

Online Training on 'Urban Groundwater Management' - Issues, Challenges, Approach, & Potential

21st June-1 July, 2022

School of Water and Waste, Centre for Science and Environment (CSE) successfully completed the online training programme on “Urban Groundwater Management” from 21 June - 1 July 2022.

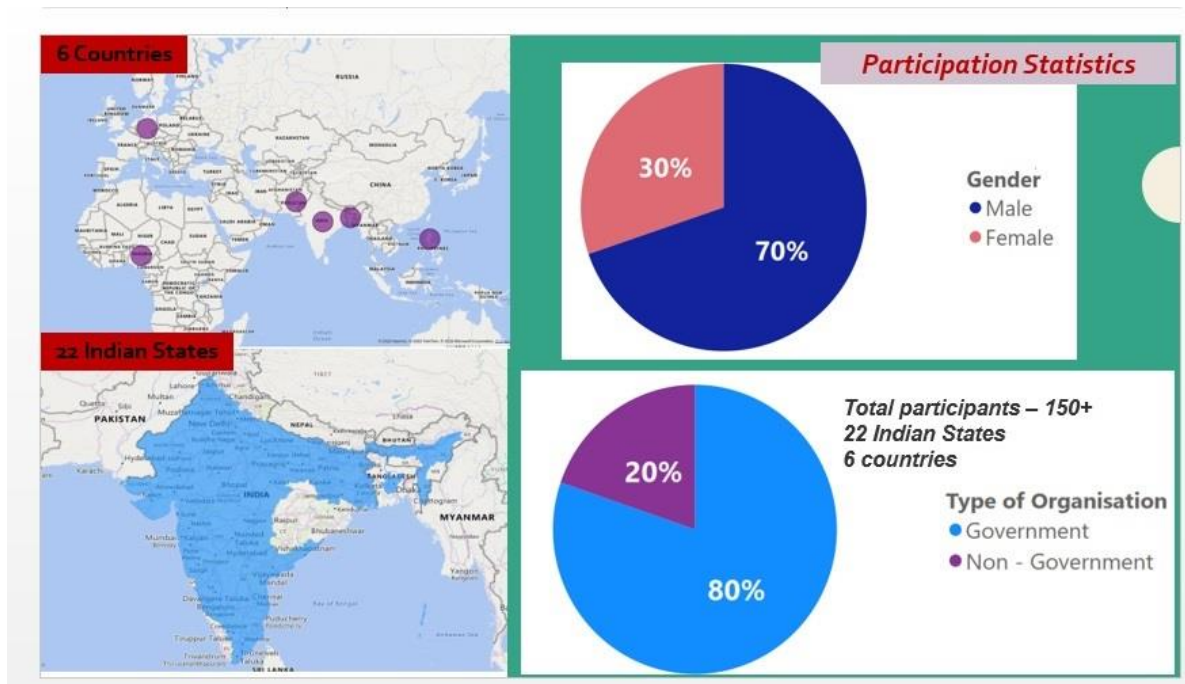
A total of 147+ participants (Govt. officials from ULBs/UPJN/SUDA/Jal Board/ Groundwater departments, architects, managers, practitioners, academicians, researchers, and NGO representatives) from diverse backgrounds and regions of India participated in this training programme.

The training was organized under a 3-year capacity-building program of CSE-NMCG collaboration for sustainable urban groundwater management and river health improvement in Ganga basin cities and making cities water sensitive.

The training programme covered the following topics:

1. Introduction: the groundwater story of India, basic concepts, and the diversity of aquifers.
2. Urban groundwater in India with reference to the Ganga basin – aquifer settings, challenges, and management issues.
3. The urban groundwater typology, approaches to understanding and demystifying groundwater in urban area.
4. Understanding city water balances with specific reference to the groundwater balance.
5. Managed Aquifer Recharge (MAR) – concepts, practices, and experiences from rural and urban India.
6. Managing urban groundwater policy framework and the process of urban groundwater governance.

Apart from CSE trainers, the following eminent external speakers from ACWADAM: Dr. Himanshu Kulkarni, Executive Director and Secretary; Uma Aslekar, Additional Director; Siddharth Patil, Senior Scientist; provided an insightful presentation and talk on the subjects. Participants were very receptive and enthusiastic.




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PowerPoint Slide Show - Technical Session1_introductory PPT - PowerPoint

Online Training on - Urban Groundwater Management Issues Challenges & Potential

Welcome/Introductory SESSION- 1



**ONLINE TRAINING ON
URBAN GROUNDWATER
MANAGEMENT**

ISSUES, CHALLENGES, APPROACH AND POTENTIAL

Dates: June 21 – July 1, 2022 | **Learning Platforms:** Moodle and Zoom
Language: English | **Last date for registration:** 15 June 2022

To register visit www.cseindia.org

Water Programme

Slide 1 of 9

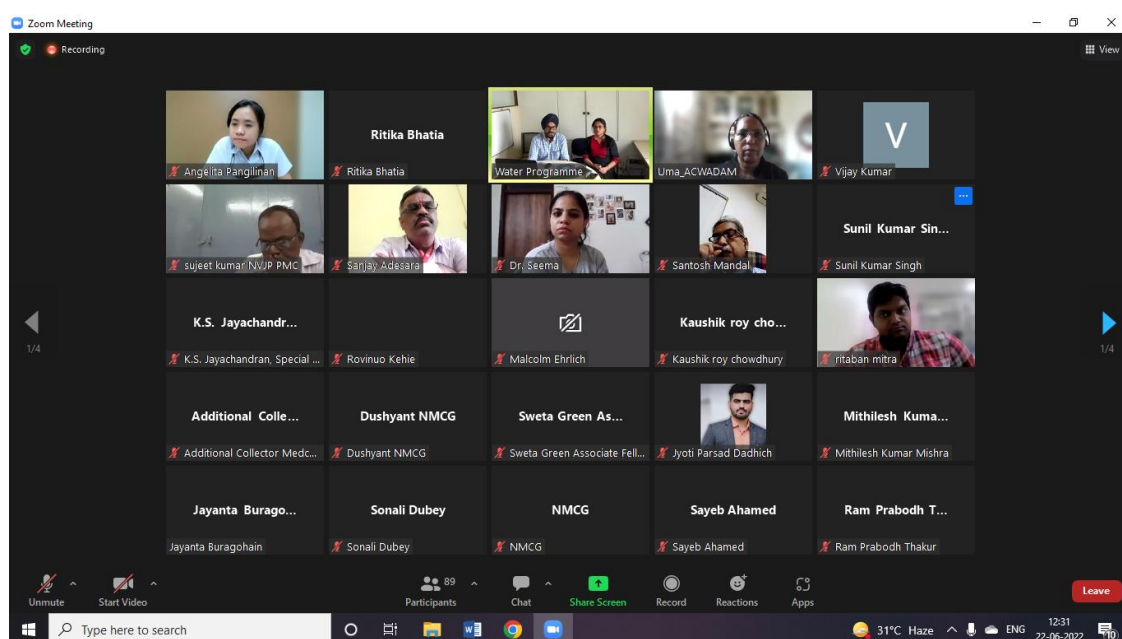
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SESSION'S HIGHLIGHTS

