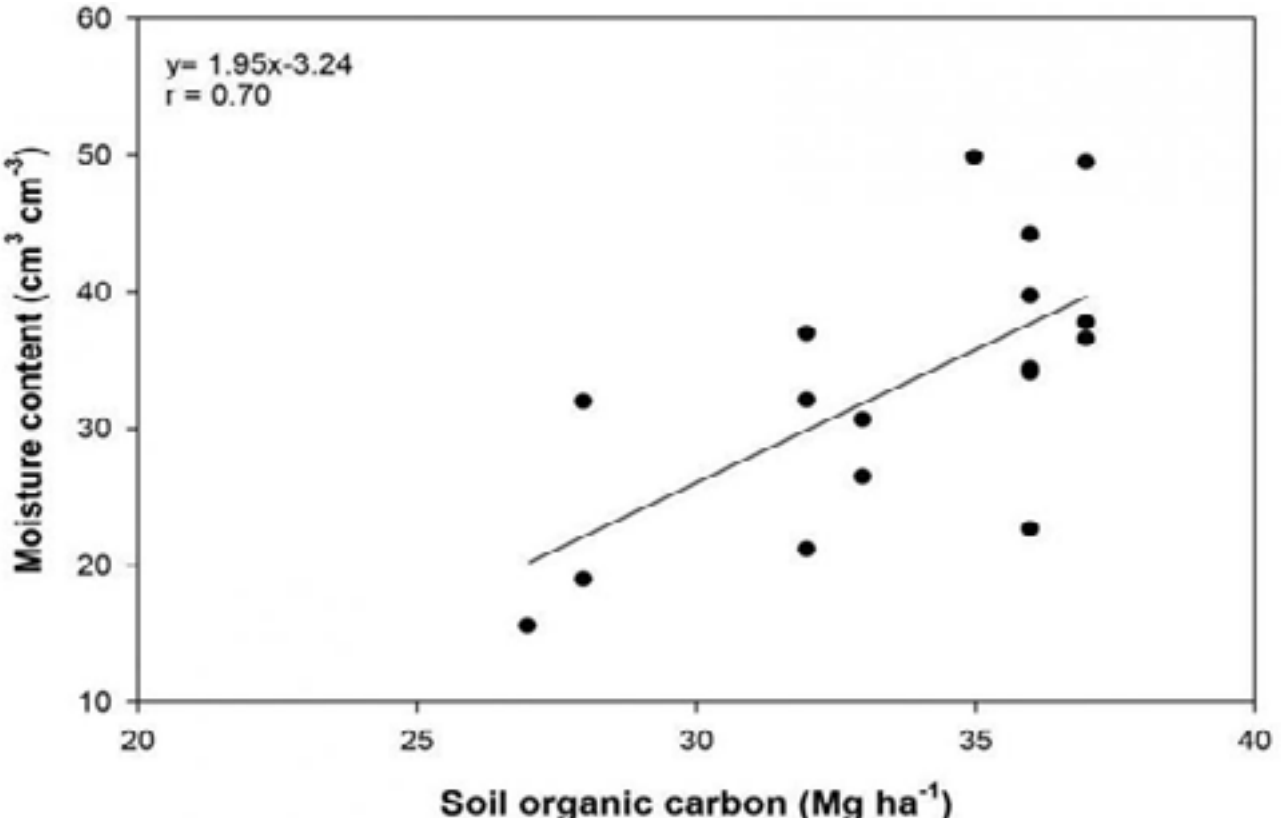

Figure 3. Increase in Soil Moisture Storage Capacity with Increase in Soil Organic Carbon in 10 Years Tillage and Crop Rotation Study (*Al-Kaisi et al., 2014*)

a) Generation of Crop Residues in Indian Agriculture

A considerable amount of crop residues is generated in India from cereal crops like rice, wheat and maize as well as sugarcane due to intensive agricultural practices (Figure 4) rather than increasing conservation agriculture practices in many other countries.

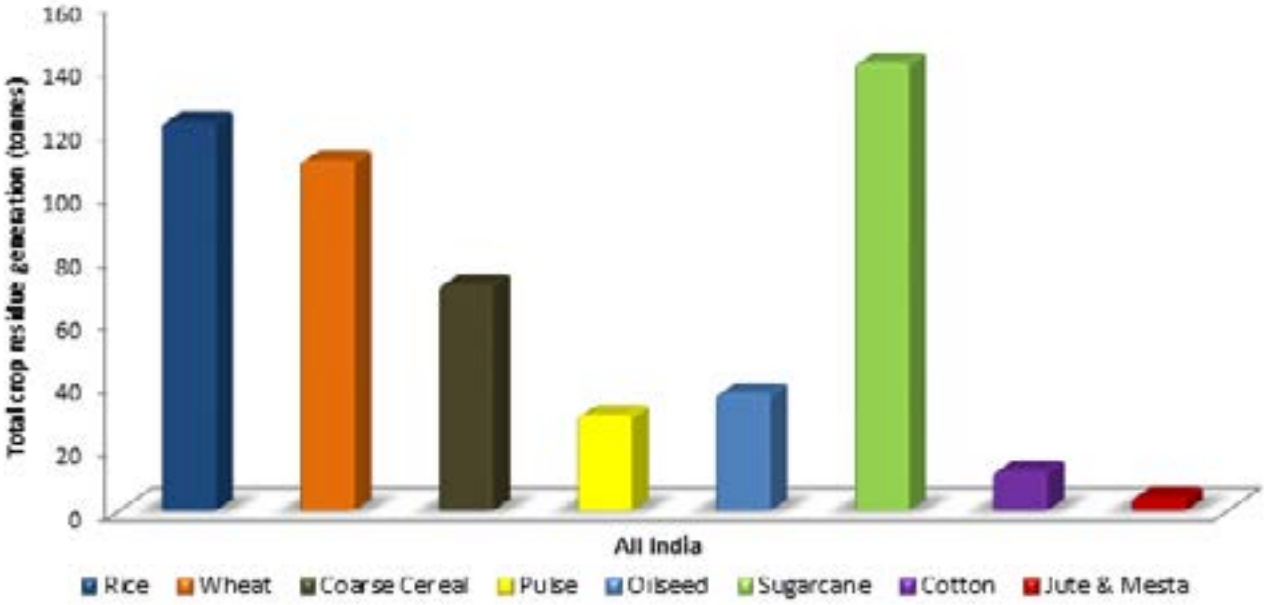

Figure 4. Total Crop Residue Generation (tonnes) in India during 2014-15 (Source: Ministry of Statistics and Program Implementation (MOSPI), 2013-14)

Sugarcane, rice, wheat and coarse cereal contributed the majority of crop residue with production estimates of 141.1 Mt, 122.6 Mt, 110.3 Mt and 71.3 Mt respectively. Among cereal crops, rice, wheat, maize and millets together contributed 70% of crop residue followed by fiber crop.

b) Crop Residue Burning

The burning of rice residue and sugarcane trash is a routine practice at many places in northern Indian Plains due to their poor suitability as fodder and immediate removal required from the fields for timely seeding of wheat crop. In

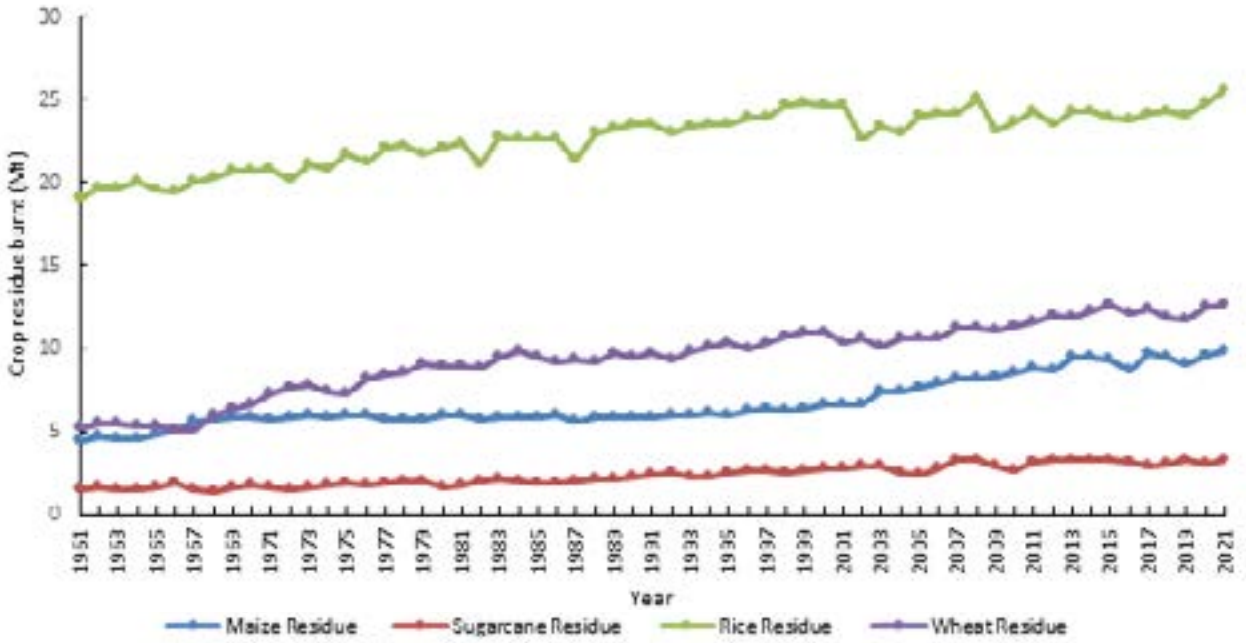

Figure 5. Trend in Crop Residue Burnt in India during 1961-2021 (Source: Food and Agriculture Organisation, 2021)

addition to the cost and time savings, farmers derive other benefits of weeds, diseases and pests control by burning the crop residues.

Crop residue burning has detrimental consequences, as it not only harms the environment but also results in the loss of valuable nutrients contained within the straw. Carbon, nitrogen, phosphorus, potassium, and various other nutrients, as depicted in Table 2, are forfeited at rates ranging from 20% to 100% when crop residues are burned.

Table 2. Loss of Nutrients via Burning of Crop Residue (Source: Meena et al., 2022)

Nutrients	Quantity
Organic Carbon	3850 million kg
Nitrogen	59 million kg
Phosphorus	20 million kg
Potassium	34 million kg

This loss of essential nutrients undermines soil fertility and agricultural sustainability. Following are some of the concerns as a result of the burning of the crop residues.

