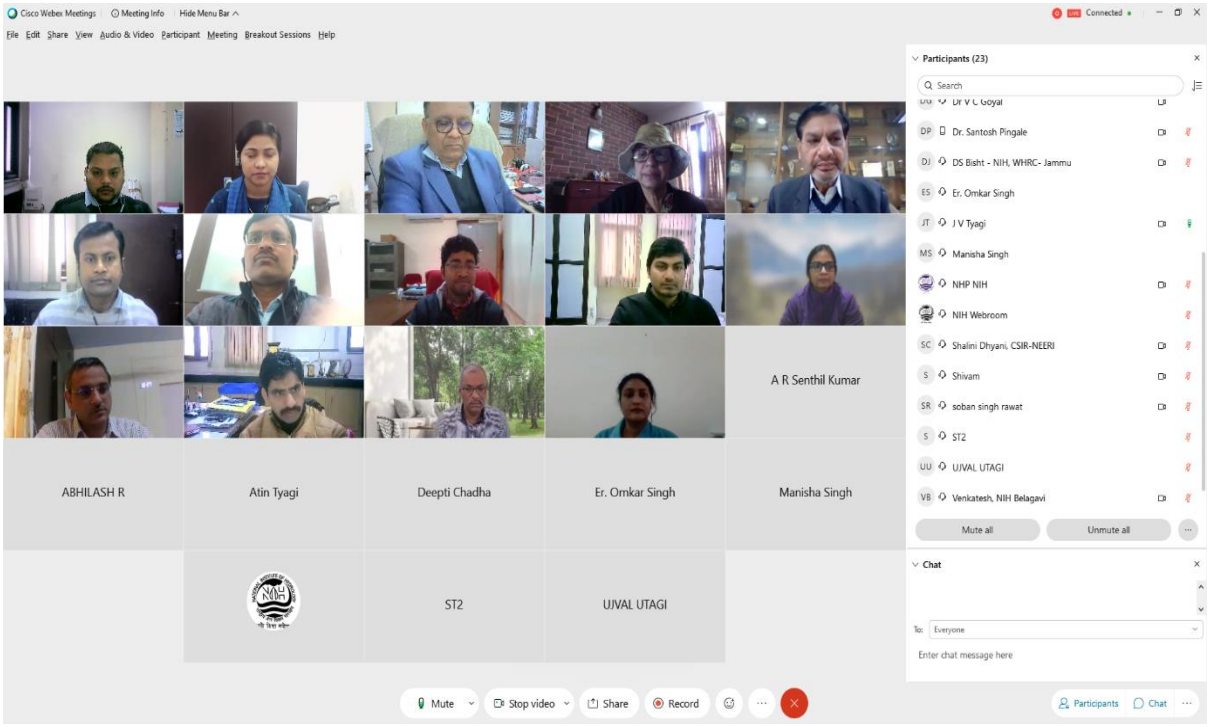
United Nations Educational, Scientific and Cultural Organization

Indian National Committee for Intergovernmental Hydrological Programme

National Institute of Hydrology

Report of the 01-day webinar
on

"Ecohydrology-Engineering Harmony for a Sustainable World"



27 January, 2021

Organized by:
National Institute of Hydrology, Roorkee

Under the aegis of
Indian National Committee for
Intergovernmental Hydrological Programme (INC-IHP) of UNESCO

Background

Water and forests both cover large portions of the earth and both are crucial to the sustenance of life and the environment. Water and forest are not two independent natural resources; a close linkage exists between the two. Forest ecosystems generate multiple benefits to society through a wide range of products for consumption and use. With population growth, climate change, and increasing forest disturbance, understanding the complex relationships between forests and water is the key to sustaining future forest resources, aquatic habitats, and water supplies. Research into forest and water interactions continues to expand our understanding of hydrological processes and our ability to assess the hazards associated with natural and human-related forest disturbances. Many agencies and scientific communities have carried out experimental research in understanding the benefits of forest and water, felt that there is a need for inter-disciplinary research for generating an in-depth understanding of the complex relationship of water and forest under the declining forest cover and changing climate. The conceptual framework of ecohydrology offers a standardized approach to classifying and quantifying the anthropogenic impact on natural resources in ways that are meaningful in quantifying hydrological, ecological, and socio-economic terms.