Technical Session-1: “The Groundwater story of India: Basic concepts and the diversity of aquifers”

Date: 22nd June, 2022

The first session of the online training on “Urban Groundwater Management: issues, challenges, approach, and potential” was conducted on the topic **“The Groundwater story of India: Basic concepts and the diversity of aquifers”**. The speaker for the session was Ms. Uma Aslekar from ACWADAM, which works toward groundwater management. She gave a very insightful session about the issues related to groundwater, the state of groundwater in India, and the diversity of aquifers.



She began the session by highlighting the importance of Groundwater. More than half of the world’s population depends on groundwater for their needs. Groundwater over extraction for meeting the demand and supply gap of urban areas. The issues and challenges related to groundwater are normally get ignored and mismanaged as it is out of sight.

UNESCO has declared the year 2022 as the year of Groundwater and the theme is “To make the invisible, visible”.

The screenshot shows a Zoom video conference interface. The main window displays a presentation slide with the title "The groundwater story of India" and subtitle "Basic concepts and the diversity of aquifers". The speaker's name, "Uma Aslekar", is visible on the slide. The background of the slide is a photograph of a traditional Indian doorway with a yellow and red patterned canopy. A motorcycle is parked in front of the door. In the bottom right corner of the slide, there is a logo for "ACWADAM" featuring a blue water drop and the text "ACWADAM". On the right side of the Zoom window, there is a small video feed of the speaker, Uma Aslekar, wearing a headset. The Zoom interface includes a top bar with "Recording" status, a green bar indicating "You are viewing Uma_ACWADAM's screen", and a "View Options" dropdown. The bottom bar shows controls for "Unmute", "Start Video", "Participants" (56), "Chat", "Share Screen", "Record", "Reactions", "Apps", and a red "Leave" button.

There are many challenges associated with groundwater today. One of the major challenges is climate change. In India, hundred years of recorded data show that the precipitation patterns have changed to erratic rainfall due to climate change. The districts receiving rainfall more than 1000 mm, now receiving less rainfall and vice versa.

Another major challenge associated with groundwater is its overexploitation. India's extraction of groundwater is the highest. The trends in India from 1950-51 to 2016-17 show that usage of Groundwater for crop production has grown from 790 billion cubic meters (BCM) to 1200 BCM and domestic water use has raised from 5 BCM to 50 BCM.


Then, the speaker also explain about the aquifers. Aquifers are the saturated rocks that store the Groundwater. Aquifer management is important to manage the groundwater. The 5 P's of micromanagement of aquifers for groundwater governance involves ***Principles, People, Processes, Practices, and Policies.***

Zoom Meeting

Recording

The 5 Ps: micromanagement of aquifers to groundwater governance

- **Principles:** values and norms around aquifers as CPR
- **People:** human behaviour, tensions, competition and conflict
- **Processes:** participative / collaborative data gathering, data-based community decisions
- **Practices:** community decision-based action
- **Policies:** securing and sustaining good practices and moving away from command and control



ACWADAM

Uma_ACWADAM

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Then, she elucidated, how India became the country that ranked number one in the extraction of Groundwater. During the biggest drought of 1970-71 in Maharashtra, India employed the bore well technology to extract water. Technology proliferated during the 1980s and subsequently, in the 1990s, electric pumps came into use and the exploitation of water increased. Today, there are around 40 million bore wells in India which worsen the groundwater management.

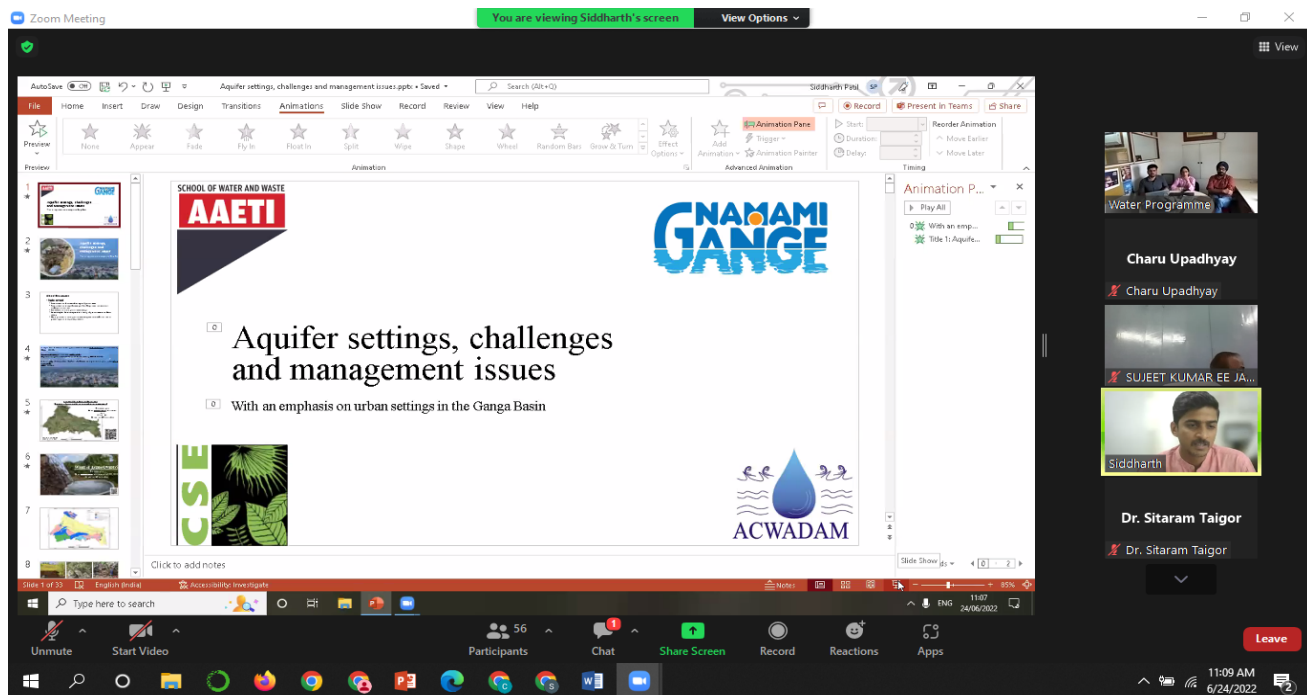
The session ended with the **Q & A**.