- One ton stubble burning along with 199 kg ash releases 3 kg of particulate matter, 60 kg of carbon monoxide (CO), 1460 kg of carbon dioxide (CO2) and 2 kg of sulphur dioxide (SO2).
- About 25% of N and P, 50% of S and 75% of K uptake by cereal crops are retained in crop residues, making them viable nutrient sources (Goud et al., 2022).
- About 90% of N and S and 15- 20% of P and K contained in rice residue are lost during burning.
- Burning of 23 million tonnes of rice residues in NW India leads to a loss of about 9.2 million tonnes of C equivalent (CO2-equivalent of about 34 million tonnes) per year and a loss of about 1.4×105 t of N (equivalent to Rs 200 crores) annually (NAAS, 2017).
- Loss of carbon from soil results in reduced microbial activity, affect soil nutrient cycling potential, soil detoxifying capacity and other soil function in long term

Table 3. Quantum of Rice Residue Burned in India Every Year in Three States

State	Total cultivable area in Kharif (lakh ha)	Area under Kharif Paddy (Lakh ha)			Paddy Straw Generated (Million ton)	Paddy Straw managed (million ton)			Paddy Straw Burnt (million ton)	Paddy area burnt (lakh ha)
		Basmati	Non-Basmati	Total		In-situ	Ex-situ	Total		
Punjab	42	4.36	27.07	31.43	19.99	9	3.5	12.5	7.49	12.57
Haryana	38	7.32	6.58	13.9	7	5.15	1.1	6.25	0.75	2.15
UP	128.73	25.89 (1.89)*	34.10 (0.015)*	59.99 (1.91)*	27.70 (0.68)*	-	-	-- (>0.67)	(NA) (146 Ton)*	NA

c) Crop Residue Usage

- India produces a vast quantity of crop residues, which find applications in agriculture, industry, and energy generation.
- India's annual crop residue production exceeds 686 million tonnes (Mt), with cereal crops contributing approximately 368 Mt to this total (Hiloidhari et al. (2014)).
- Within the category of cereal crops, rice and wheat take the lead, contributing approximately 154 and 131 Mt, respectively, to the overall crop residue production in India. Generation of crop residues is highest in Uttar Pradesh (60 Mt) followed by Punjab (51 Mt), and Maharashtra (46 Mt). Among different crops, cereals generate maximum residues (352 Mt), followed by fibres (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt) (IARI, 2012).
- The cereal crops (rice, wheat, maize, millets) contribute 70% while rice crop alone contributes 34% to the crop residues. Wheat ranks second with 22% of the crop residues whereas fibre crops contribute 13% to the crop residues generated from all the crops (IARI, 2012).
- In India, crop residues primarily serve as cattle feed and a source of cooking fuel. However, in nations such as China, Indonesia, Thailand, Bangladesh, and Sri Lanka, these residues are harnessed as feedstock for bioenergy generation, the production of organic fertilizers, and the paper industry.
- Managing rice residue, especially in the Indo-Gangetic Plains of India, presents significant challenges. In this region, the rice-wheat cropping system is intensively practiced, and farmers prioritize timely wheat seeding in fields where rice has been harvested using combine harvesters (Sidhu et al., 2007, Singh et al., 2020).
- The narrow time frame available between rice harvesting and wheat sowing, the unavailability of suitable residue handling machinery, and the labor-intensive nature of manual residue removal (Kumar et al., 2021), results in a substantial annual surplus of crop residue production in India, estimated at 178 Mt, of which approximately 87 Mt is subjected to burning.

d) Crop Residue Utilization in Selected Countries

It is important to note that in a big country like China, where about 700 Mt crop residues are generated annually, 31% of crop residues are left in the field, 31% are used for animal feed, 19% are used for bioenergy generation and 15% are used as fertilizer (Jiang et al., 2012). Some of the nutrients contained in about 31% used as animal feed eventually returns to the soil. Table

Table 4. Pattern of Crop Residues used in Select Countries

Country	Major utilization
India	Cattle feed, cooking fuel, on- field burning
China	Bioenergy, fertilizer, field retention
Indonesia	Fertilizer, animal feed
Thailand	Bioenergy
Bangladesh	Bioenergy
Pakistan	Animal feed
Nepal	Animal feed
Philippines	On-field burning, bioenergy
Afghanistan	Animal feed, cooking fuel
Sri Lanka	Paper Industry

e) SOC in Indian Soils

- Using the extensive database of the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Bhattacharyya et al. (2008) estimated that Indian soils contain only 9.55 and 24.04 Gt organic C (SOC) out of about 13.69 and 46.50 Gt of total carbon in the top 0.3 and 1 m soil, respectively.
- Sreenivas et al. (2016) estimated SOC, soil inorganic C and total soil C pool size of India at 22.72 ± 0.93,12.83 ± 1.35 and 35.55 ± 1.87 Gt, respectively, in the top 1 m.
- The Indian contribution to the global SOC pool is in the order of 20–25 Gt for the top 1 m. With an annual C emission of about 566 million tonnes from the Indian subcontinent (Carbon Dioxide Information and Analysis Center database, CDIAC), the required C sequestration rate for India would be about 23–28 per mille as opposed to the global requirement of 4 per mille.
- Promotion of pulses and legumes (for their unique SOC build-up properties), diverting a part of fertilizer subsidy and efficient use of available crop residues (679 Mt annually) and municipal solid wastes (64.8 Mt annually) along with green manuring and suitable cropping systems (rice-based) may help to improve or at least curb declining trends in SOC stock in Indian soils.

Stakeholders consulted at the ICAR-Indian Institute of Farming Systems Research (Modipuram) estimate the area under cover crops to be around 1.94 million hectares, while mulching covers around 20 million hectares.

Utilizing crop residues on farmlands, whether for soil cover, mulching, or as soil additives alongside composted organic waste like animal dung or biochar, enhances Soil Organic Carbon.

f) Crop Residue Management and Soil Health

- Soils in the Indo-Gangetic Plain contain low organic matter content and are being consistently depleted of their finite reserve of nutrients by crops (Bijay-Singh et al. 2004).
- Excessive nutrient mining of soils is one of the major causes of fatigue experienced by soils under the Rice-Wheat system.
- The quantities of nutrients removed by rice and wheat are greater than the amount added through fertilizers and recycled. Removal of all the straw from crop fields leads to K mining at alarming rates because 80% to 85% of the K absorbed by the rice and wheat crops remains in the straw (Singh and Singh 2004).
- There are numerous benefits of residue retention on cropland, especially if maintained as surface mulch and combined with direct seeding of crops without 'normal' tillage.
- The incorporation of crop residue improved soil fertility status as judged by organic carbon and available P and K contents (Prasad et al., 1999).
- Residues retention improves soil physical (e.g., structure, infiltration rate, plant available water capacity), chemical (e.g., nutrient cycling, cation exchange capacity, soil reaction), and biological (e.g., SOC sequestration, microbial biomass C, activity and species diversity of soil biota) quality (Beri et al. 1992, 1995, Bijay-Singh et al. 2008, Singh et al. 2005).

Inference: It is evident from the above that the best usages of crop residues are in situ applications on the farmlands. Such residues can be used for soil cover or mulching as well as soil additives along with other organic wastes such as animal dung, preferably after composting or as biochar. Such addition increases the SOC resulting in healthier soils with rich biodiversity, high nutrient levels, and good water holding capacity, thereby reducing irrigation requirements, topsoil loss, and fertilizer application. The reduced irrigation and soil erosion are a definite benefit for rivers and waterbodies in return. Other local uses of crop residues such as fodder for domestic animals are equally environment-friendly ways of handling crop residues.

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Sustainable development

necessitates a river-centric economy, tying economic growth to river rejuvenation and conservation. Healthy river systems rely on catchment area management that prioritizes river conservation, forming an essential symbiotic relationship for their well-being.

2. Theme II: Lifestyle for and Economics of Rivers

Managing and sustaining lifestyles and economics of rivers are interlinked. Sustainable development is unrealistic without focus on river centric economy. In other words, economic growth should be linked positively to the rejuvenation and conservation of river systems. Also, river systems can not be healthy without management of catchment area in a way that supports conservation of rivers. There are many aspects of lifestyles that influence river systems and catchment area. The two significant aspects are (i) how food (energy and nutrition) demand and supply are catered to, and (ii) how wastes (residues) are managed. These two aspects will be deliberated upon under this theme in two sessions with the objective of evolving strategy for river basin management.

2.1 Municipal Wastewater Management and Soils

A major issue faced in municipal wastewater management is the treatment level before discharging into waterbodies. After adequate removal of major inorganic and organic pollutants through primary and secondary treatment, the levels of nutrients like N and P still tend to be high, necessitating additional/tertiary treatment before discharge to prevent the rampant growth of water hyacinth and other aquatic weeds due to excessive nutrient enrichment of waterbodies and slow-moving river waters that depletes dissolved oxygen and turns fatal for aquatic biota. An environment-friendly option proposed earlier by cGanga is the four-stage water-recycling process, wherein nutrient removal from the water is effected by allowing hyacinths to proliferate in dedicated wetlands before the nutrient-removed water is discharged safely into natural waterbodies. The hyacinths can be periodically harvested and applied to nearby agricultural fields as mulch and organic soil additives, thereby benefitting both waterbodies and land in a single stroke.