In India, there have been several isolated attempts being made by various Govt. research agencies, NGOs, and academicians to evaluate the impact of reducing forest cover and changing climate on the water, ecology, and socio-economic condition of the region. These studies have been concentrated in a small pocket located either in the Himalayas or in the Western Ghats. The results of these researches have not been properly disseminated to the policymaker and respective line departments of the states covering these regions for effective implementation in the field. Thus, there exists a gap between the researcher, the policymaker, and implementation agencies. This gap can be filled by bringing all of them to a common platform where the researchers, policymakers, and implementing agencies can interact, deliberate on important issues of their region.

Objectives

Against this backdrop, the Indian National Committee for Intergovernmental Hydrological Programme (INC-IHP) in cooperation with the National Institute of Hydrology (NIH), Roorkee

(Uttarakhand) organized a 01-day webinar on 27th January, 2021 on the Cisco Webex platform. This webinar aimed to particularly cover theme#5 of the IHP-VIII framework *i.e.* "Ecohydrology- Engineering Harmony for a Sustainable World" to provide the audience with state-of-the-art knowledge on the following issues:

1. *Hydrological issues of a catchment*– understanding relationship vegetation versus surface and groundwater for a sustainable development
2. *Urban Ecohydrology*– stormwater purification and lake health for improvement of health and quality of city life
3. *Wetland conservation*
4. *Ponds/lakes/reservoir Ecohydrology*
5. *CoastalEcohydrology*– Eco hydrological regulation for sustaining and restoring continental to coastal connectivity and ecosystem functioning

Topics covered during the webinar

- Hydrological dimension of a catchment- identification of potential threats and opportunities for sustainable development
- Shaping of the catchment ecological structure for ecosystem potential enhancement- biological productivity and biodiversity
- Ecohydrology for wetland conservation
- Ecohydrology system solution and ecological engineering for the enhancement of water and ecosystem resilience and ecosystem services
- Urban Ecohydrology stormwater purification and retention in the city landscape, potential for improvement of health and quality of life
- Eco hydrological regulation for sustaining and restoring continental to coastal connectivity and ecosystem functioning

The detailed schedule of the webinar is given at **Annexure-I**.

Invited speakers of the webinar

S.N.	Name of speaker	Designation
1.	Prof. Shivam Tripathi	Associate Professor, Dept. of Civil Engineering, IIT, Kanpur
2.	Dr. Asha Rajvanshi	Senior Professional Fellow, WII, Dehradun
3.	Dr. Shalini Dhyani	Senior Scientist, CSIR-NEERI, Nagpur
4.	Er. Rohit Sambare	Scientist- 'B', NIH, Roorkee
5.	Dr. B. Venkatesh	Scientist- 'F', HRRC, NIH, Belagavi
6.	Dr. Victor R. Shinde	Sector Coordinator, NIUA, New Delhi

The brief profiles of the invited speakers are given at **Annexure-II**.

Participants of the webinar

The webinar was open for all interested audiences. It was hosted on WebEx platform and also live-streamed on the social media pages (Facebook and YouTube) of the institute. About 4142 people were reached through social media platform and more than 300 people attended live. The sessions of the webinar were recorded and hosted at Institutional Digital Repository (IDR) link http://117.252.14.250:8080/jspui/handle/123456789/313 , so that interested people can access the presentations.

Session details of the webinar

In the opening session, Member-Secretary of INC-IHP Dr. V.C. Goyal welcomed Dr. J.V. Tyagi, Director, National Institute of Hydrology, Roorkee, and Chairman of the INC-IHP, resource persons, and all the audience. Firstly, Dr. Goyal gave a brief introduction of the International Hydrological Programme (IHP) and its various activities. As IHP was started in 1975 after the completion of the International Hydrological Decade (IHD) and implemented on six-year programmatic time intervals or phases, he also briefed about its eighth phase (2014-2021), which is focused on "Water Security: Responses to Local, Regional, and Global Challenges". After completion of this phase, IHP-IX is proposed (2022-2029) with a theme of "Science for a Water Secure World in a Changing Environment". He also outlined the various themes of IHP-VIII. Further, Dr. Jyoti P. Patil, Deputy Coordinator of INC-IHP introduces the audience to this webinar. She talked about the significance of ecohydrology and the need of organizing this type of webinar. Ecohydrology is an interdisciplinary scientific field studying

the interactions between water and ecological systems. It is considered a sub-discipline of hydrology, with an ecological focus. She also discussed the objectives, topics that were covered, and the invited speakers.

