



INC of IAH
Indian National Chapter
International Association
of Hydrogeologists

Newsletter

VOLUME 09 ISSUE 03 OCT, 2022



this issue

- INC-IAH Seminar. Jaipur **P.4**
- Water Conservation **P.5**
- Groundwater News in Media **P.6**
- Glimpses of Popular Talks **P.8**
- Technical Article **P.14**
- Upcoming Seminar **P.38**
- Members Published Paper **P.42**

Governing Body (2022-24)

President

Prof. A. K. Sinha

Vice President

Prof. A. Mukherjee

Secretary

Sh. Amlanjyoti Kar

Treasurer

Dr Ashok Kumar

Executive Members

Dr. B. S. Chaudhary

Sh. Sujit Sinha

Sh. Ranjan Sinha

Dr. Ajay Kumar Kadam

Dr. Sudhir K. Srivastava

Designed and composed
by Dr Ashok Kumar,
Treasurer, INC-IAH



INC of IAH

HQ. c/c Central Ground Water
Board, Bhujal Bhawan, NH-IV,
Faridabad – 121001

E: ashok.kumar@inciah.org

www.inciah.org

President's Message

Prof. A. K. Sinha

President, INC of IAH

Vice-Chancellor,

Chhatrapati Shivaji University, Navi Mumbai

Member, Governing Council, IUAC, GOI, New Delhi
and Founder Groundwater Community Forum

E: groundwater2008@gmail.com



Dear IAH Members Friends & Colleagues

It is a matter of great pleasure and satisfaction that INC-IAH has come up with the present issue of its e-Newsletter.

I believe that the newsletter will serve as a window through which the complete profile of the academic, scientific and socioeconomic principles and practices in the domain of groundwater development and management made during the stipulated period can be viewed.

INC-IAH is committed to creating an ambience for nurturing innovation, creativity and excellence toward sustainable use of groundwater resources by organizing various activities with the support and total indulgence of our esteemed members. The issuance of e-newsletter, organisation of World Water Week on pan India basis, and continued monthly Lecture Series by imminent experts from India and abroad are activities which have been accomplished successfully and more such activities are in pipeline. Publication of e-journal and conduct of national Seminar at Jaipur are already announced. Many existing and new activities are being continued and

new vision. INC-IAH is also contemplating to organize an international Conference during March 2023. An all-out effort is being made to make INC IAH's presence felt in India and in abroad. We are particularly keen that our young and early career academician, scientists and practitioners and the students in the domain of groundwater become more knowledgeable and skilled so that they get better visibility and recognition. A short Video Competition on Groundwater issues for students which shall also form part of the INC-IAH Annual award scheme is also being envisaged. However, challenges are numerous in converting our mission into acceptable and timely output. INC-IAH is organization of all its members. Whatever has been achieved it was because of the collective efforts, commitments and participation of you all. Recently former President of IAH remarked that INC-IAH is highly active chapter of IAH today. However, to take it further higher it needs constant care by its esteemed and learned members. Our many members are scientists and academician of international repute and I am sure their little time and a little contribution will boost the competence and confidence of our youngsters as we need high quality scientific technical and managerial personnel for sustaining the future groundwater resources. It is possible that their contribution in strengthening the INC-IAH may not give them the immediate desired visibility and honor which they highly deserve but it would definitely bring more prestige, recognition and strength to INC-IAH which must be a matter of great satisfaction and pride for all its members.

I appeal to my all-colleague's friends and esteemed members of INC-IAH to join hands together and extend academic and scientific support to make INC-IAH socially, scientifically and academically highly strong and useful organization whose presence be felt not only in India but globally too. INC-IAH would be highly obliged if you in your respective areas of activities and places act as ENVOY of INC-IAH and interact with local institutions individuals and local bodies on behalf of INC-IAH to make them understand the proper management and use of groundwater as we need to be more cautious and proactive in adapting to the adverse consequences of climate change which may be achieved by reaching to the unreached and mentoring them about the values for which INC-IAH is committed to. I am sure that the INC-IAH members enhanced and effective indulgence in all INC-IAH would make INC-IAH a high-class institution.

I sincerely solicit your valuable suggestions for making INC-IAH a much sought-after organization.

Best wishes for the success and bright future of INC-IAH.

(A. K. Sinha)

Secretary's Message



Sh. Amlanjyoti Kar

Secretary, INC of IAH

*Former Regional Director, Eastern Region
Central Ground Water Board, Kolkata,
Ministry of Jal Shakti, Government of India,
E: amlanjkar@gmail.com*

Dear and respected colleagues, it's my proud privilege to greet you all after a prolonged festivity. Trust you all are in good health and spirit with family members. It gives me immense pleasure to inform all the members and the readers that the third issue of the Newsletter of INC-IAH in this calendar year is going to be published. We are putting all endeavour to bring out the issues following the desired timeline. Besides bringing out the Newsletter, we are also conducting Popular Scientific lecture in every month which is an innovative endeavour of its kind and we are getting many heartfelt comments and appreciation which have been boosting us emphatically. We have already organised the lectures by [Prof Tapas Biswas](#), CSIRO Australia and Prof Adjunct Australian National University on "[Rejuvenation of Murray Basin in Australia](#)". The second lecture was delivered by [Dr. S. K. Subramanian](#), Scientist-G (Retired), NRSC on the "[Application of Remotely sensed data in groundwater studies](#)". The latest and the 3rd lecture we have organised recently on 29.10.2022 on virtual platform where [Prof. Antonio Chambel](#), of University of Evora, Portugal and Former President of IAH has delivered an excellent lecture on the topic "[Groundwater management in the world: problems and possible solutions](#)". In all the full house lectures we have got overwhelming response from our esteemed members and the learned audience who are even non-members, students and research scholars from all over the country and abroad. Shortly we are announcing the date of submission of nomination for the INC-IAH award. Besides, we are organizing a National Seminar in liaison with the Rajasthan Institute of Engineering and Technology at Jaipur on 24.12.2022. With the approval of the governing body of INC-IAH we have already constituted an esteemed Editorial committee comprising elite academicians, professionals, NGOs from all over the country and abroad and we are quite ahead to begin with the Journal of INC-IAH. I would like to convey my heartfelt thanks to [Shri Satendra Mohan Kanwar](#), Chief Engineer (Retd.), Ground Water Department (GWD), Govt. of Rajasthan to inspire the officers of GWD from all the disciplines of to join INC-IAH which has propelled our membership drive in the current year to attain a very good shape. I also thank all the new members individually and welcome all of them into the family of INC-IAH. I convey my regards once again to all the esteemed members and hope all goodness for them and their family members in the ensuing time.

(Amlanjyoti Kar)



INC of IAH

HQ. c/c Central Ground Water Board, Bhujal Bhawan, NH-IV, Faridabad – 121001

E: ashok.kumar@inciah.org

www.inciah.org

Do not miss! submit abstract of paper



INC-IAH SEMINAR



Indian National Chapter of
International Association of Hydrogeologists (INC-IAH)
in association with

Rajasthan Institute of Engineering & Technology (RIET), Jaipur

Organizes
National Seminar

24th December 2022

Recent approaches in Groundwater Development & Management in
Semi/Arid region of India with a focus on Rajasthan

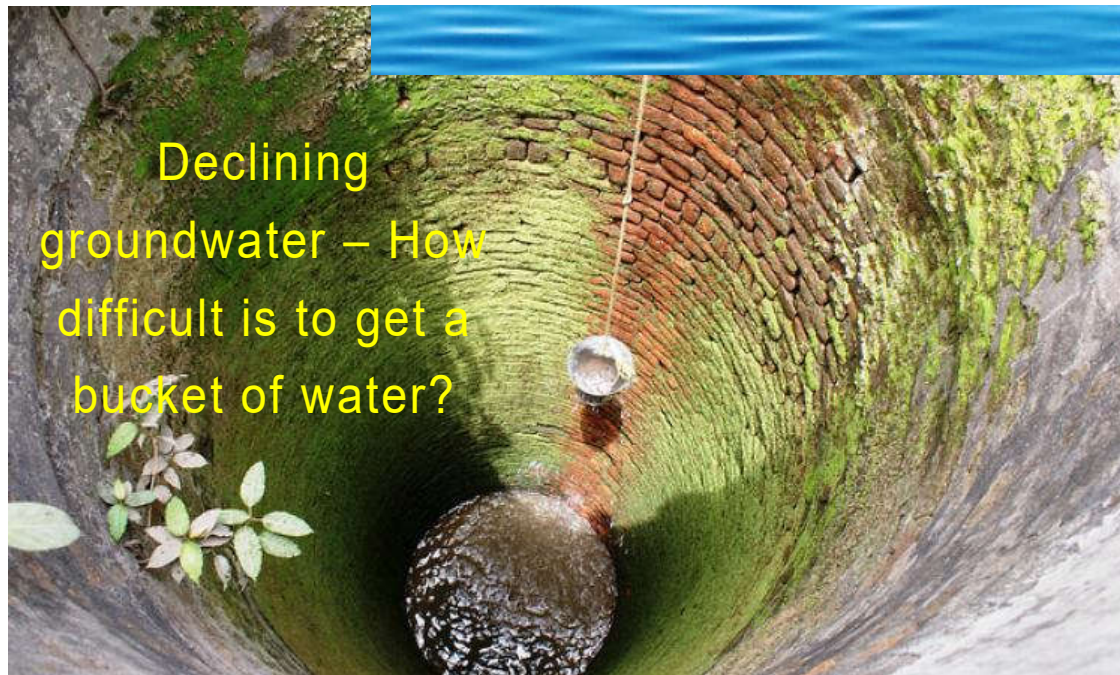
Thematic Tracks

- T-I : Innovative Techniques of Groundwater Exploration and Management
- T-II : Groundwater Recharge, Groundwater Contamination and Treatment Techniques
- T-III : Groundwater Resources vulnerability, resilience and Its sustainability
- T-IV : Groundwater Community Participation, Governance and Regulation for feasible mitigation
- T-V : Perspective on Groundwater Development & Management in Rajasthan

**VENUE: Rajasthan institute of Engineering
and Technology Jaipur, Bhankrota**

Contact: 9887060845, 9540686777, 9818174707, 9829047260, 9868843860
Email: inciahseminarjpr@gmail.com (Submit abstract & paper on this email only)

Declining groundwater – How difficult is to get a bucket of water?



जलं ददाति जीवनम्,
जलं विना मरणम्॥

जल को ना करो बेकार, जल बिना मच जायेगा हाहाकार।
जल है जीवन का आधार, इसे व्यर्थ करके ना करो बेकार।
प्रकृति का यह अनमोल उपहार, जल को इस तरह तुम ना करो बेकार। जल प्रदूषण को रोको, जल संरक्षण के विषय में सोचो।

Groundwater Conservation Tips

10 ways to protect and conserve groundwater

1. Go Native. Use native plants in your landscape. They look great, and don't need much water or fertilizer. Also choose grass varieties for your lawn that are adapted for your region's climate, reducing the need for extensive watering or chemical applications.
2. Reduce Chemical Use. Use fewer chemicals around your home and yard, and make sure to dispose of them properly – don't dump them on the ground!
3. Manage Waste. Properly dispose of potentially toxic substances like unused chemicals, pharmaceuticals, paint, motor oil, and other substances. Many communities hold household hazardous waste collections or sites – contact your local health department to find one near you.
4. Don't Let It Run. Shut off the water when you brush your teeth or shaving, and don't let it run while waiting for it to get cold. Keep a pitcher of cold water in the fridge instead.
5. Fix the Drip. Check all the faucets, fixtures, toilets, and taps in your home for leaks and fix them right away, or install water conserving models.
6. Wash Smarter. Limit yourself to just a five-minute shower, and challenge your family members to do the same! Also, make sure to only run full loads in the dish and clothes washer.
7. Water Wisely. Water the lawn and plants during the coolest parts of the day and only when they truly need it. Make sure you, your family, and your neighbours obey any watering restrictions during dry periods.
8. Reduce, Reuse, and Recycle. Reduce the amount of "stuff" you use and reuse what you can. Recycle paper, plastic, cardboard, glass, aluminum and other materials.
9. Natural Alternatives. Use all natural/nontoxic household cleaners whenever possible. Materials such as lemon juice, baking soda, and vinegar make great cleaning products, are inexpensive, and environmentally-friendly.
10. Learn and Do More! Get involved in water education! Learn more about groundwater and share your knowledge with others.
11. Source: www.groundwater.org

SOFTWARE

Geographical Information Systems

1. **QGIS:** QGIS is a completely open-source GIS tool and can be executed in any operative system. www.qgis.org

2. **SAGA GIS:** It is a GIS platform oriented to spatial analysis. It is a simple but powerful tool for spatial analysis and characterization of basins. www.saga-gis.org

River modeling

3. **HEC-RAS:** This model uses the gradient and topography to evaluate the flow depth, velocities and flooded zones. www.hec.usace.army.mil/software/hecras/

4. **iRIC:** iRIC is a software offers a complete simulation environment of the riverbed <http://i-ric.org/en/>

Hydrologic modeling

5. **HEC-HMS:** HEC-HMS is designed to simulate the hydrologic processes in basins. www.hec.usace.army.mil/software/hechms

6. **PRMS:** The modeling code PRMS is a modular system of spatially distributed parameters, which represent the physical processes of a basin. www.brr.cr.usgs.gov/projects/SW_MoWS/PRMS.html

7. **SWAT:** It is a tool to evaluate soil and water at a basin scale. www.swat.tamu.edu

Hydrogeological modeling

8. **MODFLOW:** This code performs groundwater modeling based on finite differences developed by the USGS. <http://water.usgs.gov/oq/modflow/>

9. **MT3DMS:** The MT3DMS package is a mass transport model coupled to a flux model in MODFLOW. <http://hydro.geo.ua.edu/mt3d/>

Computational fluid dynamics modeling

10. **OpenFOAM:** Pretty much any physical phenomenon associated to fluid dynamics can be represented with this software. www.openfoam.org

Hydrochemical modelling software

11. **PHREEQC:** It is a computer program is designed to perform a wide variety of aqueous geochemical calculations. <https://www.usgs.gov/software/phreeqc-version-3>



Groundwater News in Media

1.2-billion-year-old groundwater is some of the oldest on Earth

Groundwater that was recently discovered deep underground in a mine in South Africa is estimated to be 1.2 billion years old. Researchers suspect that the groundwater is some of the oldest on the planet, and its chemical interactions with the surrounding rock could offer new insights about energy production and storage in Earth's crust. The South African groundwater was also enriched in the highest concentration of radiogenic products — elements produced by radioactivity — yet discovered in fluids, according to the study, demonstrating that ancient groundwater sites may one day potentially serve as energy sources. (Originally published on Live Science)

https://www.nature.com/articles/s41467-022-31413-2?utm_medium=affiliate&utm_source=commission Junction&utm_campaign=CONR_PF018_ECOM_GL_PHSS_ALWYS_DEEPLINK&utm_content=textlink&utm_term=PID100052172&CJ_EVENT=852e4cee5e4211ed817f00c70a180511

Chennai Corporation links stormwater drains with recharge wells

Departing from the usual practice, the Greater Chennai Corporation, which is implementing the project, is linking the stormwater drains to recharge wells, instead of nearby waterways, for better groundwater recharge. The Corporation has also decided not to concretize the two-feet long boxes paved at an interval of every 20 feet in the stormwater drain at places like Coastal Road, Besant Nagar. The unpaved earthen portion would allow rainwater percolation. Work has been taken up to construct drains running to about 79.45 km at a cost of ₹608.24 crore. Recharge shafts had been planned at every 30 meters as part of Kovalam and Kosasthalaiyar Integrated Stormwater Drain projects. In sandy areas that do not have sewage inflow problems, recharge structures are being included in flood mitigation work in Adyar and Cooum basins as well. This would ensure groundwater recharge whenever shallow aquifers have capacity to receive water.