2.2 Lifestyle impact on Land and Waterbodies

Among various lifestyle aspects affecting both land and waterbodies is food. Humans have varied choices of food today within the ambit

Table 5. Land Requirement for Producing per unit of Food

Food Type	Area Needed (sq.m./ kg)	Reference
Rice & Wheat	2.8	OurWorldInData.org/environmental-impacts-of-food
Pulses	15.57	OurWorldInData.org/environmental-impacts-of-food
Millets	Approx. 7–11	https://idronline.org/article/agriculture/millet-cultivation-history-and-trends/
Milk	8.95	OurWorldInData.org/environmental-impacts-of-food
Eggs	6.27	OurWorldInData.org/environmental-impacts-of-food
Meat	12.22-369.81	OurWorldInData.org/environmental-impacts-of-food

Table 6. The Water Footprint of Some Selected Food Products from Vegetable and Animal Origin

Food items	Water footprint per ton (m^3/ ton)				Nutritional content			Water footprint per unit of nutritional value		
	Green	Blue	Grey	Total	Calorie (kcal/kg)	Protein (g/kg)	Fat (g/kg)	Calorie (litre/kcal)	Protein (litre/g protien)	Fat (litre/g fat)
Sugar crops	130	52	15	197	285	0.0	0.0	0.69	0.0	0.0
Vegetables	194	43	85	322	240	12	2.1	1.34	26	154
Starchy roots	327	16	43	387	827	13	1.7	0.47	31	226
Fruits	726	147	89	962	460	5.3	2.8	2.09	180	348
Cereals	1,232	228	184	1644	3209	80	15	0.51	21	112
Oil crops	2,023	220	121	2364	2908	146	209	0.81	16	11
Pulse	3180	141	734	4055	3412	215	23	1.19	19	180
Nuts	7016	1367	680	9063	2500	65	193	3.63	139	47
Milk	863	86	72	1020	560	33	31	1.82	31	33
Eggs	2592	244	429	3265	1425	111	100	2.29	29	33
Chicken meat	3545	313	467	4325	1440	127	100	3.00	34	43
Butter	4695	465	393	5553	7692	0.0	872	0.72	0.0	6.4
Pig meat	4907	459	622	5988	2786	105	259	2.15	57	23
Sheep/goat meat	8253	457	53	8763	2059	139	163	4.25	63	54
Beef	14,414	550	451	15415	1513	138	101	10.19	112	153

Source: https://link.springer.com/article/10.1007/s10021-011-9517-8;
https://hess.copernicus.org/articles/15/1577/2011/hess-15-1577-2011.html

of dietary requirements for nutrition. Broadly, these choices may be categorised in terms of Plant-based foods, Dairy-based foods, and non-vegetarian food products. The production of each of these categories have different land and water footprints (besides energy, transportation and other requirements), which can guide us in choosing healthy food that is also environmentally sound. The Tables 5 and 6 show the estimated land and water requirements for such foods.

It is evident that a significant lifestyle aspect concerning food emphasizing on plant products as against animal products can be of great advantage in saving land and water, which are otherwise over-burdened with our food requirements given that India only has a about 2.4% of the world's land area and 4% of the world's freshwater. Given the relatively lower costs of plant products in general, changing food habits can be easily achieved through a concerted campaign highlighting the needs and advantages subject to our dietary needs, cultural traditions and culinary choices.

Shifting towards plant-based

food over animal products could significantly save land and water. India, with only 2.4% of land and 4% of freshwater globally, benefits from this sustainable lifestyle choice.

3. Theme III: Integrated Digital Systems for River Basin Management

This session will begin with showcasing some of the best digital platforms that are being used around the world for managing river basins.

- Satellite remote monitoring including penetrating cloud-cover
- Floods, surface and ground water monitoring
- Digital Twins of catchments and valleys
- Drone and LIDAR based systems
- Advanced sensor-based AI systems / and other systems

Subsequently the participants will deliberate on best practices in governance of river basins and systems. Critical issues that will be covered are:

1. Water quality monitoring
2. Water quantity and resources monitoring
3. Ground water and surface water extraction management
4. Decision support systems to manage the critical issues / and other approaches

4. Theme IV: Inducting Samarth Ganga Concept in Preparing Basin Management Plans for Six Major River of India

Hon'ble President of India in his address at the Joint Session of the Parliament in June, 2019 announced the following –

"….My Government is fully devoted to make the flow of Ganga uninterrupted and pollution free. Recently, encouraging evidence of revival of aquatic life at several locations along Ganga have been reported. This year, during the Ardhakumbh in Prayagraj, the cleanliness of Ganga and amenities provided to the devotees have made news throughout the world. My Government has enhanced the dignity and self-esteem of every person who contributed towards the successful organization of Ardhakumbh by honouring them.

Under the 'Namami Gange' scheme, my Government will further accelerate the campaign for closure of drains releasing effluents in the river Ganga. On the lines of river Ganga, the Government will also endeavour to clean up other rivers such as Cauvery, Periyar, Narmada, Yamuna, Mahanadi and Godavari….."

Earlier a strategic Ganga River Basin Management Plan (GRBMP - 2015) was prepared by consortium of 7 IITs led by IIT Kanpur. In March, 2016, MoA wassigned between IIT Kanpur and MoWR, RD&GR (now Ministry of Jal Shakti) to establish Centre for Ganga River Basin Management and Studies (cGanga in short) to provide continual scientific support for implementation and dynamic evolution of the Plan. Centre for Ganga River Basin Management and Studies (cGanga), approved by the Board of Governors of IIT Kanpur, has now been set up and operational at IIT Kanpur that serves as a knowledge body to the National Mission for Clean Ganga (NMCG), Department of Water Resources, River Development and Ganga Rejuvenation (Do WR, RD & GR), Ministry of Jal Shakti, GoI.

On the lines of GRBMP, it is proposed to carryout Condition Assessment and prepare River Basin Management Plan for six rivers namely, Mahanadi, Narmada, Godavari, Krishna, Cauvery, and Periyar, to enable preparation of action plans for conservation/rejuvenation of entire stream network of these rivers. It is proposed to engage Indian Institutes of National Importance located in the some of the Basin States of these six river basins.

In the two sessions under the theme, the project teams and experts will deliberate on inducting the concept of Samarth Ganga (Capable Rivers) in preparing the river basin management plan and the expected requirements of and outcome from carrying out such exercise. The learnings from GRBMP and experience of implementing flagship Namami Gange programme could serve as the basis.

4.1 Background

India is bestowed with 4% of world's water resources (India-WRIS 2015) and 2.4% of the world's land resources (cGanga and NMCG, 2015). Rivers have been the heart and soul of India's growth and culture. Many of the large river systems are perennial, but some of their tributaries are seasonal. Besides the Ganga and Brahmaputra systems, the other major river systems are Sabarmati, Mahi, Narmada, Tapi, Brahmani, Mahanadi, Godavari, Krishna, Pennar and Cauvery. Over the decades, booming industrial and agricultural growth, population growth, rapid urbanization, infrastructural developments, etc. have had considerable impact on India's natural resource base and waste generation. This has

often had a damaging impact on the ecological status of India's numerous rivers, waterbodies and other ecosystems.

The GRBMP provided a framework in the government's endeavor to conserve and restore the Ganga river through the National Mission for Clean Ganga (NMCG). Subsequent discourses and reaching out to diverse experts led to further developments in comprehending and addressing the various river-related issues in the country through identification of the roles of river basin ecosystems, importance of natural resource management and ecosystem goods and services of rivers, multi-stakeholder participation in river management, importance of small (lower order) rivers/ tributaries, waterbodies and other basin ecosystems, and impact of alternative developmental processes in synchronizing river conservation with development. This advanced knowledge informs the design of the programme for rejuvenating and conserving six major rivers of India (other than river Ganga and her tributaries), namely Mahanadi, Narmada, Godavari, Krishna, Cauvery & Periyar.

4.2 Objectives

Every river in nature is characterized by typical river functions that together define its hydrological, chemical, geological, spatial, and ecological integrity. Rivers impacted by human activities in the river basin – and sometimes within the river channels themselves – may lose some of their functional capabilities, which compromises their integral nature. River restoration, therefore, is necessarily the means to make such rivers functionally able (or capable) once again to ensure optimal ecosystem services for human benefits. This is the basic concept of Samarth (meaning "Able") Ganga as applied to River Ganga, but also to any other river since Ganga denotes all rivers in the Indian context. Since the success of this restoration and conservation process is dependent on a convergence of the vision of an able river, scientific understanding, developmental actions and people's involvement, Samarth Ganga rests on the five pillars of concerted action as depicted in Figure 6.

The main objective of establishing the Centre is to develop an integrated river basin management plan for restoration and conservation of the wholesomeness of the river Mahanadi by improving their ecological health substantially which have been significantly affected by the competing human demands for river resource uses in the entire river basin. This entails assessment of existing conditions of the river and preparation of

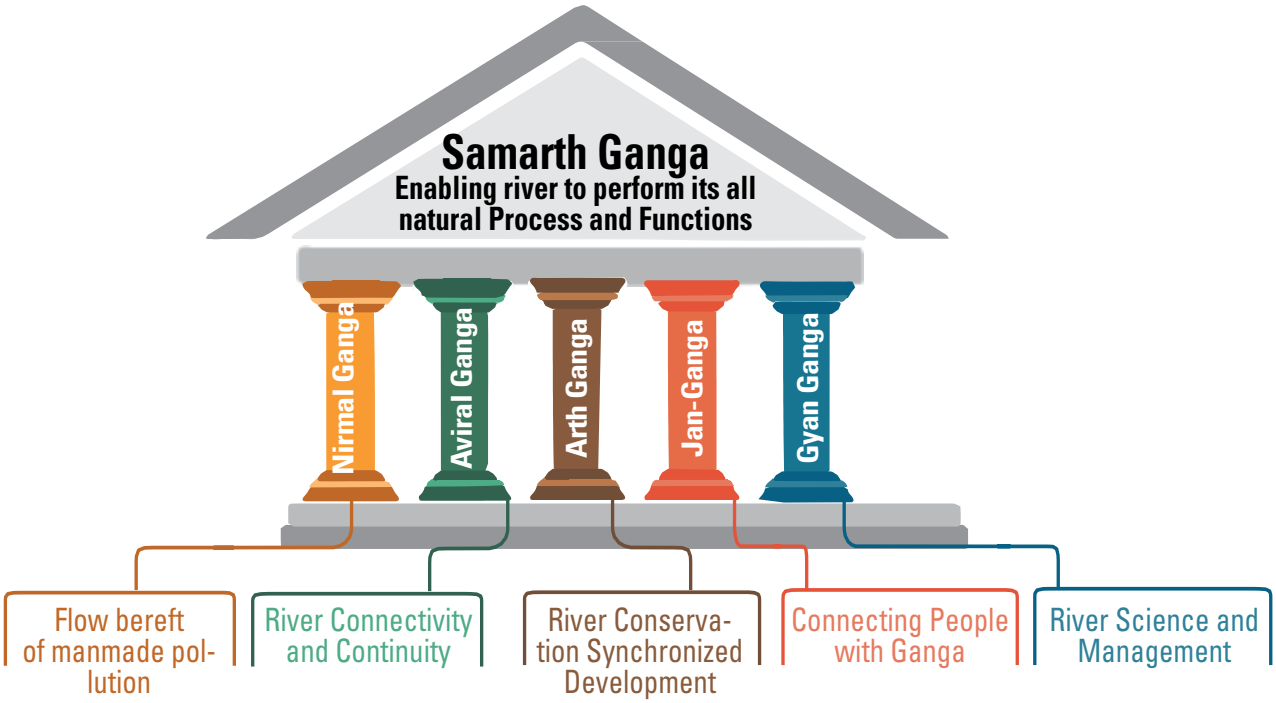


Figure 6. The Concept of Samarth Ganga

a road map/plan for comprehensive rejuvenation and conservation of the riverine ecosystems in their entirety by analyzing anthropogenic impacts on them in detail. In achieving this objective, both essential and desirable characteristics of river such as continuous flow, un-polluted flow, longitudinal and lateral connectivity, and river as an ecological entity need to be included.