Dr. J.V. Tyagi, Director, and Chairman, INC-IHP also outlined the importance of ecohydrology in the present scenario. In his opinion, this discipline has developed rapidly in the past two decades in response to watershed ecological degradation and environmental changes. He emphasized that linking ecohydrological processes to ecosystem services (carbon sequestration, water quality improvement, biodiversity conservation, regulation of water and nutrient cycles, *etc.*) is critical to properly quantifying ecosystem functions and services. An understanding of the ecosystem and potential interaction between ecosystem functions and services is especially important for projecting future ecosystem responses to climate change, land-use change, change in environmental management options, and human disturbances like- forest fires, urbanization, *etc.* In the face of increasing climate instability, demographic growth, and human migration, there is an urgent need to reverse the degradation of water resources and enhancing biodiversity by lessening the ecological threats and maximizing greater harmony within catchment processes using the general principles of ecohydrology.

At last, he wished the organizers for the successful conduction of this 01-day webinar.

The first lecture of this webinar was delivered by Prof. Shivam Tripathi on the topic "Ecohydrology for engineering applications: A hydrologic perspective". In the first slide, he gave an outline of his presentation. Firstly, Prof. Tripathi discussed the basic concepts of ecohydrology with its various definitions. He talked about three ecohydrological perspectives- flux partitioning, invasion of alien plant species, and streamflow alterations. In his opinion, the measurement of transpiration is not only difficult at larger spatial scales but even at a regional scale. If someone asks what is the proportion of evaporation and transpiration over rice-wheat system practiced over the Ganga basin? We don't have its answer. Further, he discussed one of his studies that he conducted in an attempt to partition evapotranspiration components of ET for a wheat system in IIT, Kanpur campus with the objectives of to partition soil evaporation and plant transpiration. The study site had an automatic weather station (AWS) with the usual meteorological parameters. The results showed that soil heat flux was in positive correlation with solar radiation. Temperature and relative humidity (RH) were also measured at 2 different

heights *i.e.* 2 m and 3 m above the ground level. The temperature was found to be greater at the height of 3 m and vice-versa in the case of RH. Although, there are also some limitations of this approach, which are as follows:

1. Hydrometric method provides point estimate; so upscaling requires multiple measurements,
2. Stable Isotope method for plot-scale ET partitioning, and
3. Results for only one season; more detailed long-term experiments are desirable

Further, he talked about the alien plant species giving the example of Parthenium. It is also known as Gajar ghans/gaajari, chatak chandani, and a native of America but now widespread in about 48 countries in Africa, Asia, and the South Pacific. They produce a large number of long-lived seeds that have an adverse effect on humans, crop productivity, livestock, and biodiversity. But their hydrological effects are not known. So, it may be a thrust area for new research for hydrologists. In the last, he discussed the streamflow alterations giving the example of afforestation in the light of the Forest Conservation Act (1980). If riparian corridors are planted with suitable plant species, it would be beneficial in continuous streamflow.

The second lecture of the morning session was delivered by Dr. Asha Rajvanshi on the topic "Consideration of biodiversity and ecosystem services in the planning and implementation of hydropower projects". Firstly, she gave an outline of the presentation and quickly described the term "Biodiversity" and its business connect. She emphasized that we are inextricably and wholly dependent on varied benefits provided by the natural environment and from healthy ecosystems for human wellbeing. Further, she briefly discussed the broader classification of ecosystem services. We all know the Asian tsunami that came many years ago and one of the finest examples is illustrated by the role that mangroves playing there. In the coastal areas that had mangrove forests, the impact of the tsunami was not felt. In her opinion, the ecosystem benefits for development have to be managed. The development is going to be fair only if we can manage and protect (or sustain) these benefits. She also discussed the construction of hydroelectric dams and their impact on the reduced water quality in a river system. This transforms a free-flowing river into a lake. The floodplains, the kind of agricultural productivity there, the loss of land, migration of people from the project site, *etc*. are the crisis that is linked to a single developmental project.

In the end, she concluded that protection of biodiversity and the flow of the rivers are vital during the planning of developments in the hydropower sector for sustaining ecosystem services. SEA can also support better management of cumulative effects arising from uncoordinated planning of developments in major sectors like hydropower. Regional assessment aided in policy formulation and in the enactment of new legislation for ensuring the continuity of the river flow.