<https://www.thehindu.com/news/cities/chennai/chennai-corporation-links-stormwater-drains-with-recharge-wells-in-besant-nagar/article65662572.ece>

High levels of Uranium observed in 409 groundwater samples in 18 states

The Central Ground Water Board (CGWB) conducted a study to map areas with Uranium contaminated ground water. According to the study, the occurrence of Uranium in ground water beyond the BIS permissible limits (0.03 mg/l) of water were observed in around 409 groundwater samples against 14,377 samples analysed by the CGWB in around 18 States.

<https://www.livemint.com/news/india/high-levels-of-uranium-observed-in-409-groundwater-samples-in-18-states-11658407121089.html>

EYE ON IT

Atmospheric Water Generation Research

Atmospheric water generation (AWG) uses technology to produce potable water from surrounding air. This provides the potential to expand water availability during shortages, contamination events, and other issues that can interrupt drinking water services. Natural disasters, such as hurricanes, and public water infrastructure failures, such as pipe corrosion resulting in contamination issues, have increased the interest in AWG technology as both emergency and long-term supply solutions.

Atmospheric Water Generators

AWG generators range from home-based units that can produce 1 to 20 liters of water per day to commercial-scale units capable of 1,000 to over 10,000 liters per day. Water production rates are highly dependent upon the air temperature and the amount of water vapor (i.e., humidity) in the air. The most commonly used AWG systems employ condenser and cooling coil technology to pull moisture from the air in the same way a household dehumidifier does.

Although significant quantities of energy can be required to operate these condenser and fan systems, recent technological advancements have substantially improved the energy-water ratio—increasing the feasibility of using these systems to help augment the Nation's drinking water resources.

P.6

Reaching New Levels in Groundwater Monitoring

Courtesy: Hasler, C. (2022), Reaching new levels in groundwater monitoring, Eos, 103, <https://doi.org/10.1029/2022EO220517>. Published on 3 November 2022.

Waves, Fast and Slow

Now, a new method may sidestep these problems by exploiting another source of information: seismic data. In a study published in *Nature Communications*, researchers made use of the fact that a seismic wave's velocity is related to the mechanical properties of the medium through which it travels. If the traversed sediments are dry, waves propagate rapidly. If the sediments are saturated with water, wave speed is reduced. By analyzing differences in seismic wave velocities (a technique called interferometry), scientists can back calculate how much water is stored underground.

Because the method uses seismic waves, do scientists need to wait for big earthquakes to map the inner workings of aquifers? No: For her research, coauthor Shujuan Mao used records of so-called seismic ambient noise. "The Earth's surface is always vibrating due to ocean waves or human activity," explained Mao, a postdoctoral researcher in geophysics at Stanford University. "Those vibrations are very small, so we don't notice them, but they are recorded continuously by seismic stations and contain a wealth of information about Earth's subsurface—if we can use them."

A Promising Tool for Probing the Subsurface

Ryan Smith, an assistant professor of civil and environmental engineering at Colorado State University who was not involved with the study, also considers seismic interferometry to be a promising technique. "The paper highlights an exciting new method and shows that it can be used to track groundwater levels in some regions with surprisingly good accuracy," he said, while noting that "since it's a new area of research, more investigation needs to be done on how passive seismic interferometry relates to changes in groundwater within different systems."

Smith concluded that with further development, "passive seismic interferometry has great potential to complement existing approaches for monitoring groundwater."

In her research, Mao continues to refine seismic interferometry as a tool for groundwater monitoring but is also excited to apply it to other problems. "This technique can be applied to many systems, like geothermal fluid operations, freezing and thawing processes in permafrost, and fracking," she explained. "With this profound data set—temporally continuous and in 3D—there are a lot of problems in the shallow subsurface that we can explore."

Popular Talk Series of Indian Chapter of IAH

Popular Talk # 1

Popular Talk Series of Indian Chapter of IAH

Topic: Revival of Australia's Ancient Murray River





Dr Tapas Biswas
Senior Scientist, Land and Water, CSIRO, Australia
Senior academic (adjunct), Australian National University, Canberra

Synopsis

The mighty Murray River is the main tributary (2,500 km long) within the Murray-Darling Basin, which is Australia's largest river basin, covering an area of more than one million square kilometers.

This talk will cover what went wrong with this ancient basin, especially its main tributaries and how actions such as water resources management policy change, environmental flow and community engagement are revitalising the main tributary, Murray River.

Lessons learnt from Murray river basin would be highly useful in managing the environmental flow in Indian River Basins.

August 8, 2022
2.00 PM IST

Meeting link
<https://meet.google.com/fuj-pqde-shi>
dial +1 203-850-7743
PIN: 691 122 361#

Host
Prof. A. K. Sinha
President INC-IAH
Vice-Chancellor, CSMU
Navi Mumbai
groundwater2008@gmail.com

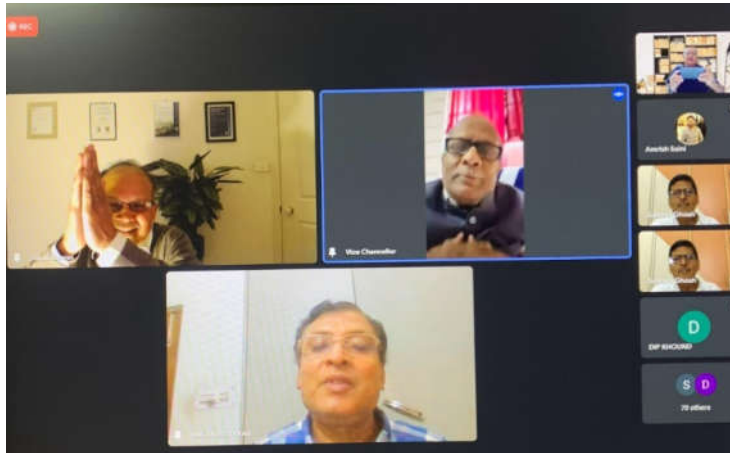
Moderator
Anilanjyoti Kar
Secretary INC-IAH
amlanjkar@gmail.com



INC of IAH
E: info@inciah.com
www.inciah.org

Meeting Admin:
Dr Ashok Kumar
M: 9818174707
E: ashok.kumar@wateraquifers.com

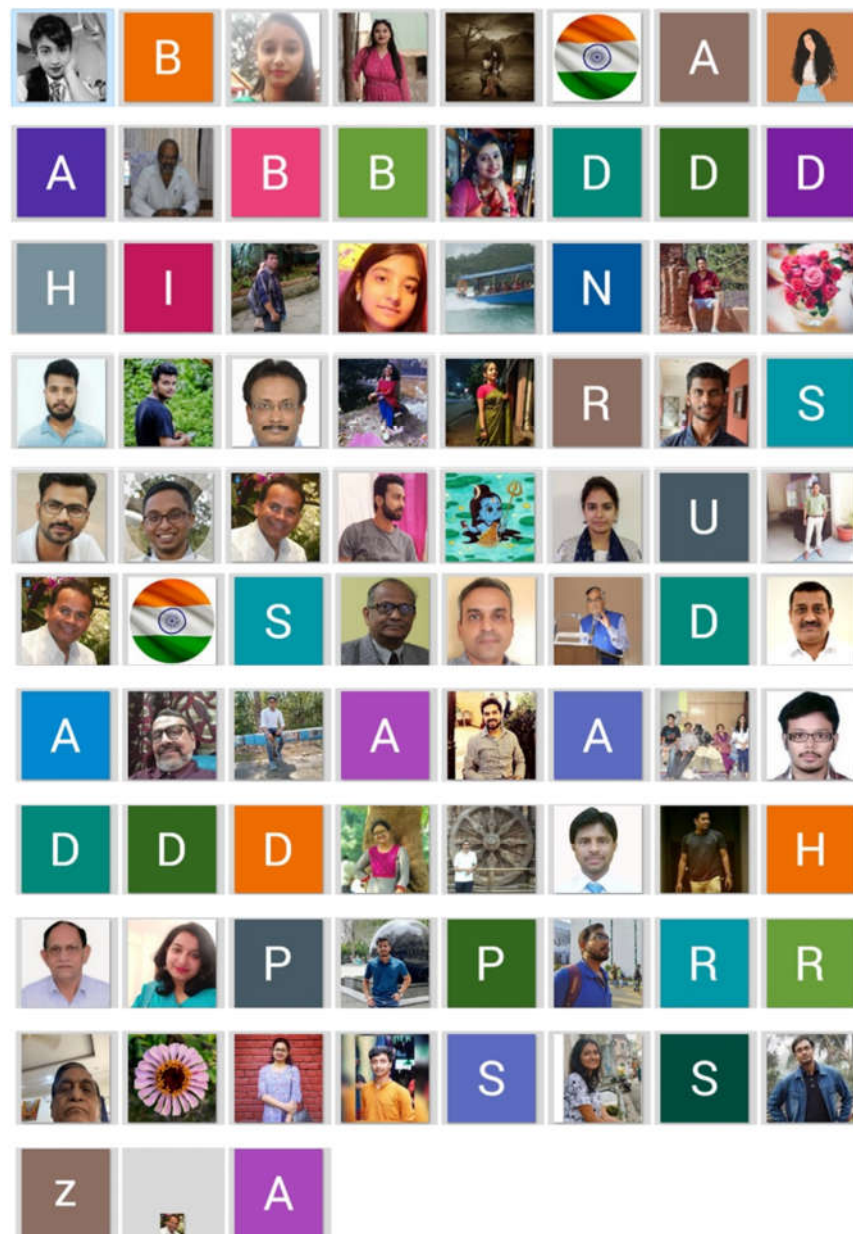
Dr Tapas Biswas, Senior Scientist, Land and Water, CSIRO, Australia, Senior academic (adjunct), Australian National University, Canberra delivered invited talk on topic "Revival of Australia's Ancient Murray River" on 8th August 2022



Conclusion

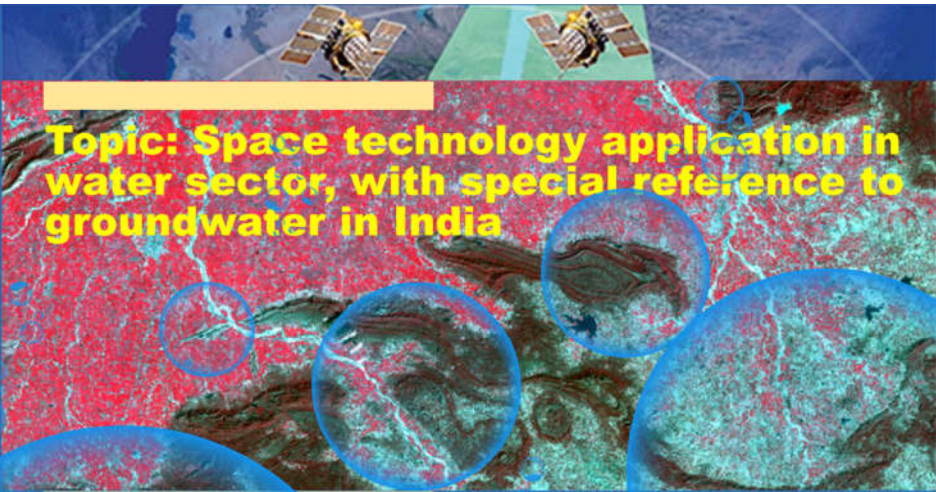
- Water is under tremendous pressure in many countries, Australia is no exception.
- Murray-Darling Basin is the largest river basin in Australia = 4x New Zealand
- It's complex- Geologically, Socially, Economically, Environmentally and Politically.
- MDB water is important for 3 million people and there is a competing needs between many users and water reform was a must thing.
- Water reform in the Basin is an ongoing story; the "Basin Plan 2012" aims to return plenty of water (2,750 GL/yr) to the environment.
- Salinity Management Strategies led to minimise salinity risk.
- Application of credible science must build the foundation for national water policy and then institutions to ensure the sustainability of reforms.
- Sustainable management of water resources is and will be a challenge under future climate change scenario.
- There are now opportunities for shared learning, but critical evaluation is required.

38



Popular Talk # 2

Popular Talk Series of Indian Chapter of IAH



Topic: Space technology application in water sector, with special reference to groundwater in India



Dr. S. K. Subramanian
Scientist-G & Group Director (Retd) , NRSC / ISRO, Dept. of Space, Hyderabad; Colin Mackenzie Chair Professor, DST(Formerly); Adviser-Technical, River Rejuvenation, Art of Living (Honorary)

Synopsis

Remote sensing technology has the advantage of incorporating the spectral data through space and time. The data can be acquired within a short period of time covering a large and inaccessible terrain. It has become a very handy tool in tracking the occurrence of groundwater resources. It also helps in the assessment, monitoring and conservation of groundwater. Satellite data provides quick and useful base line information on the aspects like geology, structure, geomorphology, soils, land use- Land cover, lineaments etc.

The talk will focus on the applicability and usage of remotely sensed data in India and various techniques to support the sustainable development and management of groundwater..

Sept. 17, 2022
3.00 PM IST

Meeting link
<https://meet.google.com/qjd-wgbi-fei>
Dial-in: (US) +1 929-399-6372
PIN: 823 664 309#

Host
Prof. A. K. Sinha
President INC-IAH
Vice-Chancellor, CSMU
Navi Mumbai
groundwater2008@gmail.com

Moderator
Amlanijoti Kar
Secretary, INC-IAH
amlanjkar@gmail.com



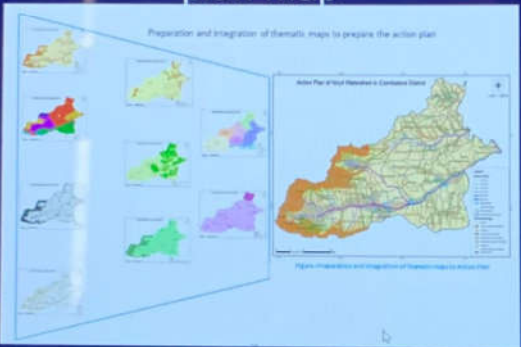
INC of IAH
E: info@inciah.com,
www.inciah.org

Meeting Admin:
Dr Ashok Kumar
M: 9818174707
E: ashok.kumar@inciah.org

Dr S. K. Subramanian, Scientist-G & Group Director (Retd), NRSC / ISRO, Dept. of Space, Hyderabad; Colin Mackenzie Chair, Professor, DST(Formerly); Adviser-Technical, River Rejuvenation, Art of Living (Honorary) delivered invited talk on topic "Space technology application in water sector, with special reference to groundwater in India" on 17th Sept 2022

Subramanian Sk is presenting

GIS – Thematic maps and action plan map



Preparation and integration of thematic maps to prepare the action plan

Action Plan for Digital Resources in Cambridge District

Participants in the video call:

- Subramanian Sk
- Shirish Kulk...
- Vice Chancellor
- Pats
- Shivendra Ku...
- pyare lal vava
- deepak srivast...
- 135 others

vgbj-fei

Participants in the video call:

- Vice Chancellor
- Prof. Amitabha Kar
- RS Chatterjee
- deepak srivastava
- Amlanjyoti Kar
- Subramanian Sk
- Pats
- 50 others

Sh.