The specific objectives include:

a. To assess the geo-morphological, hydro-meteorological, bio-physical, socio-cultural, and socio-economic condition of various ecosystems (wetlands, forests, grasslands, agro-ecosystems. etc.) and human habitations in the entire river basin.
b. To assess the insufficiency or excess of river resources (especially water, sediment, nutrients, flora and fauna, energy, and space) and of pollutants and other harmful materials in different river stretches and tributaries, and identification of stretches where they have been significantly affected by anthropogenic factors.
c. To assess the ecosystem goods and services available from the river and its tributaries for the given river resources and pollutants, and the change in these goods and services over time due to anthropogenic factors.
d. To assess the impact of anthropogenic activities including agricultural, industrial, urbanization, infrastructure, forestry, groundwater abstraction, etc. on the riverine ecosystems and its trends.
e. To assess/ identify non-local and/ or natural adversities (such as geological processes, climate change, etc.) affecting the river basin.
f. To formulate suitable interventions for restoring the wholesomeness of the river including alternative measures in view of possible implementation constraints.

4.3 Scope of work:

Major rivers and their tributaries need to be holistically studied adopting a basin-wide approach considering the major human activities that have been affecting the river ecosystems such as industrialization, urbanization, lifestyle changes, agricultural & other rural activities, deforestation/ denudation, dams/ barrages, engineering flood control measures, infrastructural developments, etc. The Consortium should comprehensively assess all such factors to identify the existing conditions affecting the river ecosystem and suggest future course of actions for their remediation. For each major river and its tributaries, an assessment of its ecological status is to be carried out with verifiable ecological, hydrological, and geomorphological indicators/ parameters (quantitative and qualitative). Spatial and temporal inter-connections between surface waters, groundwater, soil/ sediment, and terrestrial flora and fauna as well as biodiversity of the different ecosystems in the river basin and their eventual contribution to the natural resource base of the river network should be established to evaluate the goods and services expected from hypothetically (or previously) un-impacted (reference state) state of rivers. For resources that mainly come into the river from the larger basin (such as water and sediment) a mass balance (water balance, sediment budget, etc.) over the entire basin and over sufficiently long duration is needed. The impact of human activities in the basin and of direct human interventions in the river networks may then be assessed to evaluate the anthropogenic effects on the river ecosystems and their goods and services in different stretches and at different times. The results may be further qualified by any natural or global factors (e.g. climate change, plate tectonics) that are found to affect the rivers. The role of different stakeholders of the rivers and their importance and roles in reviving and conserving the rivers need to be identified. Along with any additional factors that may be relevant, these findings may be synthesized to formulate a cohesive action plan for integrated basin management of each river.

Some specific themes that may be considered for assessment for specific thematic areas are broadly in line with Ganga River Basin Management Plan – 2015 (cGanga and NMCG, 2015) prepared by Consortium of 7 IITs.

Human activities

in river basins and direct interventions impact river ecosystems and their services. Evaluating anthropogenic effects, considering natural and global factors like climate change, while identifying stakeholder roles in river revival and conservation, is crucial.

4.4 River Basin Organizations and Strategic Plan

Study river basin organizations across the globe and suggest suitable organization, process and strategies for achieving the objective of rejuvenating and conserving the riverine

ecosystems keeping national and local practices, legislative framework, institutional strengths and weaknesses, and stakeholder roles in mind. The study team may review the current legislations (both central and state government) in place in environment protection, rules, regulations from statutory bodies, orders and judgments passed by various courts and tribunals in the country, policies, programmes, etc. for arriving at suitable rejuvenation and conservation strategy.

The focus of the study may include:

- Enhancement of and inclusion in central/ state plans, projects and resources based on basin-wide perspectives to enable river conservation-synchronized development.
- Defining the parameters of and strengthening regional cooperation for the management of interstate rivers.
- Comprehensive monitoring, dissemination and communication of the River Network and Basin conditions.
- Stakeholder-inclusive and Accountable River Basin Organizations.

While preparing the strategic plan the study team may:

- Align with the Strategic Indicators and with Sustainable Development Goals, where relevant to water-related or renewable resource related issues.
- Ensure clarity of meaning, reflecting the Monitoring Parameters that are needed for each issue.
- Only include matters that most resonate with the Basin needs, particularly in relation to resource balance and ecosystem health.
- Distinguish, wherever needed, between overarching outcomes and concepts such as resilience, sustainability, the water, food, and energy nexus, etc. and specific indicators that enable an assessment of status and trends.

4.5 Data Interpretation and Presentation

River Restoration and Conservation is a cyclic process involving many steps as per Data Framework prepared by cGanga (cGanga and NMCG, 2019). The first three steps, namely Understanding, Communication and Negotiation are critical to the overall success, and needs to be done scientifically as well as by engaging with all stakeholders through synthesis of available information and evidence. As such data and information collection, its analysis, and interpretation is the most crucial and resource intensive.

This study is pegged basically on secondary data. Wherever possible the Study Team may use GIS data available to analyze and present the report by using, Satellite ortho-imagery for recent 3 years pre & post monsoon; {High Resolution Multispectral Scanner (MSS) satellite image of 50 cm} including current year. Other relevant data for the individual components mentioned above can be collected from the respective government agencies. In case any specific data required for analysis is to be procured, the Study Team may indicate the same in the approach and methodology to be submitted along with indicative cost of the same.

The Study Team is expected to comprehensively assess the status and specify corrective actions with indicative cost for revival of each component. While addressing the issues, reversible and irreversible conditions have to be clearly brought out in the reports. Also, all interventions that are currently in vogue under various schemes of Central/State/Local Governments and by Non-Governmental Organizations should be taken into consideration while preparing final recommendations. Further the report should indicate the approach for project structuring such as direct government investment, Private investment as part of business or through Corporate Social Responsibility route, and Public Private Partnerships.

The focus of the study may include:

- Basin maps – Drainage, land use/ land cover, soil maps
- All data should be submitted in digital format (e.g. as ".shp"; ".xlsx"; ".dwg", etc. files) wherever possible or in soft version (e.g. as ".doc", ".pdf", ".jpg", etc. files) with proper data tagging and metadata records.

4.6 Assumptions & Constraints:

The proposed study involves two implicit assumptions, namely:

a) Healthy ecosystems within the river basin have positive impacts on rivers through a naturally balanced supply of renewable resources and moderation of harmful inputs, but disturbed/ impacted ecosystems have limited ability to carry out these functions, and hence can affect rivers adversely.
b) Anthropogenic activity generally impacts rivers negatively or neutrally. However, it is possible for anthropogenic interventions to also have positive impacts on river ecosystems – hence interventions can be designed to meet this target.

The work of preparing river basin management plan is envisaged to have the following main constraints:

a) The work is intended to be carried out primarily by analyzing secondary data. However, requisite secondary data may not exist in sufficient detail for all river resources, status of ecosystems, diverse human impacts, evaluation of ecosystem services, and historical information about the rivers and their basins. Hence, wherever necessary, and feasible within the given time frame, primary data may be collected.
b) The legal and institutional framework and financial constraints within which the river restorations can be actually carried out may be complex and difficult to fully assess. Hence different technological intervention options may be considered and compared with respect to their relative merits and demerits.

4.7 Deliverables:

i. Inception Report identifying the substantive issues of the study, proposed methodology, perceived constraints, specific river stretches, tributaries and ecosystems to be quantitatively assessed, and proposed timeline (with milestones giving verifiable and measurable indicators).
ii. Comprehensive assessment of the hydrological, geomorphological and ecological status of the river, river basin and its main ecosystems.
iii. Maps, tables, illustrations, etc. delimitating river resources and ecosystem goods and services available from different stretches of the main-stem river and its major tributaries, indicating stretches with significantly affected resources and diminished ecosystem goods and services.
iv. Scientific assessment of environmental flows (flow quantities with depths, widths, etc. as relevant) for different river stretches and major tributaries.
v. Estimating sustainable river resource uses for both the renewable resources that come mainly from the basin – such as water, sediment and nutrients – and those generated within or intrinsic to the river – such as kinetic energy (stream power), river space (including flow channel, riverbanks, floodplains and hyporheic zone), flora, fauna and biodiversity, and genetic resources.
vi. Formulation of measures to conserve and/or moderate key ecosystems in the river basin such as wetlands, forests, and agro-ecosystems.
vii. Formulation of measures to contain or nullify the negative impacts of ongoing or pre-existing anthropogenic activities in the basin, and also of any non-local or natural adversities as a Strategic Plan for implementation.
viii. URMP, Urban River Management Plans (i.e. how to manage rivers in various Urban Centers), and RRMP, Rural River Management Plans (i.e. how to manage rivers in various Rural clusters) for main stream and its tributaries. Such plans are expected to elaborate on how various central, state, and local governments policies and programmes could be better coordinated and optimally utilized to manage rivers in Urban and Rural areas.
ix. A time-bound Strategic Plan for implementation of the measures along with measurable and verifiable indicators for monitoring, evaluation and feedback control through a well-defined mechanism of participation by all key shareholders for rejuvenation and conservation of rivers.