Technical Session -2: “Aquifer settings, challenges and management issues with special emphasis on Ganga Basin cities”

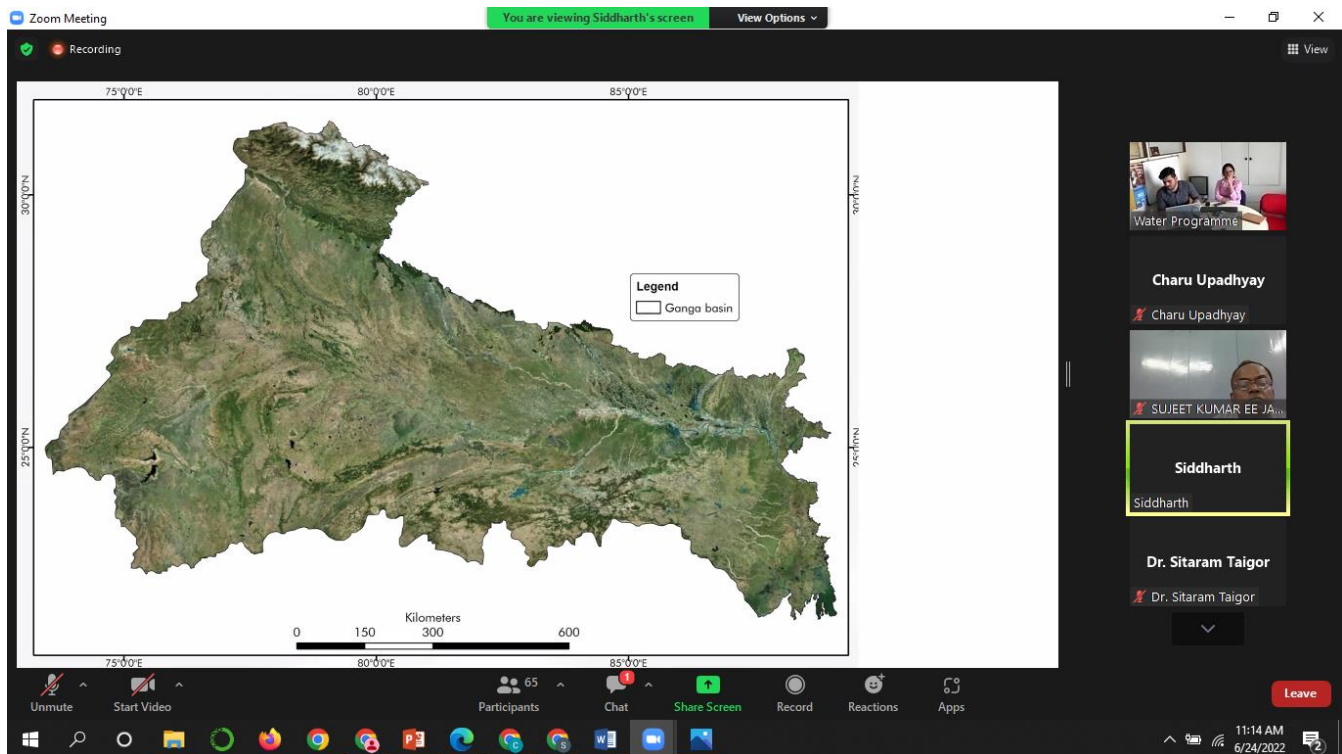
Date: 24th June, 2022

The second session of the online training on “Urban Groundwater Management: issues, challenges, approach, and potential” has been conducted on the topic **“Aquifer settings, challenges and management issues with special emphasis on Ganga Basin cities”**. The speaker for the session was Mr. Siddharth Patil from ACWADAM.

He gave a very informative session about the aquifers and how the knowledge about the geology of aquifers is important to manage the groundwater and also, helps urban planners to manage sources of groundwater. The session was attended by around 80+ participants. The speaker kept participants engaged through various Mentimeter polls and questions.

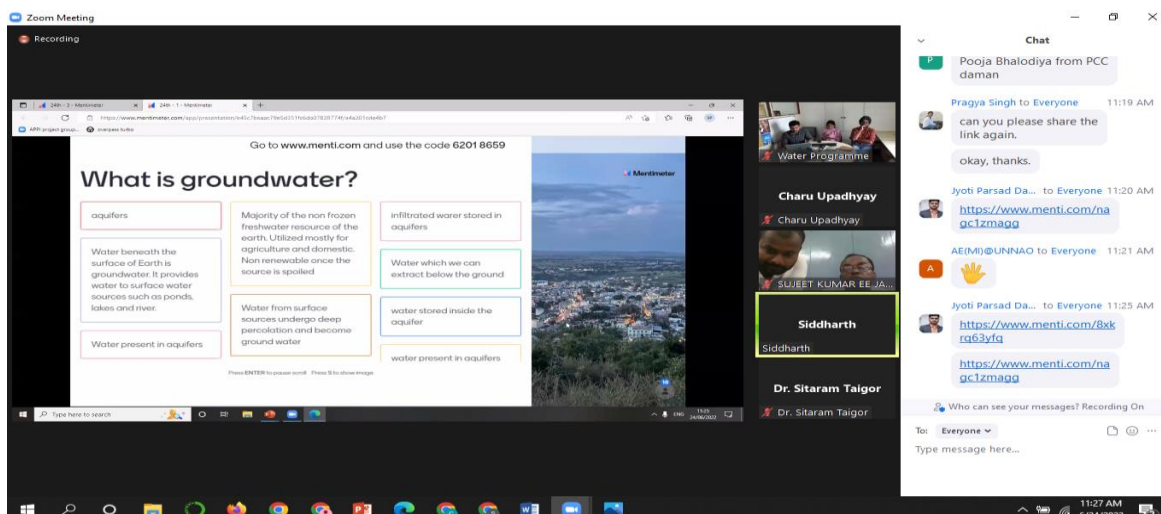


The speaker began the session by highlighting the importance and dependency on groundwater. According to the data collected by the Central Ground Water Board (CGWB) in urban cities, more than 50% of groundwater is unaccounted for in cities. 56% of metropolitan cities depend on groundwater either fully or partially and 48% of urban water supply is fulfilled by groundwater. Ganga basin is one of the most important sources of water and also many cities, almost a quarter of India lies in the Ganga Basin.