Popular Talk # 3

Popular Talk Series of Indian Chapter of IAH

Groundwater management in the world: problems and possible solutions



Prof. Antonio Chambel

*Former President of IAH (2016-2020) and
Professor of Hydrogeology,
University of Evora, Portugal*

Groundwater plays an important role in global hydrological cycle. It is the world's largest extracted natural resources. Globally a lion's share of the drinking water is catered by groundwater. It has provided a boom in the agriculture sustenance to the livelihood and food security. Since groundwater is invisible, it is largely ignored in terms of its management. The decline in groundwater resources as also that of water security is being caused due to the overexploitation as also the alarming rise in pollution of groundwater. The climatic change and sea level rise is also exacerbating the scenario. All these has created an imminent disastrous situation in want of sustainable fresh water resources in general and groundwater resources in particular. It warrants groundwater governance which needs to be tailored as per the local conditions. In matter of global sustainability of groundwater, the flow across the international boundaries through the transboundary aquifer systems, need adequate research and cooperation among the neighbouring countries. Such global issues are now very pertinent.

**October 29, 2022
3.30 PM IST**

Google Meet link

<https://meet.google.com/gvq-ixqu-egz>
Dial-In: (US) +1518-732-6832
PIN: 920 479 879#

Host



Prof. A. K. Sinha
*President, INC-IAH
Vice-Chancellor, CSMU Navi
Mumbai
groundwater2008@gmail.com*



Moderator

Sh. Amlanjyoti Kar
*Secretary, INC-IAH
amlanjkar@gmail.com*

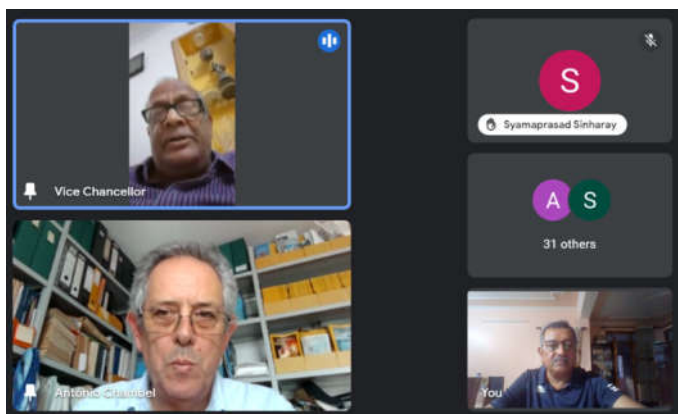
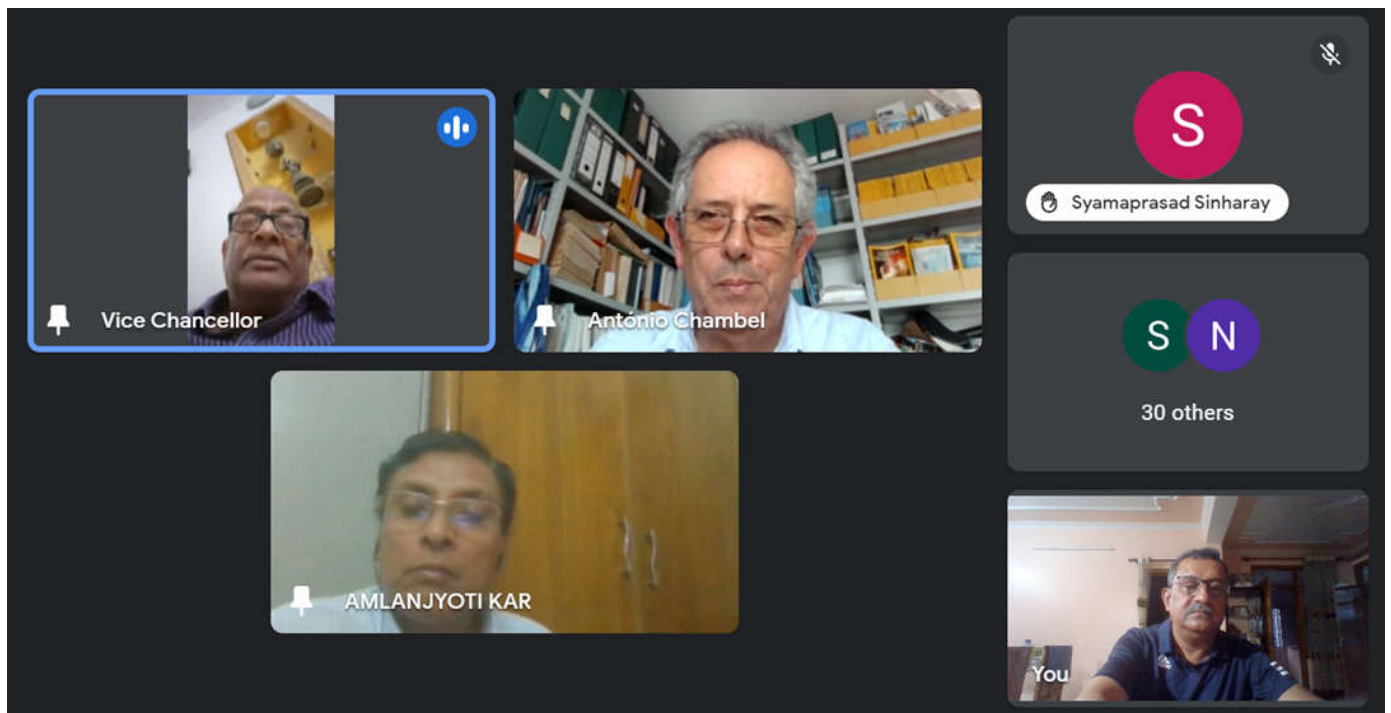


INC of IAH

E: info@inciah.com,
www.inciah.org

Meeting Admin:
Dr Ashok Kumar
M: 9818174707
E: ashok.kumar@inciah.org

Prof. Antonio Chambel, Former President of IAH (2016-2020) and Professor of Hydrogeology, University of Evora, Portugal delivered invited talk on topic "Groundwater management in the world: problems and possible solutions" on 29th Oct, 2022





Sujit Kumar Sinha

Former Scientist,
Central Ground Water
Board, and GW Expert
and Team Leader,
Technical Support
Agency WAPCOS, Atal
Bhujal Yojana,
Department of Water
Resources, River
Development & Ganga
Rejuvenation, Ministry of
Jal Shakti, Govt. of India
E: sujitsinha95@gmail.com



INC of IAH

HQ. c/c Central Ground Water
Board, Bhujal Bhawan, NH-IV,
Faridabad – 121001

E: ashok.kumar@inciah.com

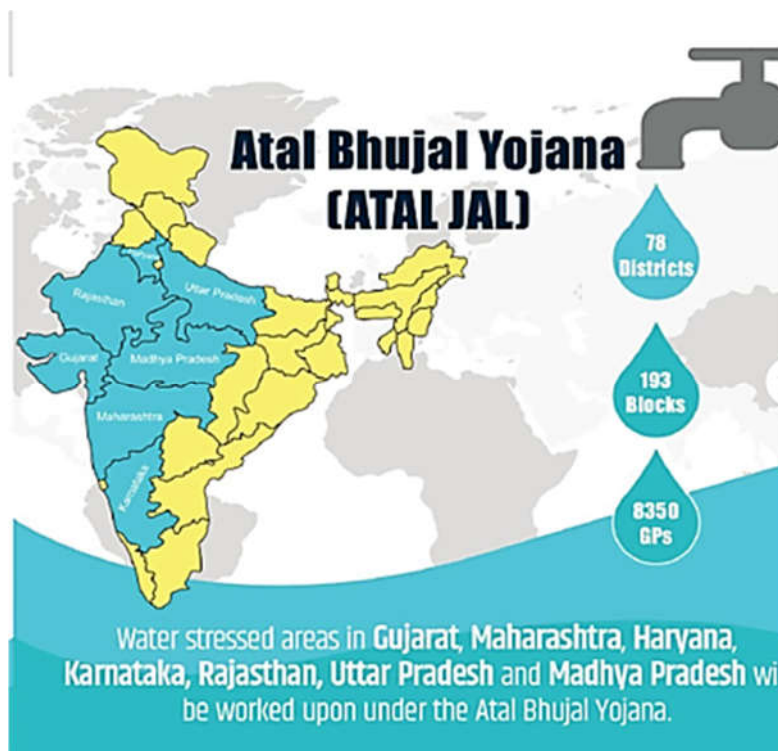
www.inciah.org

Atal Bhujal Yojana

India is one of the fastest growing economies in the world and its achievements in improving several dimensions of human development are impressive. Water security is key for India's continued economic growth and poverty reduction. However, the country continues to face daunting development challenges. Parts of India are already considered water scarce. Increased competition over fragile and finite resources poses risks to economic development, food and energy security and livelihoods.

The Government of India is increasingly placing water security at the forefront of its development agenda. Impact of climate change on ground water is emerging as a major challenge. Therefore, sustainable ground water management, aimed at ensuring sufficient ground water for the future generations is essential to mitigate such adverse impacts.

The present government and policy makers recognized the potential to institutionalize such initiatives through convergence with emphasis on social & gender inclusion, and behavioral change to ensure long-term sustainability of ground water in the country. This understanding is translated into an urgent reform in ground water management approach.

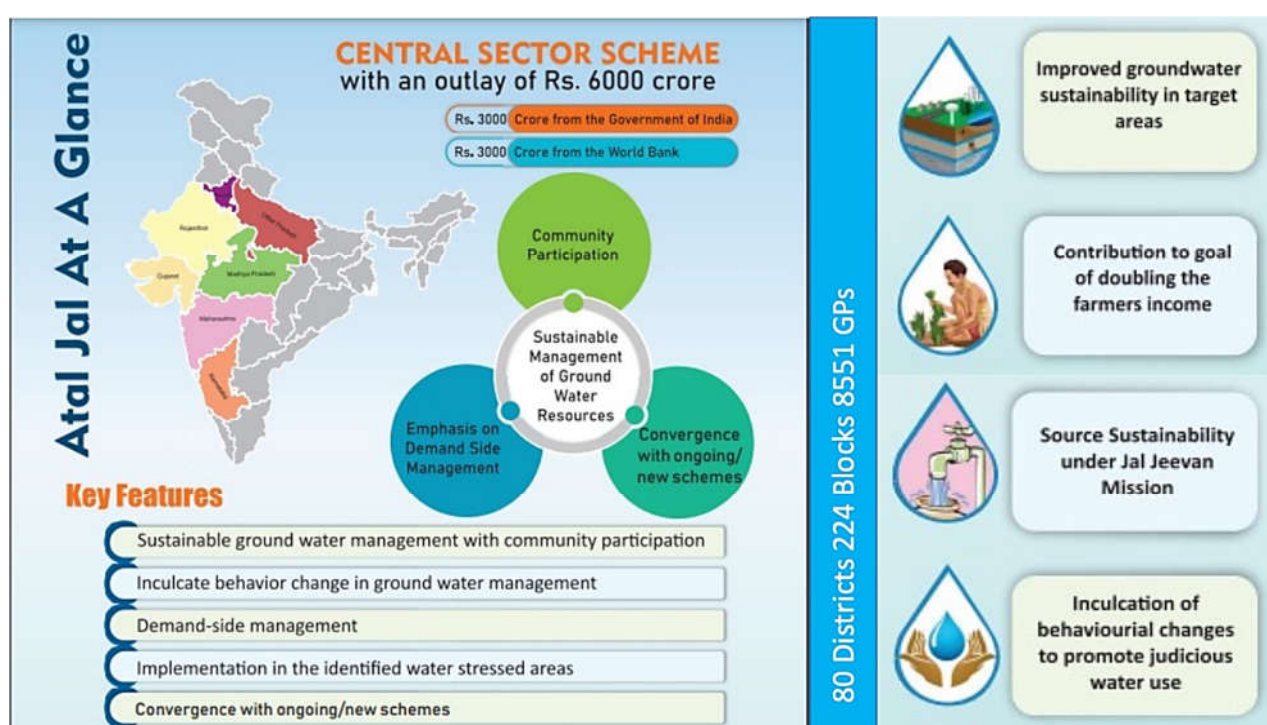


The launch of Atal Bhujal Yojana heralded a paradigm shift in the Government policy of ground water management in the country from the predominantly supply-side augmentation approach to one aiming at reducing demand of water for various uses and ensuring active community participation and bringing behavioural change for long term sustainability.

About Atal Bhujal Yojana

Atal Bhujal Yojana (Atal Jal) is a unique initiative of the Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, and the World Bank. It is a Central Sector Scheme of the Government of India. The program identified select water stressed states viz. Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh. The priority areas within these states include 80 districts, 224 blocks having 8551 Gram Panchayats for a period of five years from 2020-2025.

Atal Jal is a scientifically planned and designed program for sustainable groundwater management, being implemented in participatory way. It offers a complete techno-managerial and social solution to the availability of water to the villagers/local community.



Action taken

The Atal Bhujal Yojana broadly has two major components, the component one is strengthening the Institutional capacity in terms of man power and monitoring network, whereas component is focused incentivizing the states for good performance under various identified disbursement linked indicators. the emphasis is on demand side management. For smooth functioning of the program, state and district management units are established, headed by National Program Management Unit. For community mobilization, grass root capacity building and data collection, District Implementation Partners are put in place. A Core aspect of the program is centered around community participation to prepare water budget of gram panchayat for the preparation of water security plan. Atal Bhujal Yojana aims to strengthen the civil societies to make the state responsive in creating an enabling environment for a paradigm shift in groundwater management

Components

Institutional Strengthening & Capacity Building (Rs 1400 crore)

- Strengthening of Institutional Mechanism for GW governance
- Awareness creation & Capacity building
- Strengthening GW monitoring network
- Upgradation of water quality laboratories
- Operational Expenses

Incentive (Rs 4600 crore)

- User monitoring of GW related information & dissemination of data in public domain
- Preparation of community -led Water Security Plans
- Convergence of public funding under ongoing schemes for supply & demand side measures
- Rise / improvement in declining trend of ground water levels

Unique proposition

Atal Jal ensures active participation of the grass root level stakeholders in community-led water budgeting and preparation of water security plans, use of custom-built mobile app for capturing geo-tagged field data etc. provision for rainfall water level and quality measurements with. The program is the first one of its kind in the ground water space which provides for incentivizing the States on Program for Results (P for R) approach for achieving various pre-defined targets linked to interventions for improved ground water management. The incentives earned by the States are being used to further improve the ground water management initiatives at the levels of Gram Panchayat, block/taluk, district, and State. Participating States are encouraged to have a healthy competition in scheme implementation by a provision for better performers having access to more incentives compared to their lesser performing counterparts.