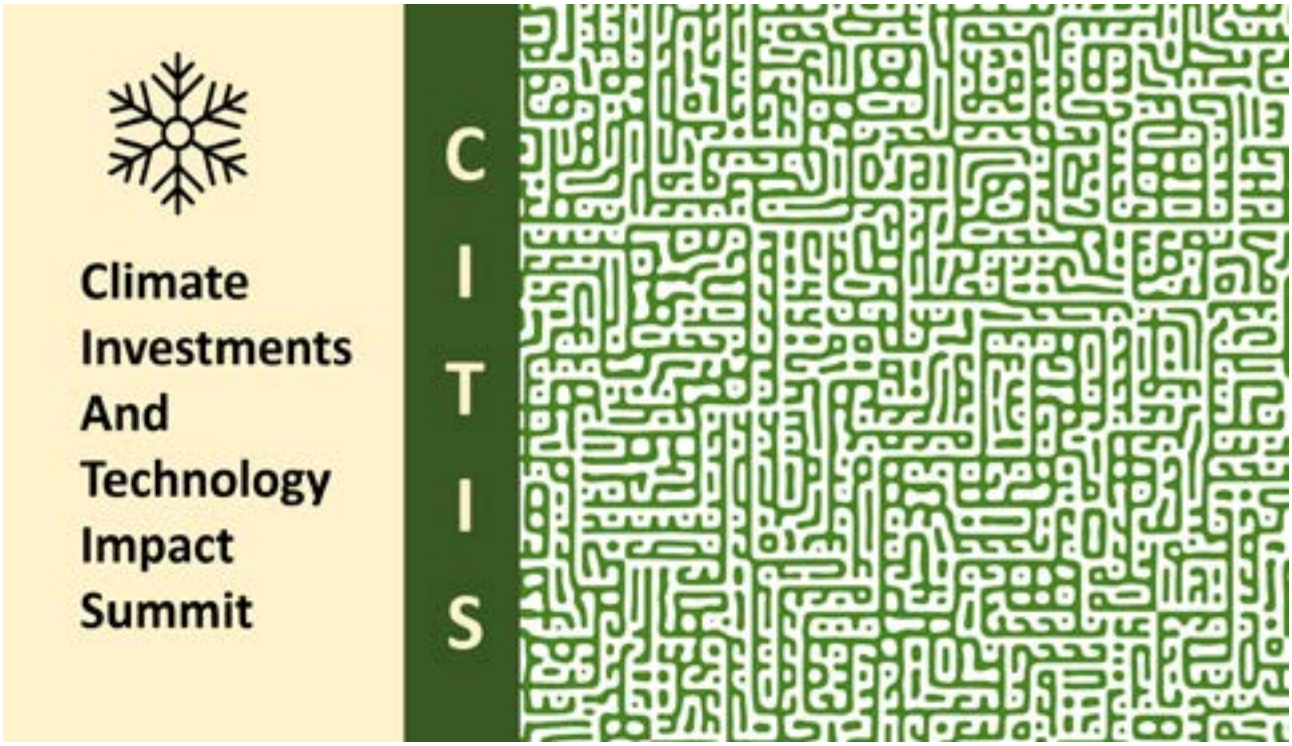
Identification of key shareholders (Central Govt., State Govt., Local Bodies, local communities, civil society organisations, businesses, and citizens, etc.) of the rivers and their roles in river restoration and conservation, and the Desired Institutional Framework and any Policy and/or Legislative changes desired for successful implementation of the Strategic Plan.

References

1. cGanga and NMCG, 2015, *"Ganga River Basin Management Plan (GRBMP)- Extended Summary; Volume 1: Main Plan Document; Volume 2: Mission Reports; Volume3: Thematic Reports"*, January 2015.
2. cGanga and NMCG, 2019, *"Concise Manual and Guide for River Restoration and Conservation"*, December 2019.

CLIMATE INVESTMENTS AND TECHNOLOGY IMPACT SUMMIT (CITIS 2023)

Climate Impact = Deep Technology + Robust Policy + Innovative Finance



1. Showcasing upto 30 disruptive technologies
2. Over 100 climate and impact investors
3. 15 grand climate challenges

TECHNOLOGY AND INNOVATION

CITIS 1, 2 & 3

CITIS 1: Day 1, 1000 - 1130 hrs
CITIS 2: Day 1, 1500 - 1630 hrs
CITIS 3: Day 1, 1700 - 1830 hrs

Innovation plays a key role in the Namami Gange programme. The programme is being used as a platform to both attract technologies from around the world as well as indigenously develop new innovations.

The Environment Technology Verification (ETV) framework developed by cGanga, IIT Kanpur in association with NMCG, Ministry of Jal Shakti, GoI is a unique mechanism to streamline and accelerate the introduction of innovative technologies in the water sector for restoration and conservation of rivers. ETV process provides a single window access to solution providers to bring their innovation to market. Currently over 30 technology companies from 12 countries are enrolled in the ETV process.

A brief on introduction, need, approach and current status are illustrated in Figure 1. ETV is to be viewed as a facilitation mechanism for improving and adopting novel solutions in India, and then down streaming to similar markets. The criteria for adopting in ETV is presented in Figure 2. As illustrated it is not meant for selection or rejection of a solution.

Schematic representation of the outline of ETV Programme, key benefits, process, and eco-system support are presented in Figures 3 – 6.

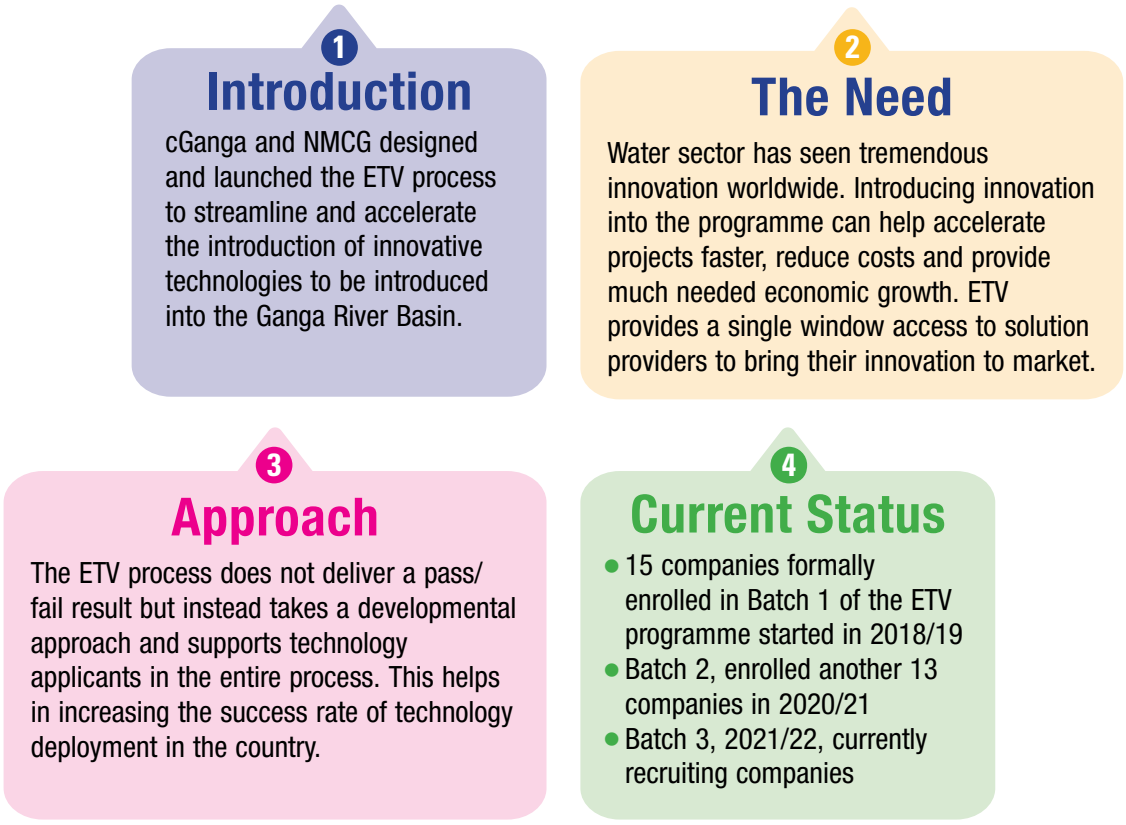


Figure 1: Vision and Status of Developing Environmental Technology Verification (ETV) Process

Figure 2: Criteria for Environmental Technology Verification (ETV)

CURRENT SEGMENTS

The ETV programme shall address issues in a range of segments. For the 2019-2021 phase, the segments are:

Decentralised Systems

- Municipal wastewater treatment
- Industrial effluents treatment
- Bio-remediation systems
- Drinking water supply systems

Data and Information (Digital)

- Data Generation – remote sensing, sensors etc
- Data management and handling
- Data analytics – AI, ML etc

Ancillary Services

- Solid Waste Management
- Sustainable Agriculture
- Sustainable Hydropower
- Energy Recovery / Hydrogen
- Water Resource Management etc
- Inland waterways

GOVERNANCE

- ETV evaluation process is managed by a panel made up of a permanent committee and additional expert members
- The permanent committee is made up of representatives from: cGanga | NMCG | NEERI
- Expert members are selected from eminent institutions and industry. The selection is based on the topic / technology class

PROCESS

The panel reviews the technology applicant and assessment is made on five criteria:

1. State of Technology Readiness Level (TRL)
2. State of Commercialisation (in India) Readiness Level (CRL)
3. Value for money
4. Overall impact
5. KPIs / Criteria for successful evaluation of the pilot

- KPIs are mutually defined as what constitutes success
- The project cost is underwritten by the Government which is re-imbursed on successful execution of the pilot. See ETV Funding and Commercial Framework section for more details

Figure 3: ETV Programme

Pilot Project

Getting access to a pilot project is one of the biggest benefits of the ETV programme. It is either very difficult for new technology proponents to secure projects as they are always asked to show reference site in the country of application (India in this case.)

Developmental Role

Unlike many of the other ETV assessment processes and programmes in India and globally, this process is more developmental. It doesn't deliver a pass or fail certificate but really helps the companies in identifying the gaps in their proposition and supports them in plugging those gaps.

Highly Subsidised Technical Assessment

In most cases a technical assessment exercise can cost significant sums to the technology company. In this case the Government of India massively subsidises the assessment cost.

Project Cost Re-imbursement or Conversion to Service Contract

At the end of successful technology demonstration, the technology company has the option to recoup the funding through cost re-imbursement or through conversion of the project into a service contract. Either ways this commitment makes it easier for the companies to secure funding for the pilot.