Subsequently, Dr. Shalini Dhyani delivered the presentation on the topic "Eco-hydrology supported Ecological Engineering for regulating water benefits and enhancing resilience in the warming world". In the initial slides, she talked about various international programmes (especially water-related) that are being run to conserve ecosystems. In brief, she also discussed the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) assessment report on Land Degradation and Restoration (2018) that says "when our ecosystems are intact that means they are healthy, we have all kind of ecosystem benefits been nicely supplied for human well-being ". There is an emerging need to understand the ecohydrological process that will be very instrumental in dealing with various challenges we are facing in recent times. In her opinion, both biota and hydrology are interrelated. There is a need for harmonization of ecohydrological measures by necessary hydro-technical infrastructures. These structures don't mean only civil engineering grey structures. Further, she showed some of the studies that she conducted in the Indian Himalaya Region (IHR). To properly address environmental degradation, nature-based solutions (NbS) like ecological restoration, ecosystem-based adaptation, green infrastructure, *etc.* are the need of the hour.

In her concluding remarks, she said that there is a growing need to communicate the societal relevance of ecohydrology in ecological engineering planning to the public, practitioners as well as policymakers. Develop a path forward to ensure ecohydrological research is mainstreamed and results are used effectively in NbS/ecoengineering applications.

The first presentation of the post-lunch session was delivered by Er. Rohit Sambare on the topic "Ecohydrology for wetland conservation". Firstly, he discussed the relevance of wetlands with their various definitions and broader classification. In his view, wetlands are the connecting link between ecology and hydrology. He briefly discussed the Ramsar Convention that was signed on 2nd February, 1971. It is the first intergovernmental panel for conserving key wetlands

globally and we will observe the 50th world wetland day this year. Further, he spoke about various Ramsar sites across India including the 5 new sites that have been included in this list last year. On one hand, it is a source of freshwater, acts as a shock absorber against natural hazards like- heavy rainfall, high tides, storm surges, floods, *etc.*, while in another hand it is beneficial in providing timber, vegetable oil, medicinal plants, the raw material for weaving and fodder for animals. He also talked about East Kolkata Wetland (EKW) and Upper Ganga River (Brijghat to Narora stretch) in Uttar Pradesh. Both the wetlands provide innumerable ecosystem services. The first one was previously used only for fisheries purposes but research found that it also acts as a natural sewage treatment plant for the city.

In the end, he discussed the various threats to wetlands. Water diversion through dams and canals, excessive nutrients due to high water and air pollution, excessive floods, loss of mangroves and corals due to high commercial use, *etc.* are some of them. Nearly 90% of the world's wetlands lost since the 1700s, those remaining are disappearing three times faster than forests. Quantification of nutrients flowing into wetlands and estimating the carrying capacity of wetlands should be carried out. There is also a need to study the geomorphology, lithology, and hydrogeology of wetlands and its catchment. We should use wetlands sustainably by involving local stakeholders, by preparing the inventory and its proper management and impact assessment and development.

Subsequently, Dr. B. Venkatesh gave an interesting presentation on the topic "Measurement and modelling of hydrologic regimes under different land covers in Sahayadri mountains, India". He presented one of his research works about the impacts of changing land cover on the hydrologic regime of Uttara Kannada district of Western Ghats. For this study, he chose *Acacia* plantations. In the beginning, he gave an outline of the presentation and tried to point out that the hydrological effects of afforestation to improve or restore hydrological behavior have not been studied yet. Further, he showed his findings that the temporal and spatial distribution of soil moisture is mainly dependent on the soil and land cover. The highest peak flow magnitude was observed in the degraded watershed, followed by *Acacia* in comparison with the forested watershed.

Lastly, he concluded that the *Acacia* plantation was very helpful in restoring the hydrologic process which was deteriorated due to degradation of the landscape to the level of natural forest

over a period of time and also ameliorates the soil physical and hydraulic properties. It helps in building up soil moisture and moderates the peak flow and increases the low flow quantities.