The program aims at ensuring long term sustainability of ground water resources through a combination of demand and supply side interventions through community led, Gram Panchayat-wise Water Security Plans, by way of convergence of ongoing /new schemes. It also aims at inculcating behavioural changes at the grass-root level toward optimal use of available water through improving the availability of real time ground water data as well as through awareness creation. In fact, this is the first programme of its kind which will involve community-based planning; monitoring; sharing and use of ground water data; capacity building of all stakeholders to demystify the complex science of ground water Further, States shall also be incentivized for adopting practices for improvement in ground water management in target areas.

Atal Jal & Sustainable Development Goals



The programme is closely aligned with the achievement of specific goal number 6.6: protect and restore water-related ecosystems, such as vegetated wetlands, rivers, reservoirs, and groundwater

Achieving gender equality is another critical goal that has been seriously followed in all sorts of planning, preparation and implementation of the programme

The focus of the programme is on demand side management, which essentially is adoption of practices for efficient water use, including crop diversification and promotion of rainfed horticulture

The push is on capacity building of the community-based ground water institutions such as, Water User Associations, Village Water and Sanitation Committee or Participatory Ground Water Management Committee members and the local community. Continued systemic and systematic targeted orientations, workshops and trainings are organised at the Gram Panchayat level to build their capacity to sustain the programme after 2025.

It also aims at bringing about behavioural change at the community level through awareness programs and capacity building for fostering sustainable ground water management in the participating States Specific attention is given on gender equality: women's participation is mandated in planning and implementation along with involving them in leadership roles.

Disclaimer: The views, thoughts, and opinions expressed in the newsletter belong solely to the author and do not reflect the view of the INC-IAH.



Amlanjyoti Kar

Former Regional
Director, Eastern
Region, Central Ground
Water Board, Kolkata,
Ministry of Jal Shakti,
Government of India;
Consultant (Water
Supply), ADB-DHI and
Visiting faculty, Dept. of
Geography, CU and
WBSU
E: amlanjkar@gmail.com



INC of IAH

HQ. c/c Central Ground Water
Board, Bhujal Bhawan, NH-IV,
Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciah.org

Island Hydrogeology: A glimpse on the hydrogeologic framework of Andaman and Nicobar Islands and successful application of artificial recharge for rural drinking water supply

Different modes of availability of fresh water in islands

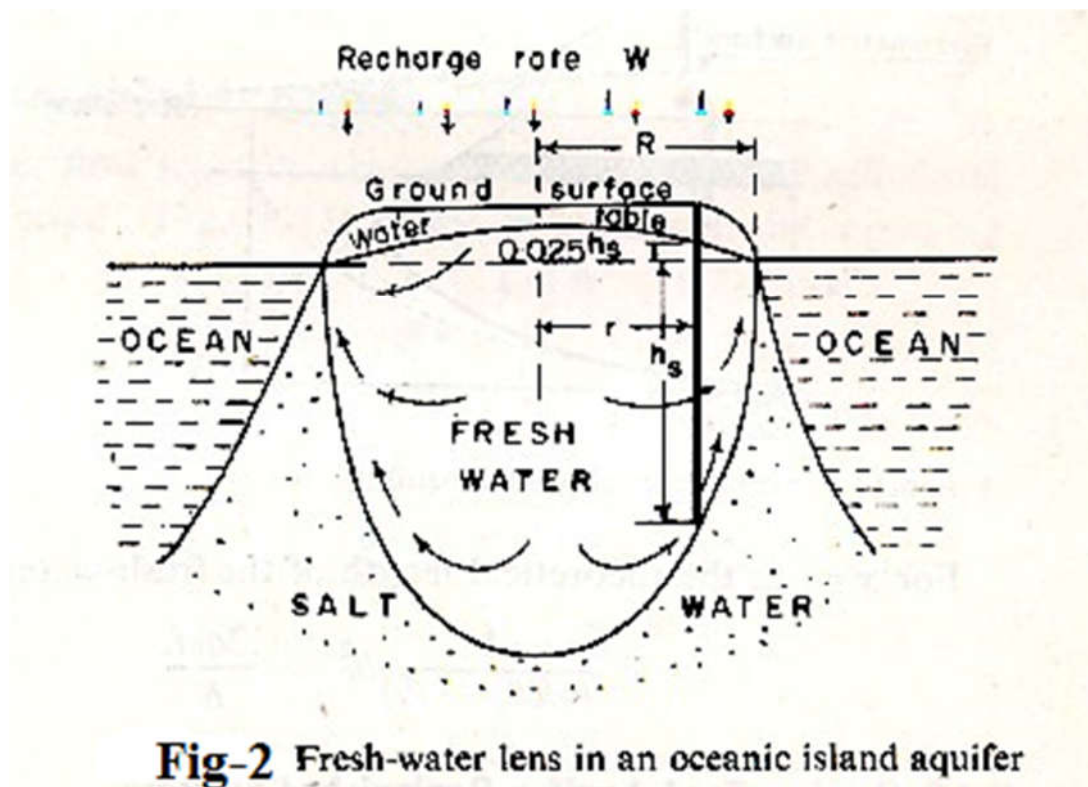
- Availability of fresh water in an island is always interesting and it is fully dependent on its hydrogeological framework.
- As such the availability of fresh water in the islands is having some similarity with that of its availability in mainland coastal aquifers.
- Only it differs as fresh water is having a single interface with the saline water in case of coastal aquifers in mainland while in island in all directions fresh water forms a boundary with saline water irrespective of its shape (Fig-1&2).



Fig-1 A birds eye view of island

- In unconfined aquifers in the small islands, the fresh water floats over saline water because of its lower density.
- The thickness of fresh water lens in the aquifers varies due to
 1. Areal extent of the island
 2. Rainfall
 3. Altitude of the island from mean sea level.
 4. Thickness of the aquifer
 5. Porosity and permeability of the aquifer
 6. Density of the trees with deep root system in the islands. Coconut trees are observed to suck appreciable quantity of groundwater in the small atolls
 7. Ground water pumping/withdrawal.

- The fresh water either in unconfined or in the confined aquifers remains in dynamic equilibrium with the saline water along their interfaces.
- Until the equilibrium is broken due to anthropogenic (over pumping) or natural causes, in general ground water always flows from coast towards the sea.
- While in case of sea water ingress the sea water intrudes into the fresh water bearing aquifers.
- The sea water ingress phenomena may happen due to groundwater over exploitation or natural causes , but it is really difficult to revive the original situation as before as it may take inordinate time.



- Sea water ingress takes place in the coastal areas along the sea coast of mainland or in the islands in case of over development of ground water through pumping.
- Sea water may also ingress naturally with the rise in Sea level due to melting of polar ice or areal devastation as occurred during Indian ocean tsunami.
- Sea water ingress creates contamination of ground water in the subsurface (i.e., in aquifers).
- Besides problem of sea water ingress, the methods of assessing ground water and its management in the islands and conservation of fresh water through artificial recharge may match with the approaches needed to be taken in mainland.
- In the following, the methodical approach of aiming at successful application of artificial recharge in A&N Islands has been highlighted.

A glimpse on hydrogeologic framework of A&N Islands and successful application of artificial recharge and rainwater harvesting

Abstract

Torrential equatorial rainfall, to the tune of over 3000 mm both from the northeast and Southwest monsoon is received in the entire Andaman and Nicobar Islands during April-May to December. Topography, geology and hydrologic variations, climatic aberration and environmental factors, demographic changes hindered the planned development of water resources which remained responsible for the scarcity of drinking water in the islands for a long time since independence especially during the non-rainy months. Pervasive impervious sedimentary rocks with very low ground water potential underlie major parts of the islands. The water supply situation has been shattered often with the drying up of reservoirs or decline in yield of water supplying springs or salinization of the sources for quite some time after the devastating tsunami and earthquake of 26th December 2004. The water supply sources, advocated following the application of artificial recharge technique have been proved highly successful even in the areas underlain by the sedimentaries. Highly productive sources have also been advocated applying artificial recharge method to alleviate acute water scarce situation felt in many pockets especially after the tsunami. The observed results are discussed which may be applied elsewhere depending upon the hydrogeological, meteorological and geomorphological characteristics.

Key words: Artificial recharge and conservation, 26th December 2004 tsunami and earth quake, Andaman and Nicobar Islands, ground water potential, Organic and inorganic Sedimentary rocks, igneous rocks (Ophiolites), Subsurface dam, check dam

Introduction

In spite of copious rainfall, complex geology and hydrogeology are mainly responsible for the formation of un-ubiquitous potential ground water reservoirs in the Andaman and Nicobar Islands. Dearth of good catchment is causing non-availability of surface water projects. Thus, development of ground water as also its management in island situation has been a perennial problem in the archipelago. The research and development work done by the author have revealed good prospect of development of ground water through artificial recharge and conservation, water shed development through conjunctive water use and rainwater harvesting.

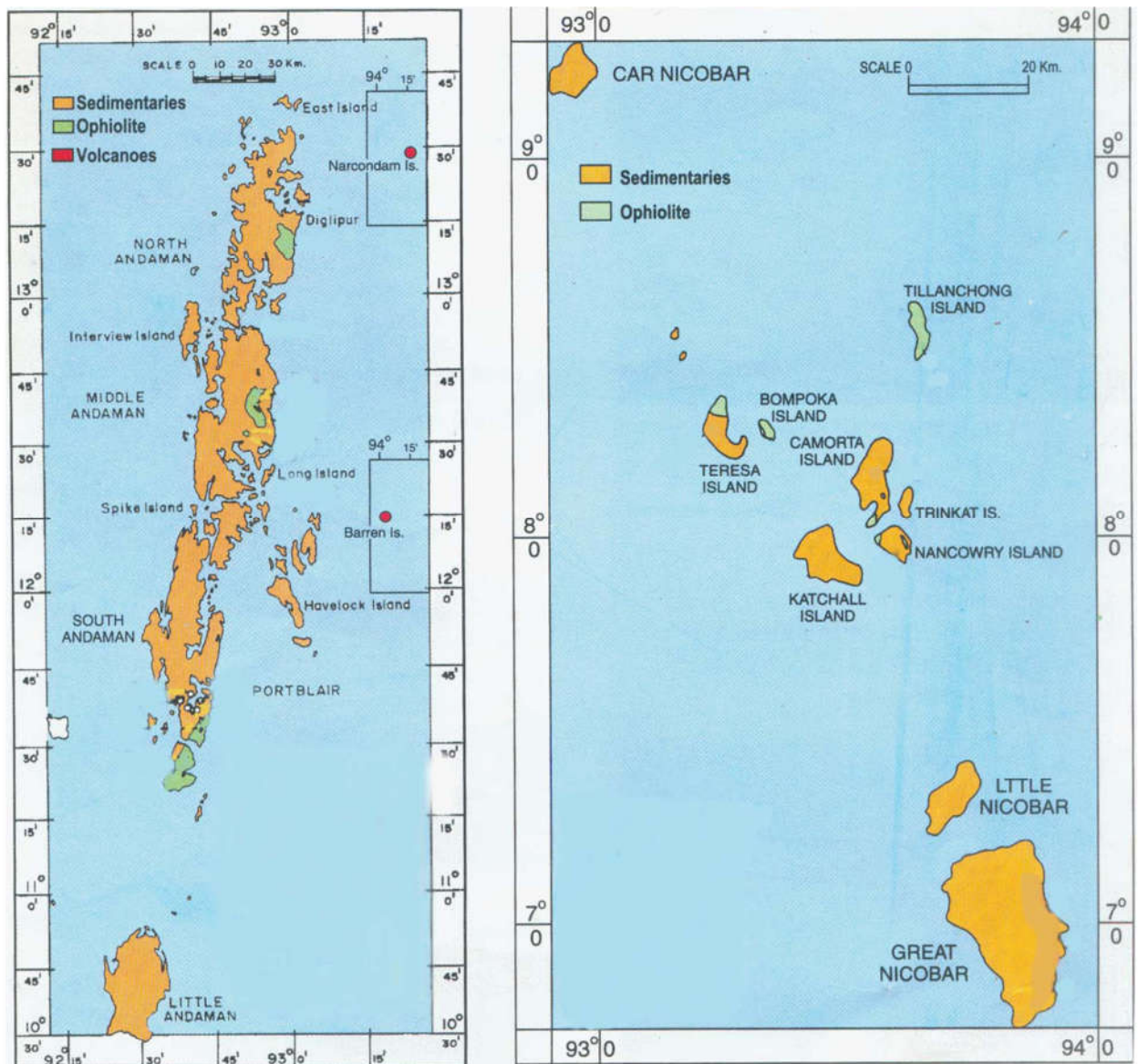
Geology and Hydrogeology

Geologically inorganic Marine sedimentary group of rocks comprising shale, sandstone, grit and conglomerate, limestones, Organic Sedimentaries viz. limestones (Coralline atolls); extrusive and intrusive igneous rocks (volcanics and ultramafic i.e., Ophiolites) occupy the entire geographical areas.

Detailed hydro geological and geophysical studies were carried out (Adyalkar et al., 1981; Banerjee et al, 1988, Chakraborty, 1991, CGWB, (84-90),2002, Kar,2001;2002a, b;2004a-c;2005a, b;2006a-d) coupled with exploratory drilling to unravel the hydro geological set up of the archipelago (Fig-3).

From the studies the following observations were made:

- Geology of the islands are highly varied (Roy et al., 1988, Vohra et al.,1989) and complex. Each Island is having separate geological characteristics, which may vary with the contiguous Islands and even within the same island.
- Nearly 80% of the total geographical area is underlain by impervious marine sedimentaries where ground water development possibility is bleak. Bore wells are unsuitable. Dug wells up to 5m depths and 6m dia. can yield only 4000-5000 liters per day.
- Nearly 8% of the geographical area is underlain by igneous rocks especially Pillow lavas and ultramafic. These rocks are highly fractured and jointed and saturated up to 60m below ground. Borewells, dugwells as also dug-cum-borewells are suitable.
- Yield potential of igneous formation is moderate. Bore wells suitable. Dug wells may yield 25,000-50,000 liters per day. Bore wells may yield 50,000-1,00,000 liters per day. Water availability in these formations was highly affected after the Mega earthquake of 26.12.04.
- The organic and inorganic limestone deposits cover the rest 12% of the total area. These are highly porous potential formations. Dug wells feasible. Yield varies from 1,00,000-5,00,000 litres per day or even more.
- Most of the islands covered by organic Limestone rocks (atolls) were highly affected by earthquake and tsunami because of their low altitude and fragility of the formation.
- Ground water quality is fresh in all islands irrespective of geology except Chowra island and in parts of Neil and Havelock Island where inherent quality problem exists. Of course, some change in ground water quality in some places along coast has been observed after tsunami.
- Rural water supply is generally met from the moderate altitude (50 to 300 m) springs. In general, the springs in Ophiolites and in Limestone are more perennial than the springs originate in inorganic sedimentaries barring the limestones.
- Out of 47 exploratory wells, only two were highly successful (Beadnabad and at Calicut in South Andaman) and four others in Middle Andaman were partially successful (all are igneous formations).