In the Himalayan region, the snowmelt water contributes only 5% to the river water whereas groundwater contributes to around 15-20% of water during the summer season.

Then, the speaker highlighted the basics of groundwater and the resource of groundwater, i.e, the aquifers. The definition of groundwater is the water that is stored and transmitted through the rocks, and the scale, variability, and heterogeneity of these rocks determine the presence of groundwater in a particular area and these saturated rocks are known as the aquifers. Aquifers are physical entities having boundaries and limits.



India has a wide variety of aquifers. These types are based on types of rocks, & soils, climatic conditions and altitude of the location. Aquifers are of two types: Confined aquifers and unconfined aquifers.

Unconfined aquifers are the shallow aquifers that are in contact with the atmosphere and water is easily pumped out from these aquifers. These aquifers are highly prone to contamination. Confined aquifers are the deep aquifers and are not under the direct pressure of the atmosphere. The pumping of water is a little difficult in these aquifers.

The two important properties of aquifers are storativity and transmissivity. Storativity is defined by the factor of porosity and determine the storage capacity while transmissivity determines the flow rate of water from the rocks.

Dimensions of aquifer depletion depend upon the nature and properties of rocks present in that area. Suppose, there's a groundwater level drop of 2 m in the catchment area of 1000 Ha., there would be different rocks in that area, say, alluvial, laterite, etc. The porosity, permeability are different for each rock type. This is an important aspect that should be considered by urban planners to study the depletion of water. For this purpose, geological data of cities can be collected through the field study, secondary data, interviews etc.

The groundwater is depleting both quantitatively and qualitatively.

The speaker also talked about the state of groundwater in one of the megacities, Pune where there's a strong dependency on groundwater.

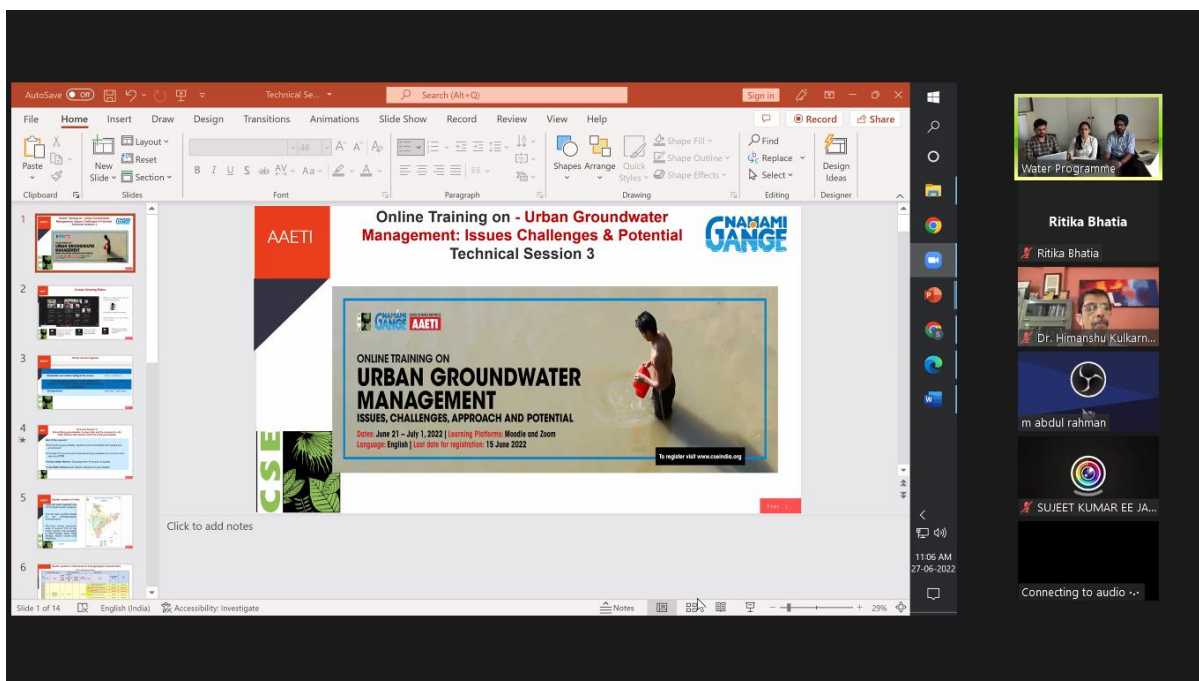
The session ended with the **Q & A**.

Technical Session – 3: “Demystifying groundwater in Urban India and the concept of a city (ground) water balance”