Access to Eco-System and Additional Support

The programme supports companies by providing access to a range of experts, grant and funding programmes, potential technology partners and other Government and private sector support initiatives.

Acceleration

This is one of the fastest technology acceleration processes in the environment sector shortening the commercial cycles for the technology companies.

Figure 4: ETV Key Benefits

ETV Enrolment

- Applicants put in an expression of interest
- If the solution is deemed innovative and addresses critical challenges in the Ganga River Basin, then the applicant will be invited to the ETV programme.
- The applicant is required to complete the administrative registration process including payment of a fee.

Identification/ Selection of a Pilot Project and Preparation/ Submission of Pre-Feasibility Report (PFR)

- A pilot project is identified.
- Applicants are required to complete a feasibility report around a project with details on each of the six criteria.
- The report is to be submitted to cGanga and any feedback and comments are provided at this stage.

Preliminary Assessment

- cGanga panel shall review the PFR and provide its feedback to the applicant and its consortium.
- This helps the applicant in fine-tuning their proposition.

Panel Presentation

- The applicant is invited to present to an independent panel of reviewers.
- If the panel is satisfied with the presentation, it will make its formal recommendation to the Government.
- The applicant has the option of nominating an observer on the panel. This makes the process open, transparent and fair.

Confirmation letter from Govt/ NMCG

- Upon receiving the formal recommendation from the panel, NMCG shall proceed on to formally approving the project.
- The letter of support will contain details of cost-re-imbursement (if requested by applicant) and confirmation of licenses / permits /approvals.

Project Development Agreement

- All stakeholders sign a project development agreement.
- cGanga will be the project monitoring agency for all projects implemented under the ETV process.

Figure 5: ETV Process

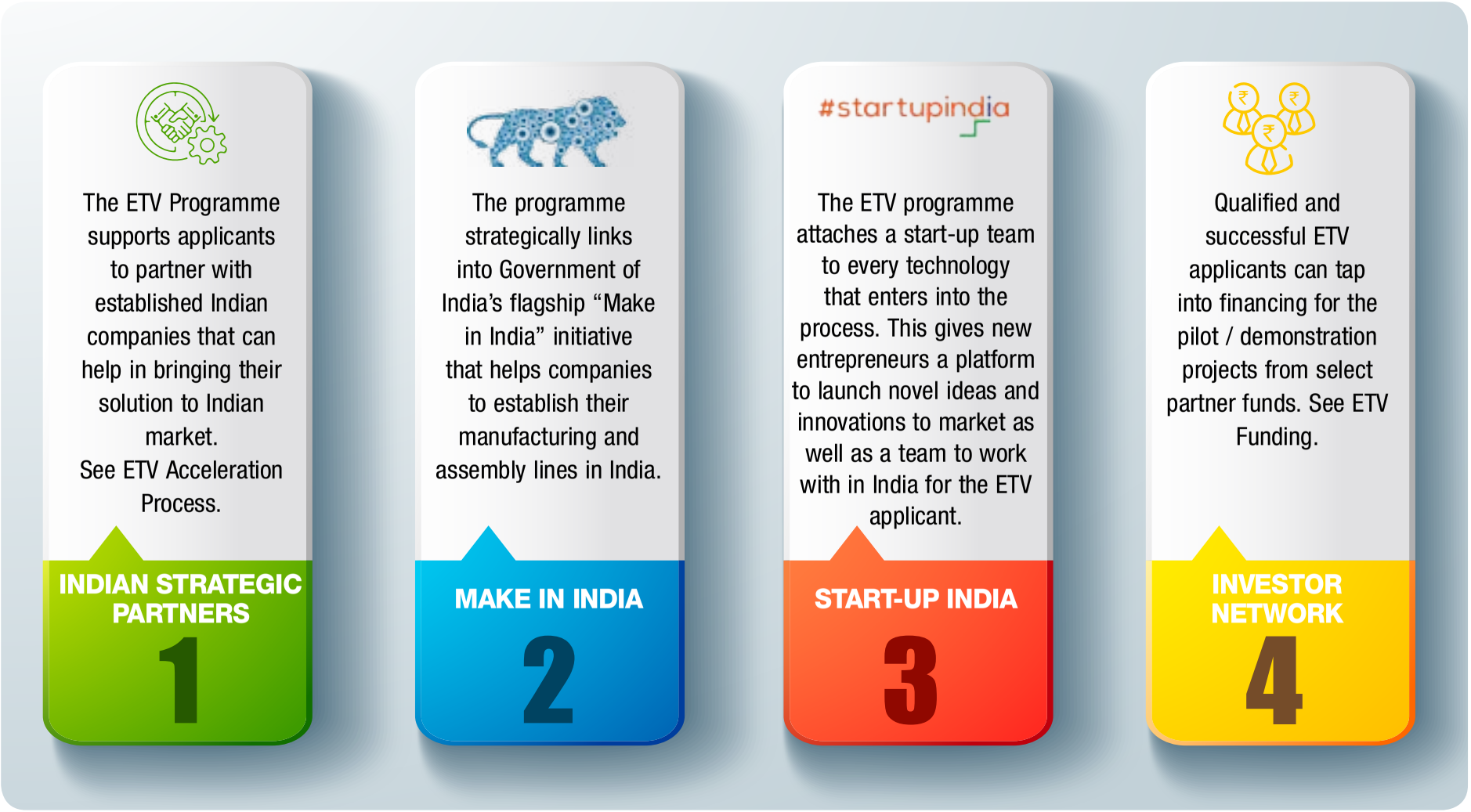


Figure 6: ETV Eco-system Support

The provision of sessions in this track gives opportunities to companies from around the world to showcase their cutting-edge technologies and innovations that have the potential of making a significant positive impact in the river basin. The 2022 Summit will focus on technologies in these areas:

- Digital Water
- Waste to Hydrogen
- Data and Information
- Waste to Biogas
- Decentralized Wastewater treatment
- Carbon Capture in STPs
- Sustainable Agriculture
- Drinking Water Systems
- Sustainable Hydropower
- Energy Efficiency Systems
- Green Hydrogen
- Inland-water Navigation Systems

This edition of IWIS, like the previous ones, will introduce new solutions as well as solutions that were introduced earlier and have made changes based on the feed back given by the ETV Expert Panel as mentioned in Table 1.

Table 1: Tentative list of ETV presentations

S No.	Organisation	Presenter	Technology
1	Hydraloop	Mr Harit Virmani	Extreme Decentralized Water Recycling Solutions for Sustainable Water Smart Cities
2	Paques Environmental Technology India P Ltd	Mr Suchit Dekivadia	Closed loop wastewater treatment for recycled paper industry
3	Planys B.V.	Mr Abhijeet Sangani	Real-time water quality monitoring using IoUT platform
4	Royal HaskoningDHV	Mr. Santosh Kumar Uppal	Innovative Technologies for Sewage Treatment Plants & Sludge treatment
5	WAVIN	Mr. Manish Khandelwal	Solutions for Urban climate resilient cities, making Indian cities ready for future challenges (storm water)
6	SunSource	Ms. Kushagra Nandan	Energy transition through Solar Power, investment in the Renewable Energy sector; Success story in India
7	BiopetroClean	Mr. Devender Fonia	ACT (Automated Chemostat Treatment) Biological Treatment Process PureBI: A Digitization Platform for water and wastewater
8	Akvazen	Mr. Chetan Agarwal	Industrial Effluent – Zero Liquid Discharge

CITIS 4: INVESTING IN WATER | SESSION BRIEF

CITIS 4: Day 2, 1130 - 1300 hrs

Investing in water infrastructure and management is paramount to achieving water resilience and water security on a global scale. As we strive for universal water coverage, it becomes imperative to address the challenges of reducing water pollution and increasing water use efficiency. These objectives are not only essential for safeguarding our ecosystems but also for meeting the growing demands of our burgeoning population. Sustainable investments in technologies and practices that promote cleaner water sources, advanced purification methods, and smart distribution networks are crucial steps in this endeavor. By channeling resources into these areas, we not only ensure the availability of clean water for all but also fortify our resilience against water-related challenges, ultimately contributing to a more sustainable and secure future.

Grand Challenges Presented

1. No water pricing – no water market
2. Tackling industrial effluent problem – organized and unorganized sectors
3. How to develop a comprehensive water data infrastructure

Key Points to be raised:

1. Unlocking the full potential of the water sector in the absence of a water market regulator poses several challenges. Exploring alternatives such as shadow-pricing or proxy pricing mechanisms is a potential solution. However, the local variability of water resources complicates the establishment of a national uniform pricing structure. Learning from international examples of water pricing may provide valuable insights for adaptation in India.
2. Industries extracting groundwater without paying the true industrial tariffs present a regulatory challenge. Leveraging technology can play a pivotal role in regulating the sector. Implementing advanced monitoring systems and real-time data analytics can enable efficient tracking and enforcement of industrial water usage, ensuring fair payment for resources consumed.
3. Monitoring non-revenue water, network losses, and systemic shocks in the water sector requires advancements in technology. The current status of the technology industry in bringing water-related data to the forefront should be assessed. Developing a robust systemic architecture is essential for effective data collection, analysis, and response to mitigate water-related challenges.
4. Investing trends in the water sector exhibit notable patterns. In technology, there is a growing emphasis on innovations for water management. Venture capital and private equity investments are increasingly directed towards water-related startups, reflecting a recognition of the sector's importance and potential for growth.
5. Considering the structure of the water sector in India, the debate between large utility players and decentralized/distributed models is crucial. Assessing the viability of disrupting the sector through decentralized approaches requires a comprehensive understanding of the local context, infrastructure, and resource distribution.
6. Integrating the water sector with emerging industries like green hydrogen and semiconductor manufacturing, which demand high-quality process water, presents opportunities for synergy. Exploring collaborative frameworks and sustainable water management practices can support the growth of both the water sector and these sunrise industries.
7. Addressing the perceived limitation in the pool of project developers and operators in the water sector requires strategic initiatives. Fostering the growth of engineering companies willing to take on long-term operations and maintenance commitments necessitates targeted investments, capacity-building programs, and industry collaboration.
8. Evaluating the experience of the hybrid annuity model in the Indian water sector is crucial for understanding its effectiveness. Learning from past projects can inform future implementations, providing insights into the model's strengths, weaknesses, and potential improvements.
9. Considering the establishment of a market-maker akin to SECI/NTPC in the water sector raises questions about its feasibility and potential benefits. Assessing the specific needs of the sector and studying successful models in other domains can guide the decision-making process for such a market-making entity.