Geology and Hydrogeology of A&N Islands

Sedimentary Formations including Coralline Formations and limestones :

Sedimentaries are poor water yielders both in shallow and deeper horizons

Borewells are not Feasible, Dugwells yield poor to moderate, Springs yield moderately, Drainage density high, rain water harvesting through check and sub surface dams, ponds feasible; Coralline Formations and limestones form prolific ground water reservoirs in shallow to moderately deep horizons, Dugwells pre-ponderant, springs highly emanating.

Volcanics and Ophiolites (Igneous formations):

Highly fractured formations, potential fractures available upto 60m. , Borewells, Dugwells, ponds are feasible. High discharging perennial springs available.

Fig-3 Hydrogeological map of Andaman and Nicobar Islands

Scientific reasons for application of artificial recharge technique in the islands

In the light of the above facts and observations and the research studies carried out (CGWB,2002; Kar, 2002a, b;2004a,2004c,2005a,2006,2007,2009,2010) revealed that lot of fresh ground water is flowing as subterranean flow, besides the surplus runoff water move to the sea along the streams. Considering the deviation of rainfall as also the prolonged dry spell, artificial recharge and conservation studies of ground water was carried out by the author since 2000 utilizing the huge rainfall in A & N islands. The basic factors favouring such type of studies in the islands are:

- Islands receive copious rainfall
- Areas are drained by numerous drainages of various sizes and the major streams exist in North-Middle Andaman and Great Nicobar Islands).
- Even in the terrains underlain by unproductive sedimentary rocks, porous valley fill deposits at places carry appreciable flow of subsurface water round the year.

Methodology and the model design of artificial recharge and conservation structure in A&N islands

- If we can restrict the subterranean flow by sub-surface dams a good amount of groundwater can be restricted to flow out (Fig-4).
- Lot of surplus run-offs may be conserved through check dam (Check weir) as also can be utilized for recharging the subsurface reservoir even in the lean period.
- The recharged and conserved water may be utilized by means of collector wells.
- Hence, as per the hydro-geological situation of the Island, to tackle the water crisis and augmentation of water supply, the artificial recharge and conservation of ground water was proved as the best option.

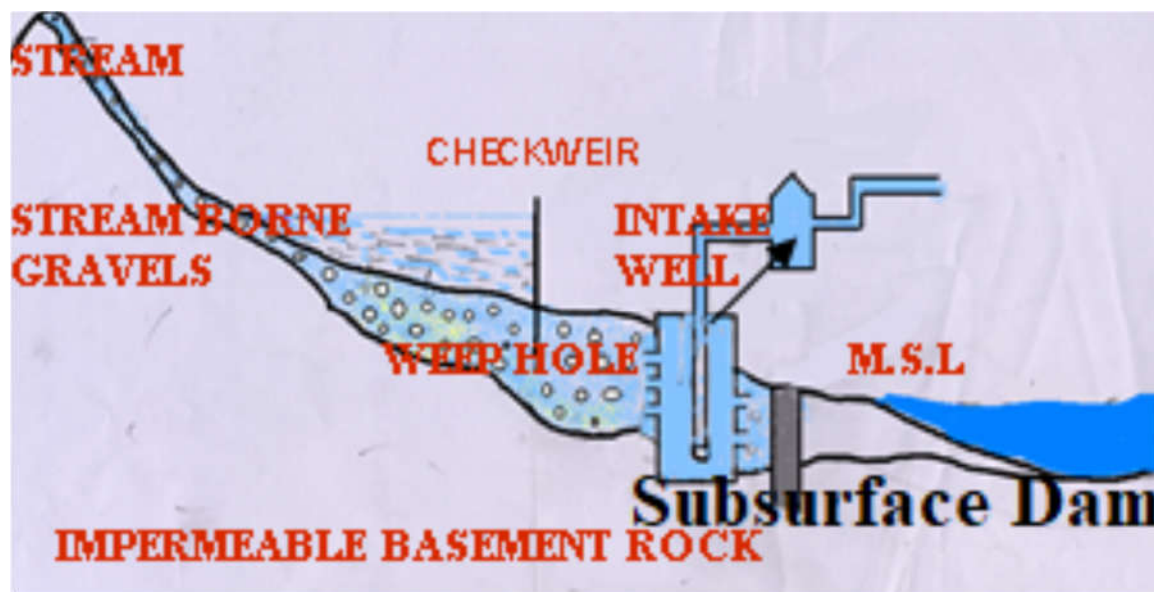


Fig-3 Section showing Model of artificial recharge, conservation and utilization of ground water in A&N islands

- Because of moderate to high slope and huge flash rain cement concrete check dams with proper engineering design are required to be constructed in the islands.
- Similarly, absence of good quantity of sticky clay in the islands hinders the construction of economic subsurface dam/dyke. For this reason, cement concrete dam/dyke of reasonable thickness are constructed in the islands. The other needful structures are cement concrete recharge shaft.
- The conserved water is drawn by means of large diameter (generally 5.0 to 6.0 meters at places even up to 8.0m) R.C.C dug wells. At one place (i.e., at Birdline) dug-cum-bore well was also constructed depending upon the local hydrogeology.
- All the sites are chosen depending upon the detailed hydrological and hydro geological surveys. To ascertain the thickness of porous deposits, which carries appreciable quantity of subsurface water, geophysical studies were also carried out in desired locations.
- The hydrogeological and geophysical studies revealed that thickness of porous deposit varies from few cm to 15 meters Accordingly the thicknesses were assumed precisely as per the detailed field observed during random selection of sites as per necessity from hydro geological surveys.
- The tentative yield of each project was determined prior to the construction from the slug/injection tests in sites to ascertain the permeability. The subsurface sectional flow in any project location were assumed following the formula: $Q=TiL$. Where Q= Extent of flow, T=Transmissivity in m^2 per day ($T=Kb$ while K= permeability in meter per day, b=thickness of aquifer in meter).
- The hydrological studies gave fairly good ideas for determination of the depth, diameter of the well; pump capacity and total yield envisaged from the project.

Artificial recharge studies in the islands during Pre-tsunami

75 recommendations involving the artificial recharge technique were advocated to the Andaman and Nicobar Administration during the pre-tsunami to augment the drinking water supply. 20 recommendations were implemented which yielded highly promising results. Such schemes have augmented the drinking water crisis in Rural Andaman successfully.

Impact of Tsunami and earthquake on Ground water resources

The giant earthquake (M=9.3) followed by the mighty tsunami made a stupendous impact of the 26.12.04 on ground water resources in the islands. This had caused the following changes.

- In high altitude terrains springs, check dams, ponds bore wells (in South Andaman) are either dried up or discharges are declined.
- In lower topographic terrains especially in South Andaman the discharge of streams, springs, and water level in wells are increased. In other places either the discharge is showings some rise or showing little decline or no change. However, in few cases the discharge ceased.

Management of Rural water supply through the new and old sources in the post-Tsunami

Water supply in the rural areas of Andaman is met from spring sources, which was emphatically disturbed, and the discharges were brought down after the earthquake of 26.12.04. However, the mighty spring sources in Rutland Island studied by the author (Kar,2004,2016,2021) for interisland transfer of Spring water to Port Blair. However, the impact of earthquake on discharges of springs in Ophiolite suite of rocks was not perceptible. However, to mitigate the drinking water scarcity after the earthquake and tsunami, new water supply sources were investigated (Kar,2005a; Kar, A et. al 2005b, 2006a,2006b, 2006d; Kar, A,2006c,2007,2009,2010,2013,2016,2018) with the application of artificial recharge and conservation techniques. A sum total of fifteen sources were selected especially in the favorable geological sites, located in the lower altitudes along the valleys. These sources coupled with the twenty numbers of old sources constructed by APWD during Pre-Tsunami were found highly useful to mitigate the acute water supply crisis envisaged after the tsunami.

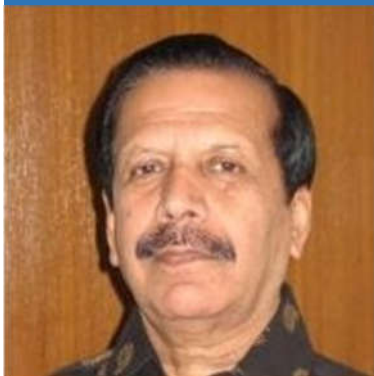
Discussions

From the foregoing discussions it is clear that a lion share of the Andaman and Nicobar Islands is underlain by impervious Sedimentary rocks where ground water cannot be developed through dug wells or bore wells. Although restricted in occurrence, the igneous formations, i.e., the Ophiolites, form moderately potential weathered and fractured aquifer system, sustain dug wells and bore wells. Prolific shallow aquifers are available in the organic sedimentary limestone formations; occur in few atolls as also in narrow coastal tracts. Bulk of the rural drinking water supply is met from the low to moderate altitude (50 to 300 m) springs. In spite of copious rainfall received in the islands, topography, geology, hydrology and climate hinder development of sustainable water supply system especially in the lean periods. The research and development studies by the author in liaison with A&N Administration proved the successful applicability of artificial recharge and conservation techniques in the islands. The rural water supply crisis can be augmented from such sources in the hydro geologically favourable locales. During the 26.12.04 tsunami and earthquake devastation, the ground water resources were stupendously disturbed. Especially at higher altitude, the yields of the ground water supply sources like springs, wells, and ponds were either declined or ceased/dried up. At lower altitude new springs originated. In parts of Andaman and in the entire Nicobar District tsunami waves contaminated the sources along the coasts. The colossal calamity has handicapped the drinking water supply in the entire archipelago. To combat with the situation new potential sources with the application of artificial recharge technique have been identified in the low altitudes along the stream valleys. Such type of sources can be tapped elsewhere in the areas having identical hydro geological situation.

Reference

- Adyalkar, P.G. and Najeeb, K. Md. (1981) Report on systematic hydro geological investigation in parts of South Andaman and Neil islands in Andaman District, A&N islands. (Unpub. Report of CGWB)
- Banerjee, I. et al. (1988) Hydrogeology and ground water resources evaluation in Parts of South Andaman and Campbell Bay, Great Nicobar Islands. (Unpub. Report of CGWB)
- Chakraborty, T.L. (1991) Report on systematic hydro geological investigation in parts of North and Middle Andaman Islands. (Unpub. Report of CGWB)
- Central Ground Water Board (1984-90) Basic data reports of exploratory boreholes in A&N islands.
- Central Ground Water Board (2002) Abridged recommendation of all water supply augmentation structures applying artificial recharge technique in A&N islands
- Kar, A (2001) Hydrogeology of Andaman and Nicobar Islands (Unpub. Report of CGWB)

- Kar, A et al.(2002a) Water supply to rural and urban areas of Andaman and Nicobar Islands with special reference to the application of artificial recharge and conservation technique. Nat. Sem. of Ind. Desalination. Assoc., Kolkata. Abs. Vol.
- Kar, A (2002b) Artificial recharge of ground water for augmentation of water supply and landscape development in Port Blair town and A&N islands. Nat. Sem., LAWMI, Kolkata, Abs. vol.
- Kar, A (2004a) Studies on Hydrogeology of South Andaman Islands with special reference to application of artificial recharge and conservation techniques of Ground water and inter island transfer of Spring water for sustainable water supply to Port Blair town and environs. Trans. M. G.M.I., Kolkata, 100(1&2): pp 37-59.
- Kar, A (2004b) Ground water investigation in water scarce Chowra island, Nicobar District, to explore the possibilities and augmentation of fresh water source through rain water harvesting. (Unpub. Report of CGWB)
- Kar, A et al.(2004c) Conservation and artificial recharge of Ground water-an urgent strategic option for water supply to Port Blair town and surroundings in Andaman Islands. Internat. Geol. Cong., Florence, Italy. Abs.vol,
- Kar, A (2005a) Report on water supply investigation in Burmanala-Macapahar, Laxmipur and Kadamtala area of South, North and Middle Andamans in view of severe water scarce situation in the post-Tsunami
- Kar, A et al (2005b). Impact of 26th December 2004 tsunami and earthquake on ground water resources in A&N islands: post-tsunami studies by Central Ground water Board (Unpub. Report of CGWB)
- Kar, A et al (2006a) Integrated hydrogeological and geophysical surveys in Little Andaman Island with special reference to tsunami and earthquake calamities and its effect on water Resources (Unpub. Report of CGWB).
- Kar, A et al (2006b) Water supply for Car Nicobar Island after tsunami and earthquake with reference to resettlement (Unpub. Report of CGWB)
- Kar, A (2006c) Abridged report with strategies, recommendations and guidelines for development of ground water resources and rain water harvesting post-tsunami, as per different hydrogeological situation in the water sheds of Andaman and Nicobar Islands (Unpub. Report of CGWB).
- Kar, A and C. P. Gawri (2006d) Hurdles in framing ground water management strategies in A&N islands in the aftermath of tsunami. Proc. of 12th Nat. Symp. on Hydrology. Nov.14-15, 2006, New Delhi, pp-181-202
- Kar, A (2007) Successful application of artificial recharge technique to mitigate acute drinking water crisis in Rural Andaman in the Post – Tsunami: a few case studies. Proc. Int. Ground water congress. Coimbatore (Published by Mac Millan, New Delhi, K. Palaniswami (Editor).
- Kar, A (2009) Management of groundwater in the mega earthquake(M=9.3) affected hard rock aquifers of South Andaman, Island, India". Proc. of Int. Conv. of 37th Congress of IAH and 8th Sci. assembly of IAHS, Hyderabad,6-12th Sept., 2009.
- Kar, A and Srivastava, K. K (2010) Post tsunami changes on groundwater quality in Andaman and Nicobar Islands and its bearing on sea level rise. Proc. of workshop on Climatic change and its impact on water resources-Adaptation issues held at Chandigarh from 23-24 Nov'10 (D. K. Chadha editor),PP-1-8.
- Kar, A (2013) Water resources development and management in A&N Islands. Presentation before the Parliamentary standing committee, MOWR, GOI at Port Blair.
- Kar, A, Majumder A, Dey, S (2016) Water management challenges in A&N Islands. Spl. Publ. No.5, Geological Society of India.
- Kar, A (2018) Water resources development and management in A&N Islands. Presentation before the Parliamentary standing committee, MOWR, GOI, at Port Blair.
- Kar, A (2021): Inter-Island transfer of spring water from Rutland Island to Portblair, Andaman and Nicobar Island, for sustainable urban water supply. Bhujal Samvad, CGWB, MoJS, Govt. of India.