Date: 27th June, 2022

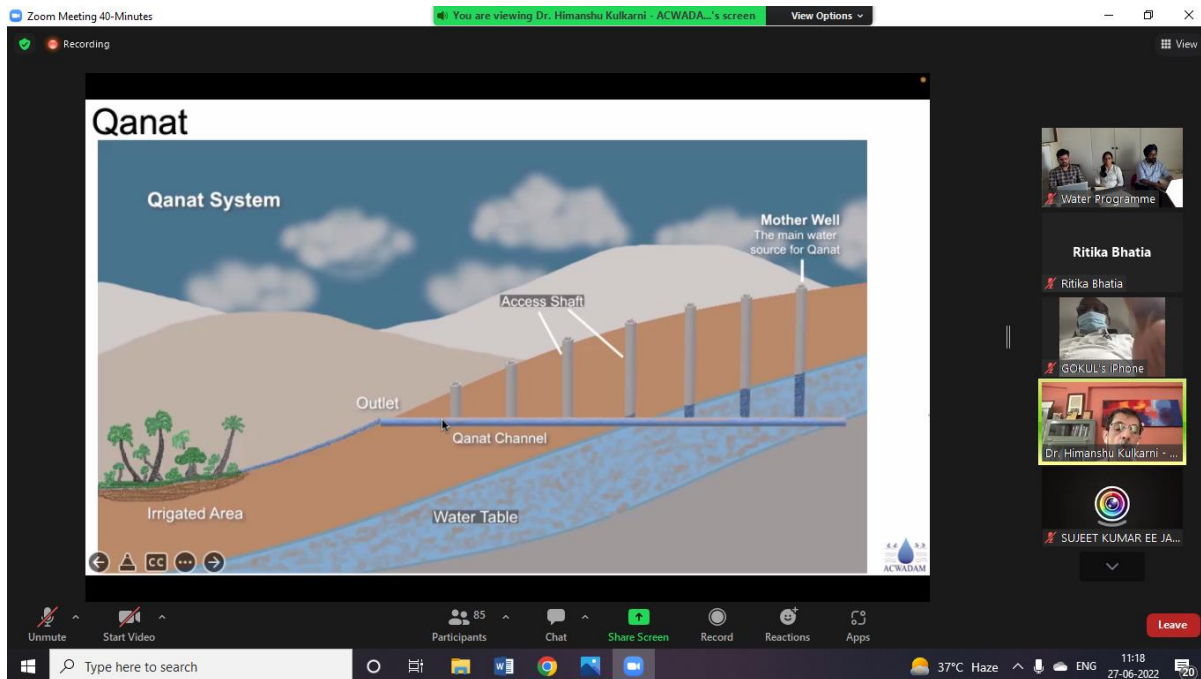
The third session of the online training on “Urban Groundwater Management: issues, challenges, approach, and potential” has been conducted on the topic “Demystifying groundwater in Urban India and the concept of a city (ground) water balance”. The speaker for the session was Dr. Himanshu Kulkarni from the renowned organization ACWADAM, which works toward groundwater management.

He gave a very informative session about the groundwater within the urban context. He elaborated the subject with a specific reference to the city of Pune and explained the city’s groundwater balance plan. He emphasized that the knowledge and management of aquifers are important to conserve groundwater. The session was attended by around 90+ participants. The speaker made the session interesting by showing very informative short videos about the concept.

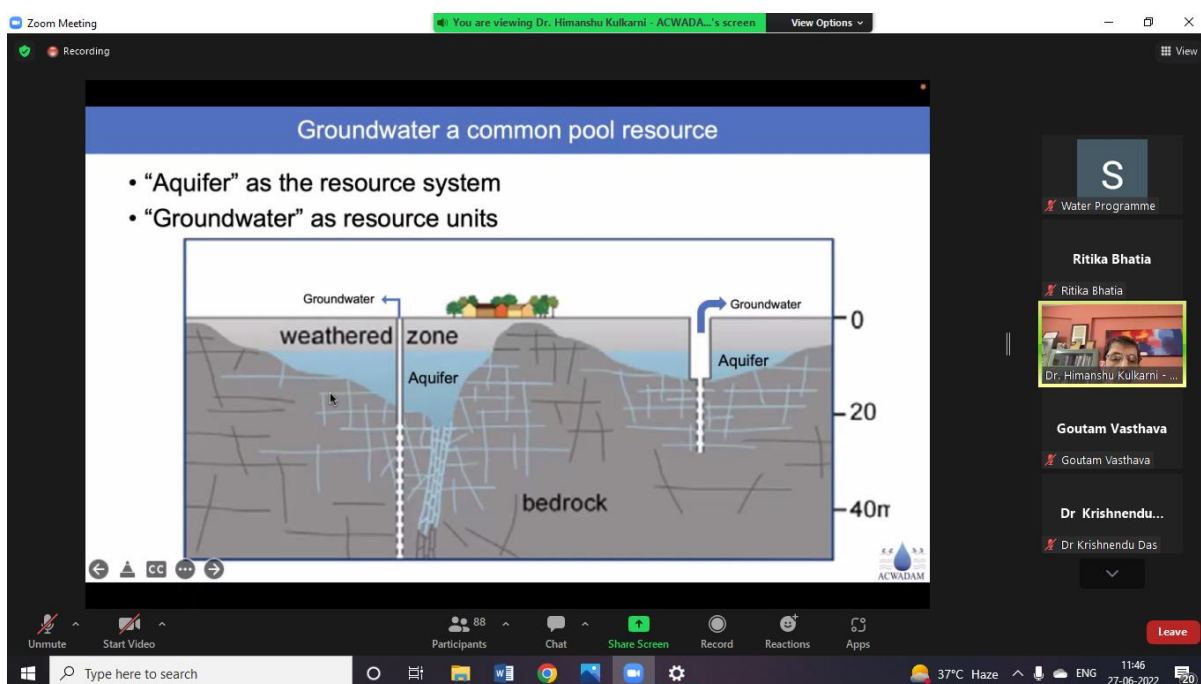


The speaker began the session by highlighting the importance of aquifers. Aquifers are important and much older heritage structures. These are the rock formations that stores groundwater. The knowledge and understanding about these geological structures is highly required to manage the groundwater. In India, there are 14 major aquifer systems, and these could be further divide, based on the hydrogeological characteristics, in 42 aquifer systems. India has a diversity of aquifers. For the management of aquifers, participation of people, the understanding of hydrogeology, and policy and governance are the basic principles that are required to be followed.

In India, on average, 1 Billion people use Groundwater every day. Earlier, the Qanat system was used to extract the groundwater, which was effective, and it used the groundwater judiciously. After the 19th century, the pattern of usage of groundwater completely changed. The access, as well as the extraction of groundwater, increased due to the increasing demand and the advancement in technology.



Then, the speaker explained about aquifer storage and potential recharge i.e. the amount of water required to recharge the aquifer and common pool resources (CPR). Depletion of an aquifer is the depletion of the common pool resource. Some of the examples of common-pool resources include fisheries, forests, groundwater, water bodies, etc.



In urban areas, part of the resource system, i.e, the aquifer is removed while making the high-rise buildings, tunnels, and other infra structures, which leads to groundwater depletion.

Zoom Meeting You are viewing Dr. Himanshu Kulkarni - ACWADA... 's screen View Options

Recording

Urban groundwater: the zero-sum game

- Drop in natural groundwater recharge in cities often remains hidden behind this zero-sum game...
- Reduction in surfaces that induce infiltration of rainwater
- Leaking mains and sewers

Water Programme

Ritika Bhatia

Dr. Himanshu Kulkarni - ...