The last presentation of this webinar was delivered by Dr. Victor R. Shinde on the topic "Stormwater Management in Urban Settings". It was a very pertinent topic as we often witness how the poor and haphazard urban planning is compounding problems from excessive rain across the country. In the initial slides, he showed some statistics. As per the 2018 report of SEEDS and the Centre for Research on the Epidemiology of Disasters (CRED), 56% of Indian cities are prone to floods. In 2018, India lost 1,808 lives and suffered losses worth an estimated Rs. 957 billion (Rs. 95,736 crores) due to floods across the country (Rajya Sabha data, 2018). The key challenge in urban centers is to control floods as well as groundwater recharge. As both are corresponding to each other, by regulating one, the other will be automatically balanced. Further, Dr. Shinde comprehensively discussed the protective measures that can be taken to minimize the impact of stormwater. Conventional solutions (grey infrastructures) like dams, stormwater drains, surface reservoirs, *etc.* are the most common response to the water management challenges. Besides these, green infrastructures (GIs) like wetlands, green roofs, permeable pavements, urban forests, *etc.* could also be beneficial as it is associated with supplementary ecosystem services. Apart from water management benefits, GIs are instrumental in carbon sequestration, biodiversity benefits (including pollination), improved air quality, climate regulation, *etc.*

In the end, he talked about the planning part of GIs. By social inclusion in this part, the effectiveness could be improved. He also discussed one of Berlin's most well-known community gardens, the Prinzessinnengarten, which is co-managed by a small team of employees and hundreds of volunteers on land rented from the Friedrichshain-Kreuzberg municipality.

In the end, Er. Rohit Sambare, one of the coordinators of this 01-day webinar gave a vote of thanks.

Annexure-I

WEBINAR SCHEDULE

Time	January 27, 2021 (Wednesday)	Faculty/ coordinator
1000 hrs-1015 hrs **Opening Session**	Welcome and About INC-IHP Introduction to Webinar Address by Chair	VCG JPP Director, NIH
1015 hrs-1105hrs	Ecohydrology for engineering applications: A hydrologic perspective	ST
1105hrs-1155hrs	Consideration of biodiversity and ecosystem services in the planning and implementation of hydropower projects	AR
1155 hrs-1245hrs	Ecohydrology supported ecological engineering for regulating water benefits and enhancing resilience in the warming world	SD
1400 hrs-1450hrs	Ecohydrology for wetland conservation	RS
1450 hrs-1540hrs	Measurement and modelling of hydrologic regimes under different land covers in Sahayadri mountains, India	BV
1540 hrs-1630 hrs	Stormwater management in urban settings	VS
1630hrs-1645hrs	Closing and Vote of thanks	RS

AR	Dr. Asha Rajvanshi (WII)	BV	Dr. B. Venkatesh (NIH)
JPP	Dr. Jyoti P Patil (NIH)	RS	Rohit Sambare (NIH)
SD	Dr. Shalini Dhyani (CSIR-NEERI)	ST	Prof. Shivam Tripathi (IIT Kanpur)
VCG	Dr. V.C. Goyal (NIH)	VS	Dr. Victor R Shinde (NIUA)

Annexure-II

Brief profile of invited speakers

Prof. Shivam Tripathi

Prof. Shivam Tripathi is an Associate Professor of Civil Engineering at the Indian Institute of Technology, Kanpur. He works in the area of hydrological processes and their interactions with climate, vegetation, and soil. His work combines experimental research with mathematical modeling. He has developed algorithms to engage measurement uncertainties in hydroclimatic modeling and has also worked in characterizing and predicting extreme hydrological events. He has earned his doctoral degree in civil engineering from Purdue University, USA.

Dr. Asha Rajvanshi

Dr. Asha Rajvanshi is a Senior Professional Fellow at the Wildlife Institute of India Dehradun, after her superannuation from the position of Scientist 'G' at the same institute. She has over three decades of professional standing as a teacher, trainer, researcher, impact assessment practitioner, and EIA reviewer for the federal government of India.

Dr. Rajvanshi has played the lead role in developing and encouraging mainstreaming tools for integrating biodiversity in impact assessment in India and the region. She has been also credited to promote EIA Strategic Environmental Assessment (SEA); Cumulative Impact Assessment; Sustainable land-use planning; Smart Green Infrastructure and mitigation planning for promoting wildlife-friendly development projects.

Dr. Rajvanshi has provided professional support in EIA and SEA initiatives led by UNEP, the World Bank, IUCN, IAIA, CBD, GIZ, and ADB. She has been one of the contributors to the global Millennium Ecosystem Assessment and has served Govt. of India nominated an expert on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), for the Regional/subregional assessments on biodiversity and ecosystem services for Asia and Pacific region. She is presently also a member of the task force for capacity building for IBPES.