L. N. Aggarwal

Former Director,
Geological Survey of
India, Govt. of India;
Principal Consultant,
Allengeotech Consultants
& Engineers and Experts
Member of Hydro Power
Projects Himachal Pradesh
and Rajasthan)
E: lnagarwal1@hotmail.com



INC of IAH

HQ. c/c Central Ground Water
Board, Bhujal Bhawan, NH-IV,
Faridabad – 121001

E: ashok.kumar@inciah.com

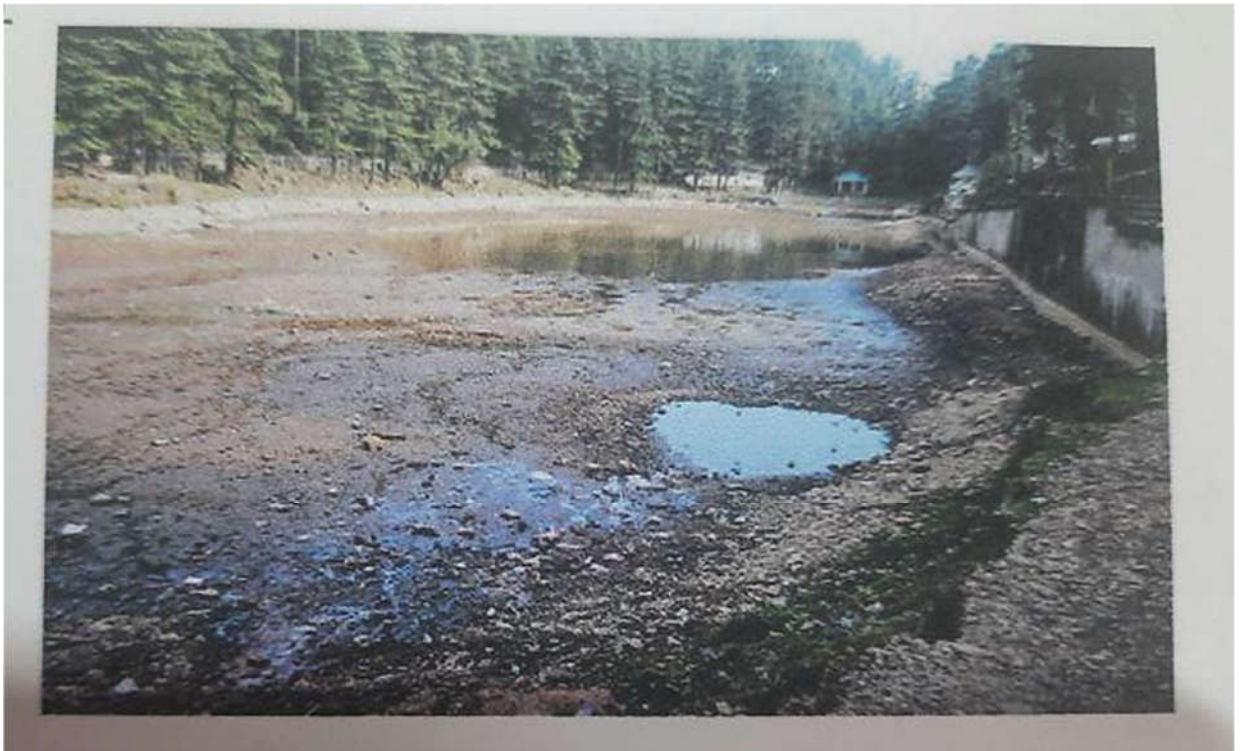
www.inciah.org

DHARAMSHALA DAL LAKE UNDER THREAT

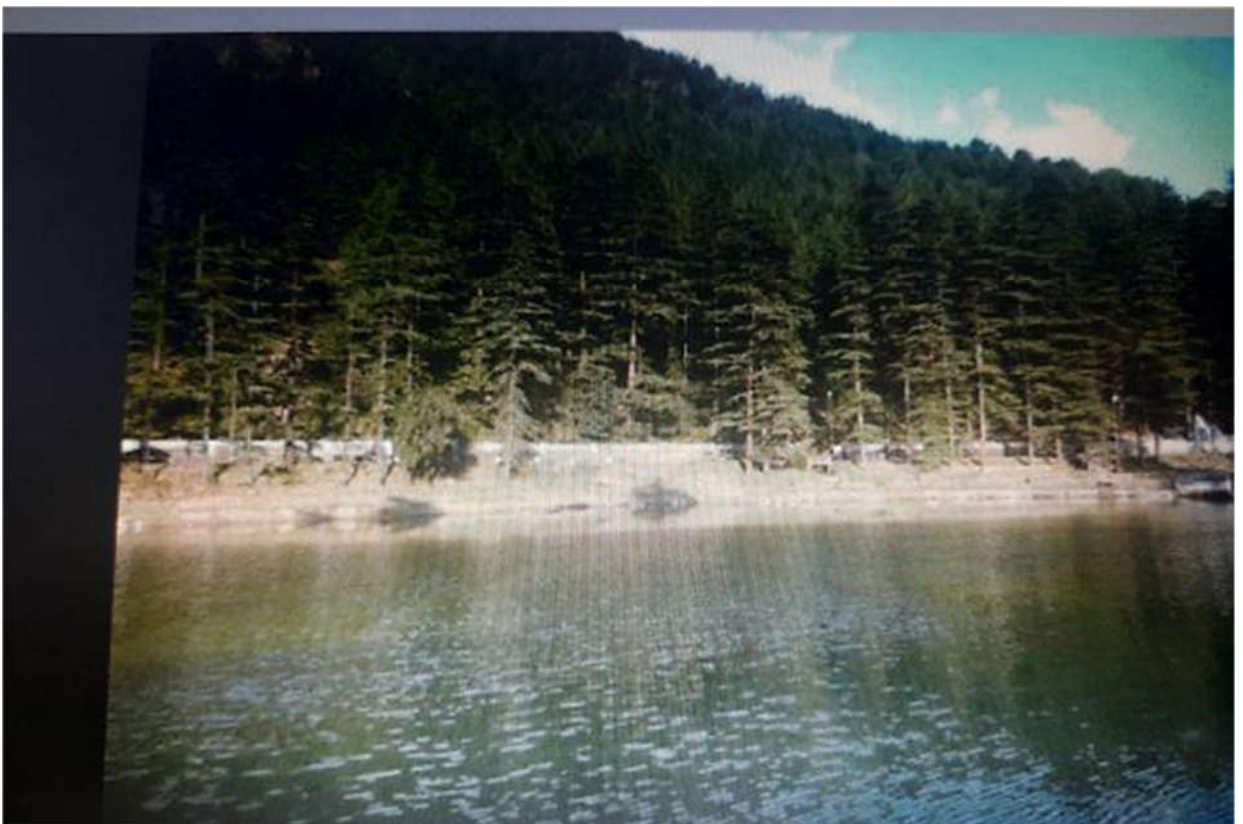
Himachal Pradesh can be called the State of Lakes having well known not less than 17 lakes and Dharamshala Dal Lake in district Kangra is one of them. It is 11 kms. From Dharamshala and 2 kms. From MacLeod Ganj at an altitude of 1775 mts. (5824 feet) above m.s.l. within the foothills of Dhauladhar mountains, flanked by tall Deodar trees on the Northern side having great scenic beauty. It has religious importance likewise that of Lama Dal Lake which is sacred to Lord Shiva and part of holy pilgrimage in district Chamba at an elevation of 12990 feet a.m.s.l. The Dharamshala Dal lake too has ancient Shiva temple on the southern bank which is considered to be as old as 200 years. According to one legend, a sage named 'Durvasa' prayed to Lord Shiva at this place and an annual fair is held on the auspicious day of Sawan Shivratri in the month of August or September depending on Hindu Calendar.

As per the revenue records, the area of the lake is about 1.22 hectares or 12,200 sq. mts., however, due to silting and negligence its area is reduced to half. During the monsoon the lake has been brimming with water and tourists used to enjoy boating in this lake. The depth of the lake that was about 10 feet has also reduced because of which the lake also lost its natural flora and fauna.

The lake was desilted about 10 years back by the local government authorities in an unscientific manner without seeking advice from the experts resulting in the seepage of water from the bed as whole of impervious blanket from the floor of the lake was removed. The area of inlet of water has also been encroached upon and inflow in the lake is minimised. Despite all this the authorities have spent more than Rs. 50 lakhs in the name of saving the lake and its beautification but all in vain. In the year 2016 in an interview with 'The Tribune' the English News Paper, the author had suggested several measures to revive the lake, stop the leakage and to increase the inflow, such as- floor of the lake should be cleaned of all the muck and unwanted material. To prevent the seepage, the permeability of the bed rock/soil should be determined, and one cut off should be provided up to suitable depth on the southern side depending on the head of water, under the supervision of Engineering geologist and groundwater expert. To check the flow of silt into the lake, small check dams can be constructed in the channels draining water into the lake. The inflow of silt should be stopped from the northern side by raising small preventive wall and plantation of grass that would prevent erosion of soil. It was also suggested that periodic inspections should be undertaken to assess the performance of the measures taken. But the authorities have paid no heed. In the year 2018 the centre is said to have approved Rs. 4 crores for the restoration and beautification of sacred lake but to no use.



Dal Lake in summer



Dal lake in rainy season

Disclaimer: The views, thoughts, and opinions expressed in the newsletter belong solely to the author and do not reflect the view of the INC-IAH.



Dr. Anadi Gayen

Regional Director (I/C),
Eastern Region
Central Ground Water
Board, Kolkata - 700091
Department of Water
Resources, River
Development & Ganga
Rejuvenation,
Government of India,
Ministry of Jal Shakti,
E: ag.cgwb@gmail.com,
anadigayen1968@gmail.
com



INC of IAH

HQ. c/c Central Ground Water
Board, Bhujal Bhawan, NH-IV,
Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciah.org

Establishing a New Water Museum in the National Level Water Training and Research Institute Campus – Concept, Design and Approach

1.0 Introduction

Water, the elixir of life has shaped rich civilizations throughout the India and has enthused the various aspects of human livelihood like the rituals and practices, art and architecture, poems, songs, music, stories, folklore, film and dance. A worthy relationship and understanding in between museum authority and the architect are of pre-requisites for planning and design a new museum. 'JAL' is the first water museum located in the Chowkaria village at a distance of 12km from Udaipur, Rajasthan, which helps to explore the relationship in between water and technology and further to provide proficient advice in water harvesting, conserving and auditing. Water museum has an important role to play for citizens to be conscious of water conservation systems, old water heritage structure and new innovative water conservation methods, which will in turn help to understand the techniques for water harvesting and sensible optimal use of water. The concept of Living Waters Museum (LWM) through a digital platform was launched in the Ahmedabad University, India to accumulate and assemble rich and varied traditions of water practices in our country and build a storehouse of imagined knowledge, which can remember the past, motivate the present and be a basis of learning for the future (Center for Heritage

Management, Ahmedabad University, 2017). Water museum can help to visualize the interrelationship among water, food and cultural practices. For example, the LWM in Gujarat has explored the interrelation possibility in collaboration with Vishala restaurant, Ahmedabad, wherein in the given agro-ecological context (semi-arid) the use of grains that are water-tolerant, such as millet, has seen a revival in local diets in recent years for health concerns. Further, the entrusted team is shaping the water footprint of a typical Gujarati thali (plate) served at the traditional restaurant along with locally popular drink in the state for existing climatic conditions.

To plan a modern water museum in the National level Water Training and Research Institute Campus, it is important to take into consideration that the architect is supposed to have detailed knowledge and technical expertise about the type of objects to be displayed and the message to be conveyed through display items. It is also important that the competent authority is supposed to entrust/ assign to the Museologist only, who will have a complete know-how about the model/ objects display mechanism and administrative structure require for the effective management of water museum.

For developing a new museum, the following factors are to be taken into consideration

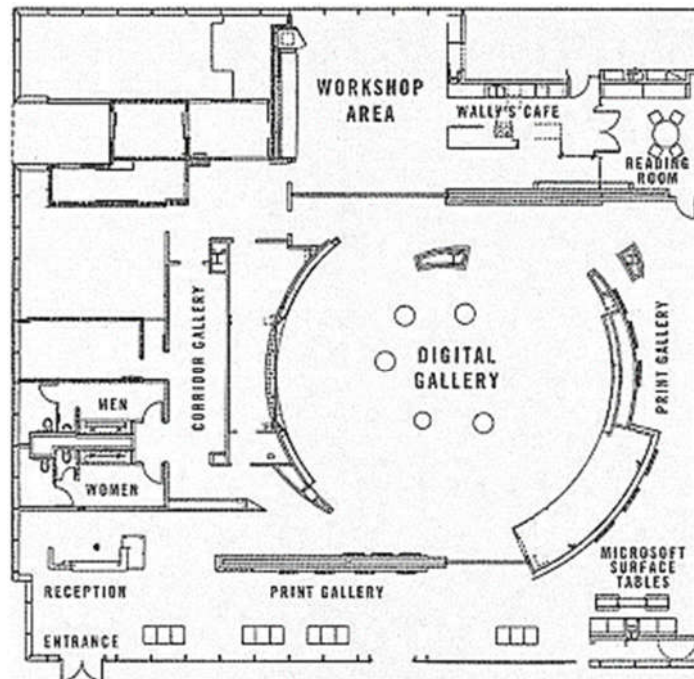
- I. Feasibility of the museum and its assessment in terms of the number and type of visitors/ trainees the museum is likely to be attracted.
- II. Long term viability of the museum.
- III. The types of objects are likely to be housed of.
- IV. The quality of services the visitors/ trainees may expect.
- V. Sufficient space including free staircases and corridors for free movement of the visitors/ trainees are of utmost importance.
- VI. Museum management and financial perspectives.
- VII. To serve as a dynamic media of effective communication in popularizing the scientific utilization and management of water resources
- VIII. To inculcate a sense of inquiry and scientific temperament in the minds of people of different cross-sections of the society on various aspects of water resources

Broadly the water museum at National Water Training and Research Institute Campus may be designed into two components:

- a) In-house water museum within the institute building and
- b) Open air water museum

1.1 In-house water museum within the National level Water Training and Research Institute campus

- Considering the necessary requirements of the visitors/ trainees, the following objects/models may be displayed in different earmarked galleries. At the entrance a display board to be placed containing the brief history of the museum, its importance, salient objects displayed and their significance. Brief history of CGWB and CGWA with logo may be incorporated for having overview/ inputs of organisation set up and activities. This will help to build an impression and significance of the museum to the visitors/ trainees.
- Immediately entering inside the museum gate at left side electronic visual running display arrangement about the history, departmental outlay and administrative structure of the organisation, scientists, and societal contributions. In right side, there will be electronic visual running display about the detailed activities of the Central Ground Water Board (CGWB) and Central Ground Water Authority (CGWA). □ At the ground floor, one library cum reading room with all water related books, leading journals and magazines etc. have to available.
- Receptions counter (Fig.1) with Floor Plan along with Digital Gallery. One register is essential to be maintained in the reception itself for visitor entry record and comments/ suggestions about the water museum.