Dr. Krishnendu...

Dr. Krishnendu Das

SUJEET KUMAR EE JA...

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With specific reference to Pune city, He told that it has 5 major aquifer systems. As the urban growth is increasing, there is a neglect of watersheds and aquifers.

Then, the speaker talked about the City Water Balance (CWB) taking in account of groundwater. To calculate the groundwater balance, two important things have to be taken into account (1) Water pumped out from the aquifer which also includes the natural discharge, and (2) Drop in the level of Groundwater. The drop in the level of groundwater also depends upon the soil types of the aquifer. The specific yield of an aquifer is taken into consideration while calculating the drop in groundwater level.

The session ended with the Q&A.

Technical Session – 4: “Managed aquifer recharge: A hydrogeological perspective”

Date: 29th June, 2022

The fourth session of the online training on “Urban Groundwater Management: issues, challenges, approach, and potential” has been conducted on the topic “Managed aquifer recharge: A hydrogeological perspective”.

The speaker for the session was Mr. Siddharth Patil from the renowned organization ACWADAM, which works toward groundwater management. He delivered an insightful session about the managed aquifer recharge, its various techniques. He also talked about various case studies. The session was attended by around 75+ participants. The speaker kept participants engaged through various Mentimeter polls and questions.



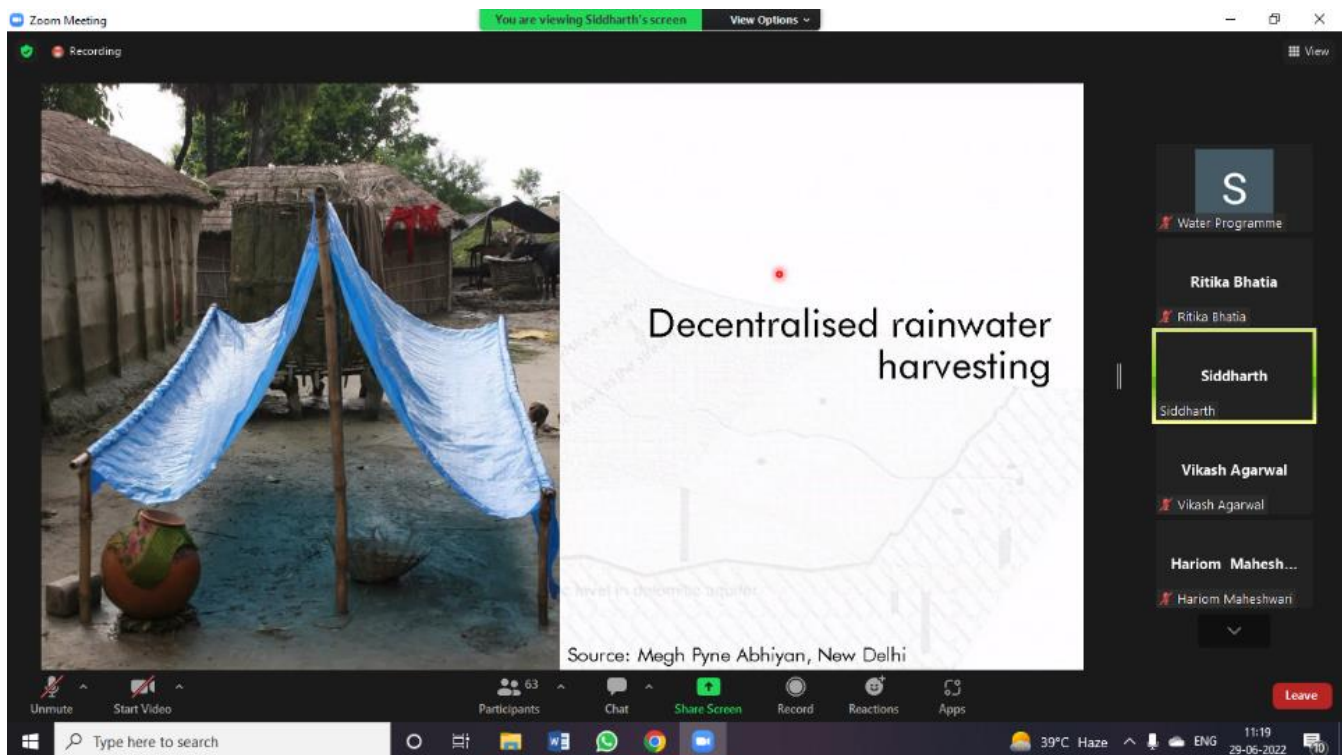
He stated that 80% of India’s drinking water requirements, and 2/3rd of irrigation needs are fulfilled by groundwater. He said that 60% of India faces an acute water crisis which is a matter of concern, and with the growing population, over-exploitation of groundwater resources, increasing trend of urbanization, and modification of the hydrologic cycle, MAR (managed aquifer recharge) has become essential. The per capita availability of water has significantly decreased from 6,042 cubic meters in 1947 to 1,140 cubic meters by 2050 as estimated.

The speaker began the session by introducing the term groundwater recharge which means the addition of water to the existing aquifer storage. Infiltrated water by the ground doesn’t always reach the saturation zone of aquifers. Sometimes, the water is absorbed by the soil and sometimes it gets stored in the

fractures of rocks. Hence, it is difficult to quantify the aquifer recharge as a calculation of loss of infiltrated water.

Then, the speaker talked about rainwater harvesting and various techniques and types MAR.