10. Enhancing water use efficiency in the agricultural sector is not just a necessity but a pivotal strategy for India. The country's agricultural landscape heavily relies on water, and improving efficiency can yield substantial gains in resource conservation and economic savings. Agriculture is a primary consumer of water, and inefficient practices lead to excessive water usage, often depleting water sources and contributing to environmental stress. By implementing innovative irrigation technologies, adopting precision farming techniques, and promoting sustainable water management practices, India can achieve a considerable reduction in water consumption while maintaining or even improving agricultural productivity. The ripple effects of such efficiency measures extend beyond immediate resource conservation – they contribute to long-term water security, mitigate the impact of water scarcity, and foster the overall resilience of the agricultural sector in the face of changing climatic conditions. Moreover, the economic benefits derived from water savings in agriculture can be substantial, allowing for the reallocation of resources to other critical areas of development. In essence, prioritizing water use efficiency in agriculture is a holistic and strategic approach that aligns environmental sustainability with economic gains, making it a crucial agenda for India's agricultural and water management policies.

CITIS 5: INVESTING IN ENERGY | SESSION BRIEF

CITIS 5: Day 2, 1400 - 1530 hrs

Investing in the energy sector is pivotal as we navigate the complex journey of the energy transition. Achieving a sustainable future demands a diverse energy mix that combines renewable sources, fossil fuel alternatives, and innovative technologies. In this context, green hydrogen and biofuels emerge as promising game-changers in our battle against carbon emissions. These clean energy sources have the potential to significantly reduce our carbon footprint and offer a bridge towards a more sustainable energy future. Moreover, as we continue to harness renewable energy, the development of efficient energy storage systems takes precedence.

Our goal should be to ensure round-the-clock access to renewable energy, mitigating the intermittent nature of sources like wind and solar power. By directing investments towards these key areas, we can accelerate the energy transition and drive meaningful progress towards a cleaner, more sustainable energy landscape.

Grand Challenges Presented

1. Green hydrogen is essential to reduce emissions in hard to abate sectors
2. Biofuels and Biogas must play a greater role in net-zero transition
3. Enabling Round the Clock green power is essential to decarbonisation

Key Points to be raised:

1. Achieving decarbonization in hard-to-abate sectors presents a formidable challenge, particularly considering the potential rise in input energy costs leading to green inflation. To bring about a paradigm shift in our approach to decarbonization, a comprehensive strategy is imperative. Leveraging blended finance, implementing direct mandates, optimizing procurement efficiencies, adopting carbon pricing mechanisms, and exploring avenues such as energy exports are essential tools. By strategically deploying these levers, we can work towards narrowing the price differential between fossil fuel-based energy and green energy, making sustainable practices economically viable on a larger scale.
2. The responsibility for addressing climate pollution prompts the critical question of who bears the financial burden without causing green inflation. The answer lies in harnessing economies of scale and market dynamics. India, with its vast scale, has the potential to drive down technology costs, rendering green energy more affordable.

This was evident in the success of the solar industry and holds promise for emerging sectors like green hydrogen within the renewable energy landscape.

3. While the biofuels and biogas sectors show promise, the persistent challenge lies in securing a consistent supply of input feedstock. Effectively organizing the supply-side market is key to ensuring the sustainability and growth of these industries, requiring coordinated efforts across stakeholders and robust regulatory frameworks.
4. Technological advancements in the energy sector are crucial for progress towards sustainability. Accelerating the rate of technology commercialization demands a collaborative effort between research institutions, industry players, and policymakers. Streamlining regulatory processes, fostering innovation ecosystems, and incentivizing private investment can contribute to a more rapid and widespread deployment of cutting-edge energy technologies.
5. Enabling round-the-clock power presents technical challenges, and understanding the economics of battery storage and pumped-hydro is essential. Addressing these challenges involves ongoing research and development, policy support for grid integration, and creating incentives for investments in storage solutions that can ensure a reliable and continuous power supply.
6. Despite the national commitment to achieve net-zero by 2070, major energy companies are setting more ambitious targets for 2045-2050. Understanding their strategies to meet these goals involves delving into their plans for technological innovation, renewable energy integration, and carbon offset initiatives, providing valuable insights into the future of the energy landscape.
7. Meeting the capital investment requirements of USD 400-500 billion in the renewable energy sector by 2030 is a monumental task. Unlocking such large sums of money necessitates a multi-faceted approach, including attracting foreign direct investment, fostering public-private partnerships, and creating a conducive regulatory environment that instills confidence among investors. Additionally, exploring innovative financing mechanisms and leveraging international collaborations can play a pivotal role in mobilizing the necessary funds for India's renewable energy ambitions.

CITIS 6: INVESTING IN WASTE | SESSION BRIEF

CITIS 6: Day 2, 1600 - 1730 hrs

Investing in waste management and fostering a circular economy is not just a local or regional concern; it has evolved into a pressing global issue with far-reaching consequences. Municipal solid waste has grown into a formidable challenge that transcends geographical boundaries, bringing forth escalating public health, environmental, social, and economic costs that reverberate worldwide. Moreover, it is crucial to recognize that inadequate solid waste management significantly exacerbates climate change, contributing to approximately 5% of global carbon emissions. This sobering statistic underscores the urgent need for comprehensive solutions. Furthermore, it is disheartening to note that poorly functioning Municipal Solid Waste Management (MSWM) systems are responsible for a staggering 80% of ocean plastic pollution. By strategically investing in advanced waste management practices and embracing circular economy principles, we can mitigate these challenges, reduce carbon emissions, and work collectively toward a more sustainable and cleaner future for our planet.

Grand Challenges Presented in the Panel:

1. End of life-tyres – turning hazard into an opportunity
2. Municipal waste – still far away from being sorted
3. Enabling a structured commodity market for waste

Key Points to be raised:

1. Waste management in India continues to be a persistent challenge, with city landfills reaching their capacity and posing

environmental hazards. The complexity of waste management in the country stems from a combination of factors, including population density, inadequate infrastructure, and cultural practices. Addressing this issue requires a holistic approach that encompasses improved waste segregation, enhanced collection systems, and innovative technologies for sustainable disposal.

2. Examining the economics of waste prompts a critical question: is waste a valuable commodity with intrinsic worth, capable of covering its own management costs, or merely a resource with limited financial potential? Understanding this dynamic is crucial for formulating effective waste management policies and implementing solutions that strike a balance between environmental sustainability and economic viability.
3. While the concept of circularity in waste management is appealing, its practical implementation poses challenges. Achieving a closed-loop system requires comprehensive strategies that encompass product design, recycling infrastructure, and consumer behaviour. Striking a balance between circularity aspirations and real-world limitations is key to making meaningful progress in sustainable waste management.
4. Exploring the possibility of creating a commodity market for trading waste raises intriguing possibilities. Defining the contours of such a market and implementing regulatory interventions to support its establishment require careful consideration. Effective market mechanisms could incentivize responsible waste management practices and contribute to a more sustainable and circular economy.
5. India has the potential to emerge as a global leader in managing specific waste streams, such as end-of-life tires. Innovations in handling complex waste streams are crucial for achieving this leadership position. Understanding and promoting disruptive technologies in waste management can unlock opportunities for sustainable practices and economic gains.
6. Globally, advancements in waste management technologies are shaping the future of sustainable practices. Keeping abreast of these developments and attracting corresponding investments is essential for India to stay at the forefront of innovative waste management solutions. International collaborations and knowledge exchange can play a pivotal role in adopting cutting-edge technologies.
7. Considering a higher gate/tipping fee for the waste asset class in India is a pertinent question. Implementing an increased fee structure could potentially incentivize responsible waste disposal practices and contribute to funding sustainable waste management initiatives. However, careful consideration of economic implications and stakeholder perspectives is necessary.
8. In the midst of these developments, the role of unorganized workers, particularly ragpickers, cannot be overlooked. Safeguarding their interests and integrating them into formal waste management systems is essential. Implementing inclusive policies that recognize the contribution of these workers while providing support and training can ensure a just transition towards more organized and sustainable waste management practices.

CITIS 7: INVESTING IN FOOD AND AGRICULTURE | SESSION BRIEF

CITIS 7: Day 3, 0930 - 1100 hrs

Investing in food and agriculture is a multifaceted endeavor with far-reaching benefits. One promising avenue of investment is in regenerative agriculture, a holistic approach that not only enhances soil health and biodiversity but also reduces the environmental footprint of farming practices. Additionally, investing in innovative agricultural technologies and practices holds the potential to increase farm yields and uplift farmer income, thereby fostering economic growth in rural communities. Furthermore, it is crucial to allocate resources towards agricultural practices and technologies that help reduce agriculture emissions, as this plays a pivotal role in addressing climate change. By channeling investments into these key areas, we can not only ensure food security but also promote sustainable farming practices that benefit both farmers and the planet.

Grand Challenges Presented

1. Top-soil continues to erode at a dangerous rates – how to regenerate
2. Advanced farming can massively increase yields and farmer incomes
3. Farm-waste burning continues to wreak a havoc

Key Points to be raised:

1. Elevating farmer incomes in India hinges on enhancing productivity and establishing direct market connections to minimize intermediary costs. Exploring a range of interventions—technological, economic, and commercial—is essential for empowering farmers. Embracing precision agriculture, leveraging digital platforms for market access, and implementing value-added processing can be transformative. Additionally, interventions such as improved irrigation practices, access to credit, and skill development can contribute to a holistic approach aimed at bolstering agricultural income.
2. The readiness of farmers to adopt advanced farming technologies, including climate-controlled and vertical farms, is a critical consideration. Assessing factors such as technological literacy, infrastructure support, and economic feasibility is essential in understanding and facilitating the adoption of these innovative practices. Tailoring strategies to address specific barriers and providing necessary support can pave the way for the successful integration of advanced technologies into traditional farming practices.
3. Despite the growing interest in sustainable agriculture, organic farming faces several hurdles. Understanding and addressing challenges related to certification processes, market access, and the transition period to organic practices are crucial. Policymakers and stakeholders need to collaborate on creating an enabling environment that encourages the adoption of organic farming and addresses the concerns of farmers.
4. The persistent threat of topsoil erosion to the farming economy necessitates urgent attention. The slow response to this natural catastrophe can be attributed to factors such as limited awareness, inadequate conservation practices, and the need for comprehensive soil management policies. Accelerating efforts to promote soil conservation techniques, raising awareness among farmers, and implementing robust regulatory frameworks can mitigate the impact of topsoil erosion on agricultural productivity.
5. Understanding global technological and investment trends in the food and agriculture sector is essential for shaping strategies in India. Exploring innovations such as precision agriculture, digital farming, and sustainable practices can guide domestic policies and attract investments. Leveraging international collaborations and staying abreast of emerging trends can position India at the forefront of agricultural advancements.
6. Tackling the burning of farm waste in northern India, a significant contributor to air pollution, demands urgent attention. Implementing effective alternatives to crop residue burning, such as mechanized harvesting techniques and promoting biomass utilization, requires coordinated efforts. Policymakers, farmers, and environmental agencies must collaborate to address this critical issue, safeguarding both air quality and agricultural sustainability.