Source: <https://www.pinterest.com/pin/213639576054203317/>

Fig.1 Sample Water Museum Reception counter & Reading Room with Floor Plan

Hydrology Gallery

Hydrological parameters and their applications and significance for ground water investigation and management with facts and figures through display of laminated charts (Fig.2).



Fig.2 Hydrological Cycle

Ground water Exploration Gallery

Plaster of Paris (PoP) models of drilling rigs (Fig. 3) used for different geological formation to be displayed with signage and brief description. Aquifer disposition in the Kolkata Municipal Corporation area and Geological Map along with Aquifer Disposition details of study area is shown in fig.4 and fig.5 respectively.



Fig.3 Direct Rotary Drilling Rig for Alluvium area

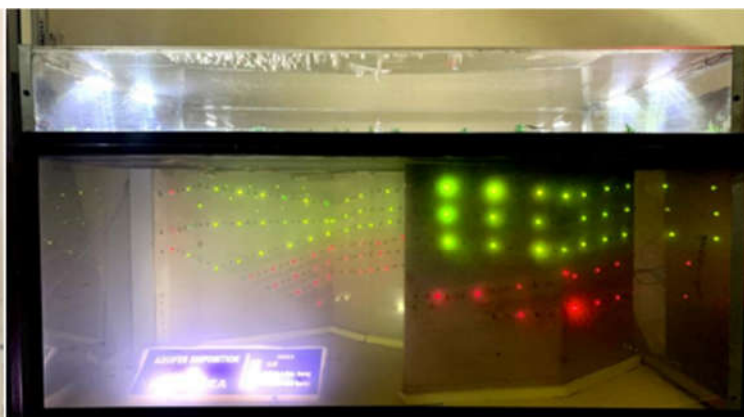


Fig.4 Aquifer disposition in the Kolkata Municipal Corporation area

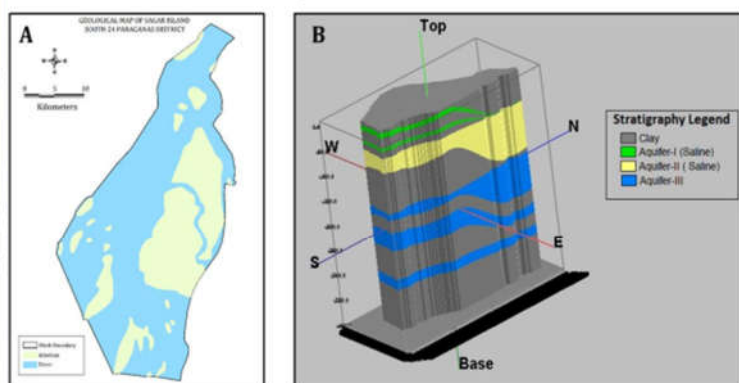


Fig.5 Geological Map along with Aquifer Disposition details of study area

Ground water monitoring and Regional Office Data Centre (RoDC) Gallery

Laminated flipchart display explaining briefly the selection criteria of monitoring stations, significances, applications and societal implications of ground water regime monitoring. PoP models of different types of abstraction structures like dug well, tube well, bore well and piezometers may be displayed with signage. Automatic Water Level Recorder (AWLR) / Digital Water Level Recorder (DWLR). Telemetric monitoring method and utilities to be explained through laminated display chart.

Ground water Appraisal and Management Gallery

Charts and Figures including field perspectives

Geophysics Gallery

Geophysical instruments, including TEM, their applications and significance for ground water research. Vertical Electrical Sounding (VES) data interpretation is shown in table 1 and Geophysical Logging chart in the Arsenic affected area is depicted in fig.6.

Table 1. Interpretation of VES data for determining aquifer characteristics

Location	Co-ordinates	Resistivity in ohm-m					Thickness in metre				Lithology	Zones Tapped	Hydrolic Properties of Subsurface Aquifer System
		P1	P2	P3	P4	P5	H1	H2	H3	H4			
Kachuberia	21.8407N 88.1389E	1.7	1.1	6.5	25.5	3.8	3.9	56.1	15.0	205.0	0.00-75.00 mbgl. brackish formation, below fresh formation down to 280.0 mbgl. Again brackish formation	164-170 m 172 – 175 m 204 – 210 m 251 – 263 m Saline sealing: 152-162 m. Well construction depth: 269.54 m bgl	Pump stage: 4 Stage VT pump Static Water level: 4.04 m bgl Duration: 08 hours. Discharge: 27500 Gallon per hr. Maximum Draw down: 7.04 m.
Location	Co-ordinates	Resistivity in ohm-m					Thickness in metre				Lithology	Zones Tapped	Hydrolic Properties of Subsurface Aquifer System
		P1	P2	P3	P4	P5	H1	H2	H3	H4			
											starts.		
Bamankhali	21.8246N 88.1249E	1.5	1.0	7.4	38.0	--	3.5	97.5	22.0	--	0.00-123.00 mbgl. brackish formation, below fresh formation.	244-264 m 274-286 m Saline sealing: 90-100 m. Well construction depth: 290.93 m bgl	Static Water level: 6.50 m bgl Duration: 05 hours. Discharge: 15100 Gallon per hr. Maximum Draw down: 6.81 m.
Krishnanagar	21.7776N 88.0926E	1.1	0.9	6.8	35.0	--	3.3	138.7	31.0	--	0.00-173.00 mbgl. brackish formation, below fresh formation.	194 – 212 m 225 – 231 m Saline sealing: 168-178 m. Well construction depth: 237.80 m bgl	Pump stage: 3 Stage VT pump Static Water level: 5.20 m bgl Duration: 08 hours. Discharge: 19500 Gallon per hr. Maximum Draw down: 16.74 m
Rudranagar	21.7444N 88.1036E	2.2	1.3	7.5	42.0	--	4.1	120.9	27.0	--	0.00-152.00 mbgl. brackish formation, below fresh formation.	198-222 m 238-248 m 261-272 m Saline sealing: 112-120 m. Well construction depth: 275.66 m bgl	Pump stage: 3 Stage VT pump Static Water level: 5.41m bgl Duration: 09 hours. Discharge: 25500 Gallon per hr. Maximum Draw down: 7.90 m.
Ganga Sagar	21.6460N 88.0723E	2.1	1.2	7.4	41.5	--	3.9	135.6	27.5	--	0.00-167.00 mbgl. brackish formation, below fresh formation.	176 – 188 m 190 – 196 m 230-242 m Saline sealing: 163-173 m. Well construction depth: 255.54 m bgl	Static Water level: 5.49 m bgl Duration: 48 hours Discharge: 19500 Gallon per hr. Draw down: 11.71 m

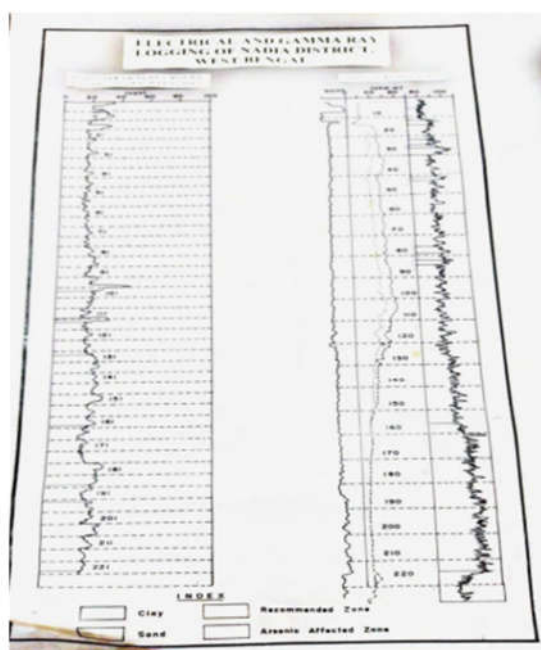


Fig. 6 Geophysical Logging chart in the Arsenic affected area



Fig.7 Ground water Quality management (Model & Diagram)



Fig.8 Pollution of groundwater by industrial effluents

Remote Sensing and GIS Gallery: Satellite imageries, interpretation methods, their applications and significance for ground water research.

Ground water Modelling Gallery: Ground water modelling methods and successful models of different hydrogeological conditions to be displayed through electronic visualization.

Ground water Resource Estimation Gallery: Display of laminated charts describing ground water resource estimation methods with salient points and significance.

Ground water Hydraulics: Methods, applications and significance to be displayed through charts, diagrams and figures.

Ground water quality and pollution management Gallery: Ground water quality parameters along with their pollution components and remedial strategies for ground water management with facts and figures through display of laminated charts.

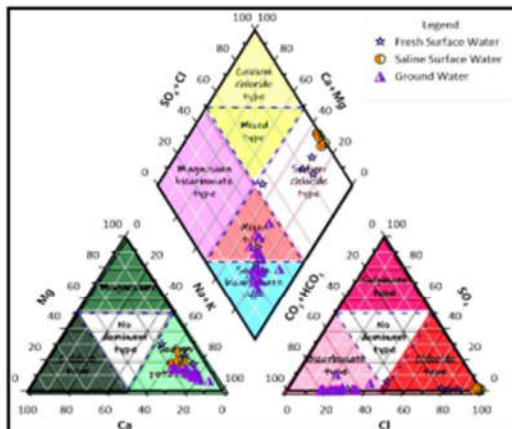


Fig.9 Piper Diagram on display



Fig. 10 Chemical Equipment

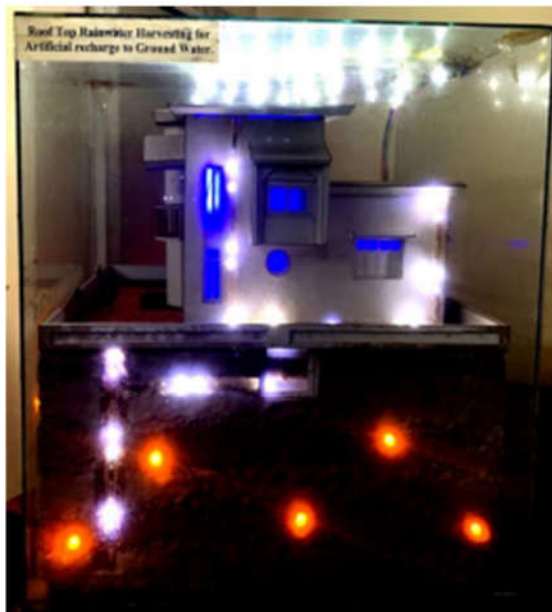
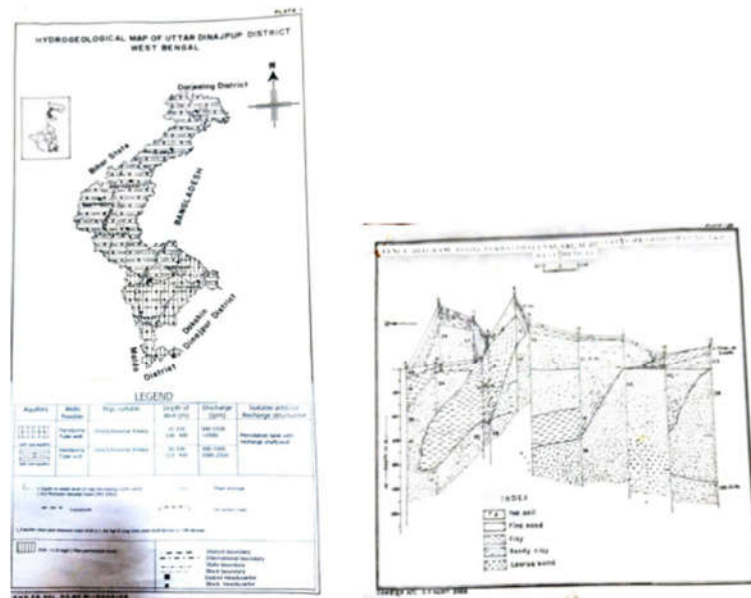


Fig.11 Roof-top Rain water Harvesting and Artificial Recharge



Source: CGWB, Eastern Region

Fig.12 Hydrogeological Map and Fence Diagram on display prepared by Cartographers

Ground water conservation and recharge gallery: PoP models of rain water harvesting, drawings, laminated charts are to be arranged to explain the methods and strategies of rain water harvesting (RWH), conservation and artificial recharge (AR) / managed aquifer recharge (MAR).

Cartographic Gallery: Preparation of different ground water maps/ figures through different software to be explained by display of laminated charts.

Water Heritage and Water Architecture Gallery: Since the inception of this universe, water has served and sustained societies for the humankind. People have enthusiastically shaped its course, form, and role for human settlement followed by the development of civilizations. They have created water oriented socio-economic structures, policies, and cultures; a rich world of stories, laws, and practices; and an all-embracing tangible network of infrastructure, buildings, and urban clusters. Today, the multifaceted and varied systems of the past are essentially the framework for preservation and reuse as well as for new systems. The water Heritage gallery is a solicitation to consider the treasurable liquid and its optimum utilization. The gallery may include a collection of donated water in public and associated stories. These donations include water from the last ice age, a muddy puddle, water from Mecca and the Ganges, ghost water, breaking waters, Norwegian spit, and water from sub-surface typical aquifer system.



Source: <https://www.watermuseums.net>

Fig.13 Water Architecture Gallery

Museum architecture by means of water has been of growing significance over the centuries, especially more in recent times. A challenge for water-oriented museum architecture is the differing purposes of the building. The museum collection including water related traditions/ structure must be preserved and essentially needs to be made easily accessible to the visitors. The museum has remained one of the most important cultural institutions for centuries. The preservation and proper presentation of the water related art works, artifacts, and other objects in museums are useful for sensitizing the visitors for their educational programmes, engaging entertainment, and world-class architecture.

1.2 Important aspects/ features of the In-house Water Museum

- a) All the display items need to be showcased by transparent water proof durable long lasting sheets.
- b) One experienced guide may explain and help to the visitors in the water museum.
- c) The display arrangements in the water museum must be properly planned and maintained.
- d) Display objects are needed to be preserved regularly through restoration and conservation by the expert.
- e) Artificial lighting may be achieved with the help of fluorescent lights, spot lights, false sky light, louvered lights, trough lights, troffer lights etc.
- f) Ventilation in the museum should be achieved through natural means, Security arrangement is one of the important factors to be considered during designing the museum.
- g) Architect should take care of beauty, functions and utility of the water museum.
- h) Planning and design should be done in such a manner that both interior and exterior of the museum building will develop a recreational as well as learning atmosphere to the visitors/ trainees.

2.0 Open Air Water Museum: The available open space surrounding the National Water Training and Research Institute campus building may be utilised for open air museum without making the space clumsy

- Ground water exploration corner: Drilling rig (defunct), drilling rods uses of different stages of drilling, drilling bits of different sizes, casing pipes, sample catcher, sample keeping box with partitions, defunct VT pump (4"/ 6"), V notch 900 & 600 and related items.
- Hydrometeorological corner: Wind mill, soil infiltration test arrangement, rain gauge station, humidity measuring instrument and other weather monitoring components.
- Ground water hydraulics corner: New one bore well in a corner area of National Water Training and Research Institute (NWTRI) campus may be drilled for pumping test demonstration to the trainees.
- Rain water conservation through reservoir pond: One pond in the available space may be constructed with beautification of the boundary to display as water conservation structure.
- Roof top rain water harvesting arrangement to be made at the National level Water Training and Research Institute Campus hostel building for demonstration to the trainees.