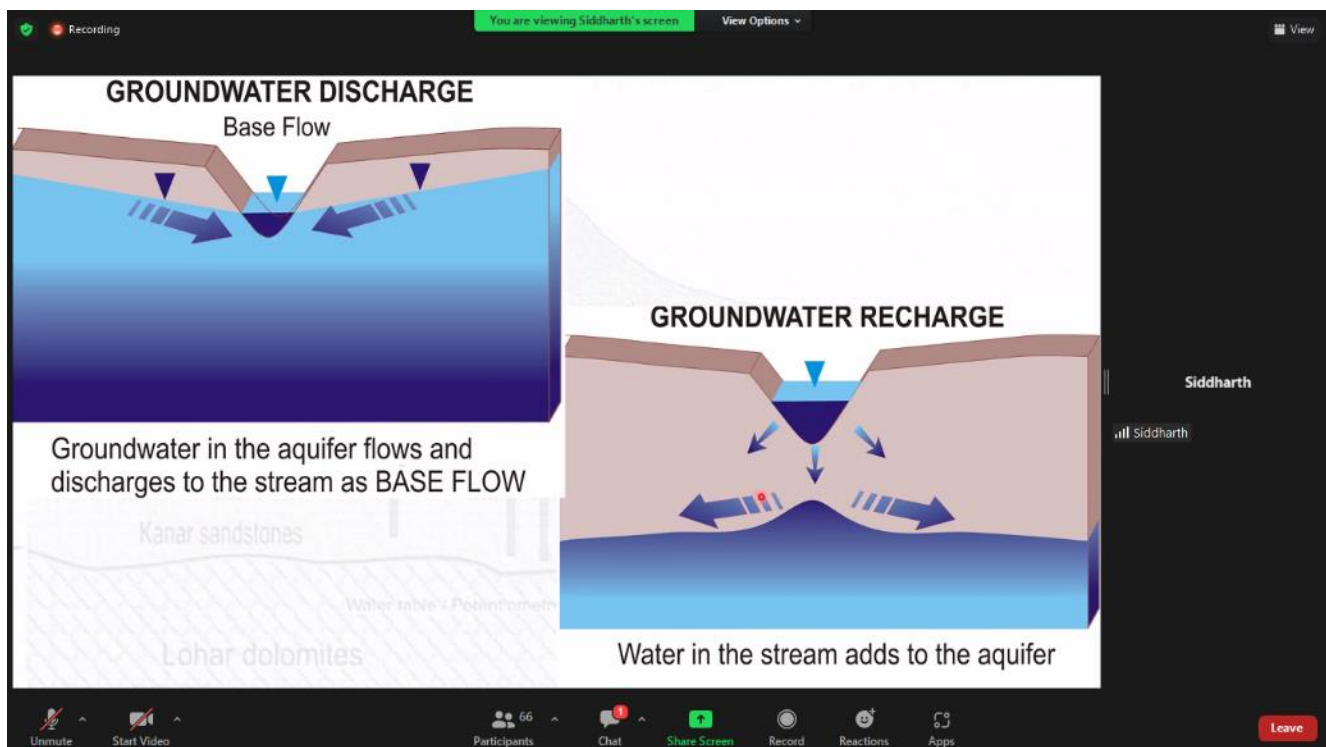
Rainwater harvesting is a great way of Managed aquifer recharge (MAR) which has been in practice for the ages. The oldest bore wells in the Harappan civilization prove that rainwater harvesting is not a new practice. People, e.g. in Bihar, have devised innovative methods to conserve rainwater which could later be used during the times like floods. One of the techniques can be seen in the following picture:



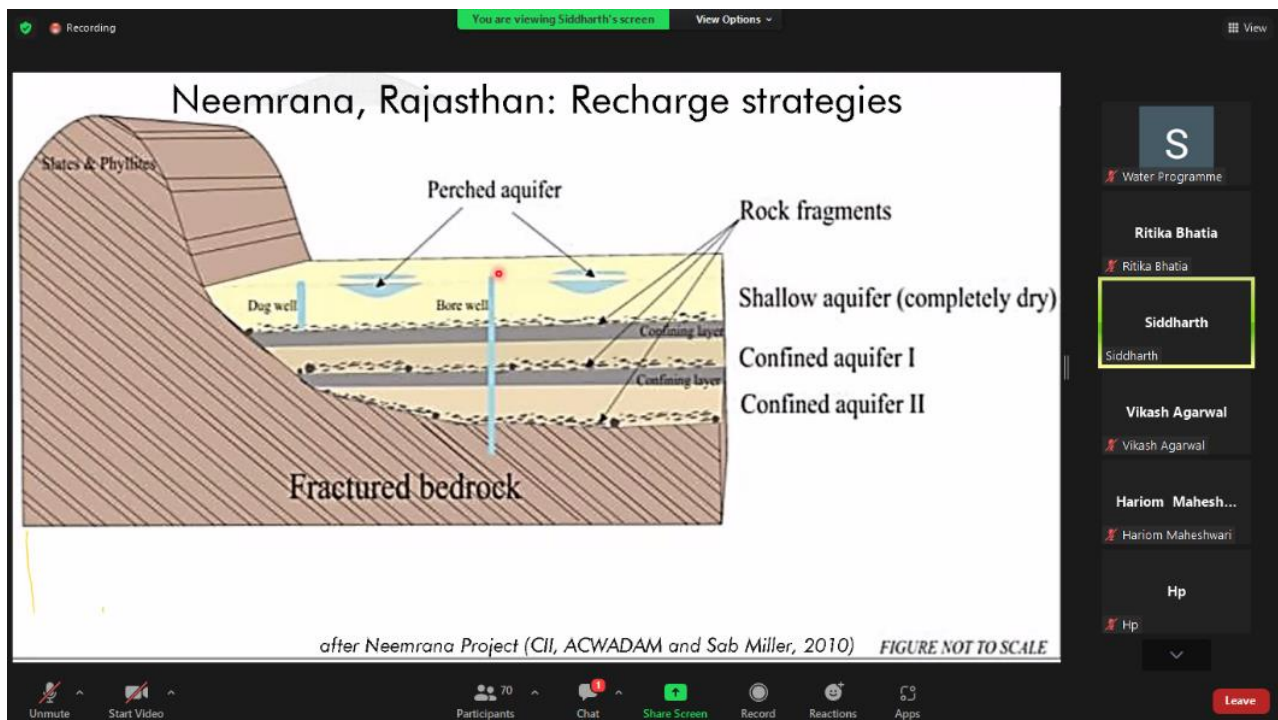
The two major types of Rainwater Harvesting could be classified as urban rainwater harvesting and rural rainwater harvesting. Urban rainwater harvesting is a point-source water harvesting technique where the water is being collected at a particular point in dug wells, tube wells, or bore wells generally from the rooftops. Rural rainwater harvesting is a diffused type of rainwater harvesting where the water is stored and used for various purposes such as irrigation, drinking, etc.