She has served for over two decades on the ‘Expert Appraisal Committees of Development Projects’ of the Ministry of Environment, Forest and Climate Change, Govt. of India, and also on the national committee of the Quality Council of India for developing accreditation system for EIA consultants in India.

Dr. Asha Rajvanshi is a recipient of the prestigious Lifetime Achievement Award from the International Association from Impact Assessment for the year 2019 for her sustained efforts in promoting EIA.

Dr. Shalini Dhyani

Dr. Shalini Dhyani is a Senior Scientist in the Critical Zone Research Group of Water Technology and Management Division in CSIR-National Environmental Engineering Research Institute, Nagpur. She is South Asia Regional Chair for IUCN CEM (Commission on Ecosystems Management) and IPBES Lead Author for thematic assessment on Sustainable Use of Wild Species. Her work focuses on biodiversity inclusive impact assessments, the impact of climate change on species and ecosystems, and climate-sensitive restoration planning by promoting Nature-based Solutions for reducing disaster risks and enhancing climate resilience.

Er. Rohit Sambare

Er. Rohit Sambare is a Scientist- ‘B’ at the National Institute of Hydrology, Roorkee. He completed his Bachelors' in Engineering (B.E.) in Civil Engineering from Nagpur University, Maharashtra. His Master's of Technology (M. Tech.) is in Remote Sensing and GIS with Water Resources as a specialization from Indian Institute of Remote Sensing (IIRS-ISRO) Dehradun. Previously he worked as Junior Research Fellow at Uttarakhand Technical University Dehradun and Design Engineer (Flood Modelling) at Waterco Consultants India Private Limited, Hyderabad, a subsidiary firm of Waterco Consultants, United Kingdom. Currently, his work is based on water conservation and water harvesting structures, Ecohydrology, and Mitigation measures for water pollution.

Dr. B. Venkatesh

Dr. Venkatesh completed his BE in Civil Engineering from BDT College of Engineering, Davanagere, in 1988 and completed his Master's degree with the specialization in Hydraulic and Water Resources from Karnataka Regional Engineering College (Presently NIT) Surathkal in 1991. Presently he is working as Scientist 'F' and Head, Regional Centre of National Institute of Hydrology from 2003 till date. During his tenure at the National Institute of Hydrology, he has published more than 80 technical papers in national and international Journals, seminars/symposia. In addition to that, he has been involved in various projects sponsored by Govt. of India and various other international agencies, to note some of them are;

During his tenure as a Scientist, he has completed more than 40 technical reports, 9 international/national sponsored projects, 10 consultancies, and about 100 technical papers in national and international referred journals. He also edited a book on "**Forest Hydrology**". He has supervised the work of 6 Ph.D. students, and about 15 M.E. /M. Tech project dissertation works are completed.

His research interests are broadly in the area of Rainfall-runoff modeling, Forest hydrology with special emphasis on dynamics of soil moisture, assessing the impact of climate change, modeling of flood dynamics. His work has received extensive funding from DST, MoES, MoEF&CC, UNESCO, Ford Foundation, and the Ministry of Water Resources. He has also been a consultant to several organizations including KPCL, Govt. of Karnataka, Govt. of Maharashtra, NTPC, Govt. of Madhya Pradesh, and NPCL.

From 1999 onwards, he has been involved in imparting training to the Engineers from Water Resources Department from different states *viz.* Andhra Pradesh, Karnataka, Kerala, Maharashtra, and Tamil Nadu on Hydrological data monitoring and processing using dedicated softwares such as SWDES and HYMOS.

Dr. Victor R. Shinde

Dr. Victor has more than 13 years of work experience—both professional and academic—in the environmental sector in six countries, in Asia and Africa, of

which the last seven years have been in the water sector. He is currently based in New Delhi working at the National Institute of Urban Affairs (NIUA), which is the think tank of the Ministry of Housing and Urban Affairs. He manages NIUA's work related to water and the environment. Concurrently, he is also a senior research specialist in Water Engineering and Management at AIT. He specializes in 'urban water' issues, particularly in relation to supply-side and demand-side engineering and management of water, and has worked on prestigious projects funded by APN, CGIAR, CTCN, and UNEP. He also works on interdisciplinary studies, e.g. water-energy nexus, river health-human health linkages, and cross-sectoral climate change adaptation. He has published 17 articles in books, journals, and conferences. He has carried out extensive work in the interdisciplinary sector (required for this technical assistance), and also in relation to climate change.