CITIS 8: INVESTING IN TRANSPORT | SESSION BRIEF

CITIS 8: Day 3, 1130 - 1300 hrs

Investing in the transport sector is paramount as we navigate the transformative shifts in mobility and sustainability. A crucial aspect of this investment is accelerating the pace of electric vehicle (EV) charging network expansion. This infrastructure development not only encourages the adoption of EVs but also addresses range anxiety, making electric vehicles a more attractive option for consumers. Furthermore, investments in a dynamic electric vehicle supply chain are essential to support the growing demand for EVs and to ensure a steady and efficient flow of electric vehicles from manufacturing to market. Additionally, the emergence of electric vertical takeoff and landing (eVTOL) vehicles represents a disruptive force in the transport industry. These innovative aircraft have the potential to revolutionize urban transportation, reduce congestion, and lower carbon emissions. By strategically directing investments into these areas, we can propel the transport sector towards a sustainable and technologically advanced future.

Grand Challenges Presented

1. Accelerating pace of EV charging network
2. Establishing a dynamic electric vehicle supply chain
3. Enabling the EVTOL industry in India

Key Points to be raised:

1. The undeniable impact of electric vehicles (EVs) on reducing emissions in the transport sector comes with the prerequisite of establishing a robust charging infrastructure. Simultaneous rollout is crucial to address range anxiety, a significant concern for potential EV users. Identifying and overcoming major impediments to establishing a national charging infrastructure, such as regulatory challenges, funding constraints, and standardization issues, is imperative for the successful adoption of EVs on a large scale.
2. The reliance on rare-earth metals and special minerals in electric vehicle manufacturing raises concerns about industry vulnerability within specific segments of the value chain. To mitigate this risk, the EV manufacturing industry must strategically diversify its sourcing and invest in research and development to explore alternative materials. Developing sustainable and domestically sourced components can enhance control over the supply chain, reducing dependence on rare-earth minerals.
3. The growing issue of certain insurance companies refusing coverage for EVs due to concerns about battery damage leading to complete vehicle write-offs is a noteworthy challenge. Addressing this concern requires collaboration between the insurance industry, manufacturers, and regulatory bodies to develop comprehensive guidelines and risk assessment frameworks that accurately reflect the repairability and resilience of EV components, especially batteries.
4. Electric vehicles extending to other modes of transport, such as Electric Vertical Take-Off and Landing aircraft (EVTOLs), signify the expanding scope of EV technology. Assessing the Indian ecosystem's readiness and progress in adopting EVTOLs, considering factors like regulatory frameworks, infrastructure development, and industry collaboration, is pivotal for understanding the potential of this innovative transportation solution.
5. The prospect of India becoming a global manufacturing hub for EVs en masse hinges on several factors, including policy support, infrastructure development, and industry collaboration. Fostering an environment conducive to investment, encouraging research and development, and streamlining regulatory processes can position India competitively in the global EV manufacturing landscape.
6. Understanding global technological and investment trends in electric vehicles is essential for staying at the forefront of industry advancements. Exploring innovations such as battery technology, charging infrastructure, and autonomous features can guide domestic policies and attract investments. Keeping abreast of emerging trends, such as solid-state batteries and vehicle-to-grid integration, ensures that India remains aligned with the evolving landscape of global EV technology.

ENGAGE WITH US

A. Engagement Models during the Summit

The Summit is a great multi-disciplinary platform to showcase your efforts, solutions, knowledge through a range of strategic engagement plans. These are:

Strategic Partnerships

This engagement mode is for Government departments at all levels (central, state, municipal), public sector entities, multilateral institutions, NGOs, and foundations who wish to deepen their strategic engagement with India for the River Restoration and Conservation programmes. It could entail releasing a special report, initiating a project, highlighting select areas of work or other initiatives.

Sponsorship

For private sector companies or entities wanting brand recognition, the Summit offers a multitude of opportunities including but not limited to hosting networking events, display of special solutions and other showcases. Please get in touch with the Summit team for more details.

Technology and Innovation Showcase

Companies or organizations that have developed solutions, which have the potential of high impact in Indian River Basins, can get an opportunity to present to stakeholders, potential Indian partners and investors.

Knowledge Partners

Professional Service Firms and Knowledge-oriented institutions are invited to partner with cGanga and NMCG to prepare and launch a number of special reports during the Summit as well as curate and organize the various Summit sessions.

B. Ongoing Engagement Models

There are various ongoing engagement models that enable partners to find various touch points with the Ganga River Basin. These are:

1

Working Groups and Task Forces

Interested parties can channel their novel ideas through dedicated task forces and workinggroups. These groups have in-depth deliberations which are summarised in the form of white-papers submitted to Government and various stakeholders. The working groups are a sub-set of5 major task forces: (i) Science & Research (ii) Engineering & Operations (iii) Technology,Innovation, Entrepreneurship & Skills (iv) Policy, Law & Governance (v) Finance & Investments

2

Pilots / Demonstration Projects

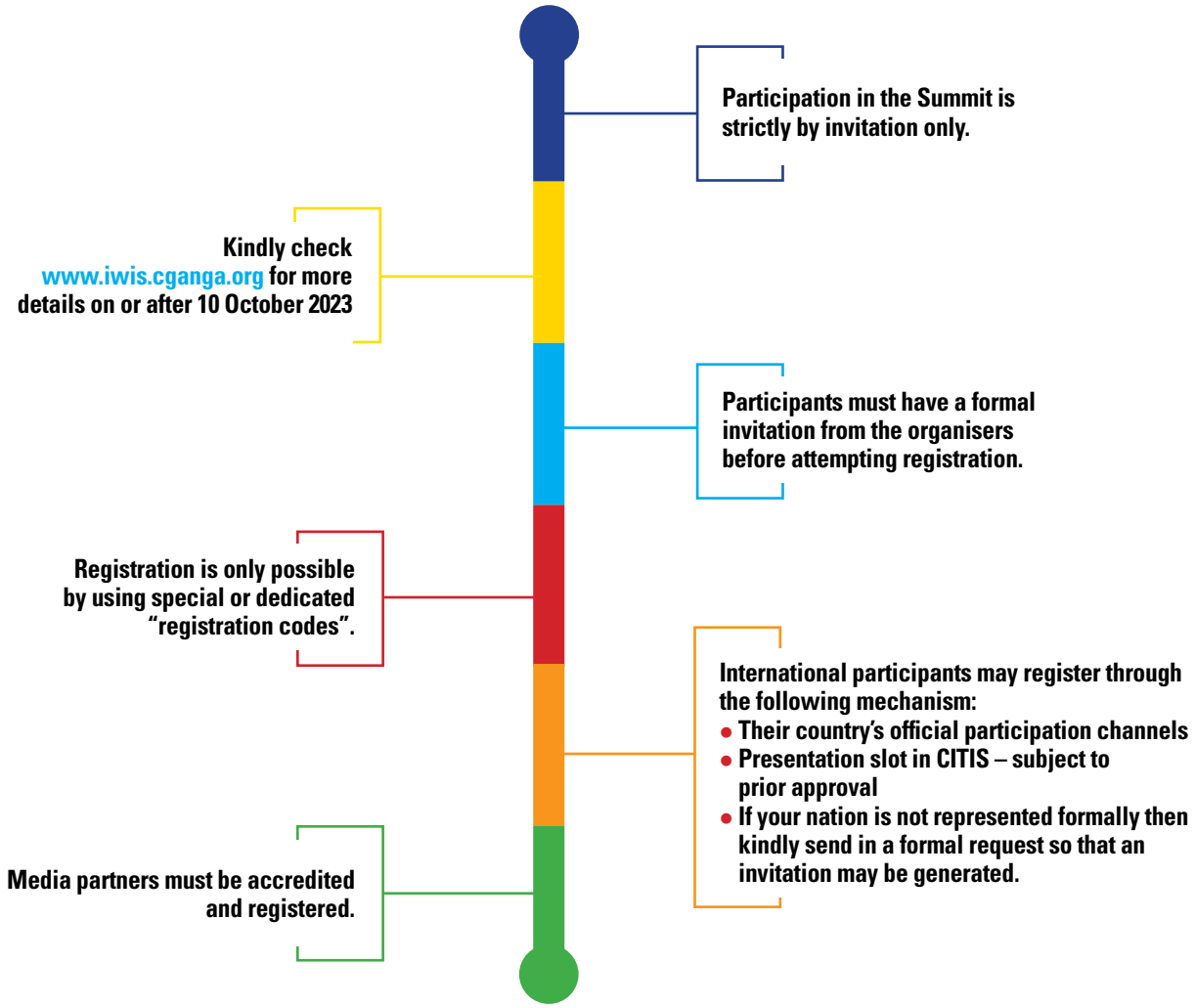
Companies interested in introducing their solutions into the River Restoration and Conservationprogrammes can do so through pilot/demonstration projects. They must however first gothrough the Environment Technology Verification (ETV) process. This allows stakeholders toassess the technologies and ascertain value for money.

3

International Chapters and Roadshows

cGanga and NMCG regularly conduct international roadshows to increase the outreach andawareness. Additionally, countries can establish their own local country chapters to channel theircollective innovations and interests into India.

REGISTRATION AND PARTICIPATION IN THE SUMMIT



REGISTRATION FOR YOUR PARTICIPATION

- All invitations to the Summit shall be issued during 15-30th October 2023.
- If you have not received the invitation, then please get in touch with the Summit organizers.
- The links to the registration process is on through www.iwis.cganga.org.

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