Then, the speaker explained the concept of Managed Aquifer Recharge (MAR). Managed Aquifer Recharge is the intentional or designed recharge to the aquifers. It is also known as artificial recharge. MAR is required to meet the water demands of the people and also natural recharge is not sufficient to recharge aquifers. For an efficient MAR, understanding groundwater balance is essential. MAR is essential

not only to meet the demands of the growing population but it also improves the water quality in aquifers by preventing the entry of contaminants such as nitrates, fluorides, etc., it also prevents land subsidence. Based on the geometry of aquifers, there are groundwater recharge and discharge areas. The shapes and geometries of these aquifers decide the location of groundwater recharge areas which could provide justice and equity to the people accessing the groundwater.



Taking the example of Neemrana in the Alwar district of Rajasthan he told that, the recharge area is in a different form. The fractured rocks are inclined towards the alluvial plains. The research has shown that to recharge the shallow aquifers, it would take around 40 years with 100% rainfall. So, a diffuse system of recharge and injection wells have been deployed to recharge the aquifers.



Managed Aquifer Recharge (MAR) is determined by the aquifer characteristics largely by storativity and transmissivity. Storativity will determine the amount of water that will be accepted by the aquifer and transmissivity will determine the rate at which the water will be accepted by the aquifer.

The following graph shows the quantity of water recharged in an aquifer with time. It can be seen that the recharge rate depends on the time as it keeps fluctuating during the summer and monsoon seasons. The lowest point represents the exploitation of groundwater and the highest point represents the potential recharge, beyond this point, the aquifer cannot be recharged. The green and the pink portion in the graph shows the demand of the growing population. The demand is more than what an aquifer could provide which is a matter of concern.



With proper planning and support by the government and all institutions, managed aquifer recharge (MAR) could be successful in reviving the aquifers of the country and could meet the demands of the people.

The session ended with the Q&A. Participants asked very knowledgeable questions and the speaker answered all the questions and enlightened the participants with his knowledge.

Technical Session- 5: “Groundwater Governance: Policy framework and Urban Groundwater Governance”

Date: 1st July, 2022

The fifth and the concluding session of the online training on “Urban Groundwater Management: issues, challenges, approach, and potential” has been conducted on the topic “Groundwater Governance: Policy framework and Urban Groundwater Governance”.

The speaker for the session was Dr. Himanshu Kulkarni from the renowned organization ACWADAM, which works toward groundwater management. He gave a very informative session about groundwater governance- the challenges associated and the policy and management framework to address those challenges.

The session was attended by around 70+ participants. The speaker kept the participants engaged by asking questions on the subject.



Some of the major authorities which are working toward groundwater management and governance are the Ministry of Environment, Forests and Climate Change (MoEFCC), Ministry of Jal Shakti, Central Ground Water Authority, etc., and some of the major acts and policies that consider the Groundwater Governance are Environment Protection Act, 1986, National Water Policy, 2012, etc.

India has diverse geological settings. Nature has given us the gift of diversity of aquifers, which make water governance a challenge in itself. It is a must that this diversity of aquifers should be taken into consideration by the people responsible for groundwater governance.

The speaker then talked about the issues associated with urban water. The major challenge is the growth in urban sprawls and hence the increasing urban population, skyrocketing the demands. Due to the sprawl, rural areas are being converted to urban areas which were responsible for providing ecosystem services to urban areas. There's a conflict between domestic water use in urban areas and the use of water for irrigation purposes in rural areas. There are many informal sources of water in urban areas that go unnoticed. Urban is getting diverse. From small towns to urban agglomerations, a transition is being seen from small to huge eco-geographies. Urban areas produce a huge amount of sewage and only one-third of that sewage is being treated. There have been disputes and a lack of partnership among the urban local bodies and the state departments that supply the water.

Then, the speaker highlighted the definition of Groundwater Governance. Groundwater Governance is the process by which groundwater is managed through the application of responsibility, participation, information availability, transparency, custom, and rule of law. He said that aquifer governance is the groundwater governance.

Groundwater governance is required because there has been the exploitation of the groundwater both quantitatively and qualitatively. In India, the 1970s was a period of development for the groundwater sources, where the groundwater became more visible to people; wells were dug, tube wells and bore wells were being drilled; technology boomed. The 1990s was a period of groundwater management. People then started realizing the importance of groundwater and hence managing the source.

The 2010's saw the development of legislation around Groundwater and became the period of Governance. The 5P's for groundwater governance include the 1) principle; values and norms around aquifer as a common pool resource, 2) people; public participation and awareness play an important role, 3) process; participative data gathering, 4) practices; community decision-based action, and, 5) policies; proper policy framework and 6) Plurality: it is getting attention nowadays. P stands for a plurality of aquifers. The diversity of aquifers should be taken into account to govern the groundwater.

Recording You are viewing Dr. Himanshu Kulkarni - ACWADAM's screen View Options

The short temporal dimension - phases

1970s - gwD
Groundwater resources development – gaining access

1990s & 2000s - gwM
Groundwater management – mainly conservation and water use efficiency

2010 to recent - gwG
Groundwater governance mainly – regulation

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Dr. Himanshu Kulkarni ...

Some of the reforms could be proposed for groundwater governance. Cooperation between Urban local bodies, Centre, and State; all the players in the water supply is important. Proper governance of sanitation, waste disposal, and recharge is required. Another reform should be using multiple disciplines to create awareness rather than just building infrastructure. The governance team should consist of hydrogeologists, social scientists, and other experts. Governance in water data, education, and research should be there which is lacking in many parts of the country.

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A colourful canvass of approaches and strategies

MAR through Watershed Management

Trained (Para)hydrogeologists

Village water security

Self Help Groups – managing agriculture and its marketing

Public recharge in Urban Areas using MAR

Groundwater quality for human health and ecosystem well-being

Socio-hydrogeological strategies in groundwater conservation

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Dr. Himanshu Kulkarni ...

The session ended with the Q&A.

Participant's Feedback:

Dr.Naveed Ahmed Thanks for this very fruitful training.

N Yanger Pongen, EE(PHED) Nagaland: Learned a lot, hopefully will have better understanding after going through the training materials again.

Dr Krishnendu Das: Thanks so much for bringing so much clarity in my understanding of urban ground water management

Amit Bhalerao: Thank you CSE for providing valuable training and information concerning groundwater.

Sartaj Khan: Thank you so much for this very enriching and informative training

Pushkar Kulkarni: Thank you CSE & ACWADAM for this training program

Mithun Mondal: I have learned many new technology from this session session. I work on Climate Change Adaptation project. This training will be help me for ground level advocacy. I am looking forward for more training. I will be grateful if there will be a session on climate change.