3.0 Conclusions

Mother earth is peerless and unique, because this planet is the only identified place across the universe, where water is present as a liquid and is supporting life forms in all its variety to flourish. In the initial stage, when the growth of human population was insignificant, its influence on the earth and its water resources was controllable. But over the historical periods, population explosion has an adverse effect on both quality and quantity of fresh water resources. Human impact has resulted in growth of expansive cities, industries and agricultural production, which is consequently polluting river water and ground water with cumulative amounts of waste and thus precious water systems, is being threatened. The water museum would be of great help to create

awareness about this stressed white gold, which will sensitise the museum visitors especially the children about the water, which is considered as the lifeline of all the living beings. The exhibits/ displays/ models/ documents in the water museum intend to portray the total array of water-oriented issues starting from the occurrence, distribution, management, and sustainability issues of water resources. In the current water stressed world the burning issue its availability, at the place of need, climatic aberrations, and change in hydrological cycle causing the threat perceptions. Related issues include heritage water conservation practices, significance of water all life forms and effect of water pollution from industries, irrigation return flow and other sources. Water bodies/ rivers have a prominent role to play in various cultural practices also. Indiscriminate extraction of ground water and wastage are creating a havoc, which may help to develop consciousness among the visitors about the preservation of water wealth and they may realize the gravity of the water issues and challenges that future generation likely to confront. To attract the visitors / trainees coming to the water museum, the following factors are to be taken due care of:

- i. The proper maintenance of the museum.
- ii. Cleanliness.
- iii. Variation in the display arrangement.
- iv. The friendly and helpful staff.

References

CGWB, Eastern Region, Kolkata

<https://www.pinterest.com/pin/213639576054203317/>

<https://indianculture.gov.in/other-collections/water-elixir-life-new-gallery-national-science-centre-new-delhi>

<https://www.watermuseums.net>

<https://www.livemint.com/mint-lounge/features/rajasthan-s-immersive-new-water-museum-1564733356866.html>

<https://www.watermuseums.net/museum/living-waters-museum-center-for-heritage-management-ahmedabad-university/>

<https://www.livingwatersmuseum.org/storyofvav>

<https://www.livingwatersmuseum.org/invisiblewater>

Disclaimer: The views, thoughts, and opinions expressed in the newsletter belong solely to the author and do not reflect the view of the INC-IAH.



Upcoming Groundwater Conferences



INC of IAH

HQ. c/c Central Ground Water Board, Bhujal Bhawan, NH-IV, Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciah.org

Upcoming Groundwater Conferences

21-23 Nov 2022 – Perth Convention and Exhibition Centre

IAH Events

Australasian Groundwater Conference 2021

Science, Resilience and Adaptation. (POSTPONED TO 2022 OWING TO PANDEMIC)
Groundwater is increasingly recognised as a vital global resource, supporting healthy people, economies and environments. AGC2021 will be hosted by the International Association of Hydrogeologists at the Perth Convention and Exhibition Centre, Monday 21 to Wednesday 23 November 2022. The Conference promises to attract a large number of delegates and organisations representing industry, consulting, government and academia, making it the premier groundwater industry conference in the Australasian region. This year's conference theme is Science, Resilience and Adaptation, topics that have been well and truly at the fore over the past 12 to 18 months.



<https://agc2021.com.au/>



AGC2021@arinex.com.au

23-25 Nov 2022 – Albacete (Spain)

IAH Events

Annual Iberian Groundwater Meeting

Annual meeting. The purpose of this congress is to bring together groundwater professionals of the Iberian Peninsula in order to share knowledge and experiences. In this sense, the call is open to consultants, drillers, academics, students and, in general, to all those who orient their activity to hydrogeology. Official languages are Spanish and Portuguese.

Price: € 350 - 500

Organised by Spanish Chapter IAH.



<https://cias2022.webs.upv.es/>



c.guardiola@igme.es

6-8 Dec 2022 – Las Vegas, Nevada, USA

Other Events

Groundwater Week 2022

Leading the Way. Join with thousands of groundwater professionals to share knowledge, ideas, and insights to lead the way of the industry during Groundwater Week 2022, which is taking place December 6-8 in Las Vegas, Nevada (USA). Hear the latest in groundwater research during the Science & Engineering Forum at Groundwater Week covering everything from emerging contaminants and managed aquifer recharge to groundwater remediation and sustainability. In addition, there are workshops, networking opportunities, an unparalleled lineup of exhibitors, and more, all designed to define the industry's, and your personal, path to success.

Price: Varies

Organised by National Ground Water Association.



<https://groundwaterweek.com/>



customerservice@ngwa.org

7-8 Dec 2022 – Paris

IAH Events

UN-Water Summit on Groundwater 2022

The UN-Water Summit on Groundwater 2022 aims to bring attention to groundwater at the highest international level.

Held in December 2022, the Summit will use the UN World Water Development Report 2022 as a baseline and the SDG 6 Global Acceleration Framework to define actions towards more responsible and sustainable use and protection of this vital natural resource.



Upcoming Groundwater Conferences



INC of IAH

HQ. c/c Central Ground Water Board, Bhujal Bhawan, NH-IV, Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciah.org

The Summit will unify the statements from all major water-related events in 2021 and 2022 into one comprehensive groundwater message for the UN 2023 Water Conference. The hybrid event, based in Paris, will be from 7 December 2022 to 8 December 2022. More details will be available soon.

Organised by UN Water.



<https://www.worldwaterday.org/stories-2021/story/un-water-summit-groundwater-2022>

12-13 Dec 2022 – Universality of Larbi Tebessi-Tebessa, Algeria

Other Events

5th international symposium on the geosciences at the service of sustainable development

Larbi Tebessi University –Tebessa is launching a call for papers for the symposium on the question of "Geosciences at the service of sustainable development", which will be organized on December 12 and 13, 2022 at the University of Larbi Tebessi-Tebessa, Algeria (online by Zoom or Google Meet). The primary purpose of this scientific event is to bring together the most significant number of specialists in the field of geosciences to allow exchanges and the updating of newly acquired scientific knowledge in this field.

Deadline of abstract reception: 15/09/2022, Notification of acceptance and issue of invitation: 30/10/2022, Final program: 20/11/2022.

Organised by Larbi Tebessi-Tebessa University, department of earth science and universe.



<https://bit.ly/38Fq7JU>



karima.seghir univ-tebessa.dz

20-24 Mar 2023 – Medellin

IAH Events

VII Congreso Colombiano de Hidrogeología

Groundwater for sustainable development. The Colombian Association of Hydrogeologists and IAH Colombia extend a cordial invitation to the VII Colombian Congress of Hydrogeology to be held in the city of Medellín from March 20 to 24, 2023. For this VII version of our emblematic event will have the participation, discussion and knowledge of international experts, private entities, governmental, associations, Academy and Community for "Groundwater for Sustainable Development".



<https://www.asociacioncolombianadehidrogeologos.org>



congresoach@gmail.com

22 Mar 2023 – World Wide

Other Events

World Water Day

Accelerating Change. UN-Water Members and Partners decided that the theme of the 2023 World Water Day (March) and the World Toilet Day (November) campaign will be "Accelerating Change." The UN World Water Development Report will further focus on partnerships and cooperation with the provisional title "Accelerating Change through Partnerships and Cooperation".



<https://www.unwater.org/about-un-water/what-we-do/inspire-action>

22-24 March 2023 - The UN 2023 Water Conference

The UN 2023 Water Conference – formally known as the 2023 Conference for the Midterm Comprehensive Review of Implementation of the UN Decade for Action on Water and Sanitation (2018-2028) – will take place at UN Headquarters in New York, 22-24 March 2023, co-hosted by Tajikistan and the Netherlands.



<https://www.unwater.org/news/un-2023-water-conference>

A wide-angle photograph of a large, modern lecture hall. The room features a curved ceiling with a large, illuminated rectangular light fixture. Rows of blue chairs are arranged facing a stage area with a large screen and two speakers. Large windows on the sides offer a view of the city.



INC of IAH

HQ. c/c Central Ground Water Board, Bhujal Bhawan, NH-IV, Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciiah.org

. 23-28 Apr 2023 – Vienna, Austria, and online

Other Events

EGU General Assembly

The EGU General Assembly 2023 brings together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary, and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience.

November 2022: call for abstracts now open.



<https://www.equ23.eu/>

25-27 May 2023 – Trabzon Turkey

IAH Events

HYDRO'2023

Hydrogeology and water resources. Biannual National Symposium on Hydrogeology and Water Resources organized by the Turkish National Chapter HIDRODER in collaboration with a university.

Price: 250 Turkish Liras

Organised by Karadeniz Technical University and Turkish National Chapter HIDRODER.



ktuhidro2023@gmail.com

14-16 Jun 2023 – Malta

IAH Events

Flowpath – National Meeting on Hydrogeology

The Italian Chapter of the International Association of Hydrogeologists (IAH) is pleased to invite you to the 6th Edition of FLOWPATH, the National Meeting on Hydrogeology. Following the tradition of the previous editions of FLOWPATH, the conference will be an opportunity for hydrogeologists and professionals to exchange ideas and discuss different issues on groundwater resources.



<https://www.iahitaly.it/news/flowpath/flowpath-malta-2023-first-announcement>

27 Aug - 1 Sep 2023 – Stockholm, Sweden, and online

Other Events

SIWI World Water Week

Innovation for water. Further details to follow.



<https://www.worldwaterweek.org/>

24-25 April 2023 - San Antonio, Texas

Managed Aquifer Recharge: Unleashing Resiliency, Protecting Groundwater Quality
(conference #5029)

1-3 Dec - Bangkok & Online

Water Security & Climate Change Conference

The Water Security and Climate Change Conference (WSCC) is an annual event where scientists, policy makers, and stakeholders from various sectors discuss the diverse facets of water security and its relationship to climate variability and climate change.

Upcoming Seminar



NATIONAL SYMPOSIUM CUM WORKSHOP ON SPRINGSHEDED MANAGEMENT

18-19th November 2022
NERIWALM, Tezpur, Assam

Organized by
North Eastern Regional Institute of Water
and Land Management (NERIWALM)

In collaboration with

National Institute of Hydrology
Department of Water Resources, RD &
GR,
Ministry of Jal Shakti, GoI

&
Central Ground Water Board
Department of Water Resources, RD &
GR, Ministry of Jal Shakti, GoI

THEME

- Springshed management for sustainable hills of NE India.
- Water resources of NE India and spring dependency assessment.
- Climate change and impact on springshed.
- Spring rejuvenation and policy initiatives for sustainability.
- Hydro-logy and geological aspects of springs in the sub-Himalaya region of India.
- Capacity Building, initiatives and road maps for spring rejuvenation.

Important Dates:

Abstract Submission	30th September 2022
Abstract Acceptance	10th October 2022
Full Paper Submission	20th October 2022
Last Date of Registration	30th October 2022
Date of Symposium cum Workshop	18th-19th November 2022

How to apply :

Please fill up the registration form and send it by email to neriwaltraining18@gmail.com or register in google form code: <https://forms.gle/gQtCqxxLA6VBmRDJA>

The accepted abstract will be notified latest by 10th October, 2022. Authors whose abstracts are accepted will have to submit a full paper on or before 20 October, 2022. Selected papers will be published in pre and post seminar proceedings.

Venue

The Seminar will be held at NERIWALM campus at Tezpur. It is located at about 2200 Km. east of New Delhi, and 900 Km. north east of Kolkata and 180 km away from Guwahati. The NERIWALM campus is located just 3 Km. away from Tezpur town. It is well connected by roads, railway and air.

Accommodation

Accommodation will be provided for delegates/paper presenters. For participants, accommodations will be arranged by NERIWALM on their request.

RESEARCH

Contribution by INC-IAH Members



INC of IAH

HQ. c/c Central Ground Water Board, Bhujal Bhawan, NH-IV, Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciah.org

Environmental Earth Sciences (2022) 81:430

<https://doi.org/10.1007/s12665-022-10520-8>

THEMATIC ISSUE

Hydrogeological investigation of fluoride ion in groundwater of Ruparail and Banganga basins, Bharatpur district, Rajasthan, India

Vikas Rena¹ · Chandrashekhar Azad Vishwakarma¹ · Priyadarshini Singh¹ · Nidhi Roy¹ · Harshita Asthana¹ · Vikas Kamal¹ · Pardeep Kumar¹ · Saumitra Mukherjee¹

Discover Water



Research

Groundwater and agriculture potential mapping of Mewat District, Haryana, India

Gokul Pradeep¹ · Gopal Krishan²

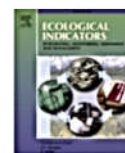


ELSEVIER

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind



A comprehensive water quality index based on analytical hierarchy process

Herojeet Rajkumar^a, Pradeep K. Naik^{b,*}, Madhuri S. Rishi^c

Environ Monit Assess (2023) 195:37

<https://doi.org/10.1007/s10661-022-10555-1>

Assessment of groundwater salinity using principal component analysis (PCA): a case study from Mewat (Nuh), Haryana, India

G. Krishan^a · A. Bhagwat · P. Sejwal · B. K. Yadav · M. L. Kansal · A. Bradley · S. Singh · M. Kumar · L. M. Sharma · M. Muste

Jour. Geol. Soc. India (2022) 98:1407-1416

<https://doi.org/10.1007/s12594-022-2188-6>

ORIGINAL ARTICLE

Human Health Risk Assessment of Harmful Heavy Metals and Uranium Exposure in Shallow Aquifer of Nagaon, the Highest Populated District of Assam, India

Rinkumoni Barman¹, Snigdha Dutta¹, Keisham Radhapyari^{1*}, Suparna Datta², Rishi Raj³, Biplab Ray¹ and Sudhir Kumar Srivastava⁴



Environ Monit Assess (2022) 194:923
<https://doi.org/10.1007/s10661-022-10637-0>

Potentially toxic elements in groundwater of the upper Brahmaputra floodplains of Assam, India: water quality and health risk

Snigdha Dutta · Rinkumoni Barman · Keisham Radhapyari ·
 Suparna Datta · Kiran Lale · Biplab Ray · Tapan Chakraborty ·
 Sudhir Kumar Srivastava

CHAPTER 3 Surface and groundwater interactions: Methodology and changing chemical processes

Gopal Krishan and Anjali Bhagwat
 National Institute of Hydrology, Roorkee, Uttarakhand, India



Applied Geomorphology and Contemporary Issues
 pp 411–423 | [Cite as](#)

Review on Sustainable Groundwater Development and Management Strategies Associated with the Largest Alluvial Multi-aquifer Systems of Indo-Gangetic Basin in India

[Anadi Gayen](#)



CASE STUDIES in Geospatial Applications to Groundwater Resources

Edited by
 Pravat Kumar Shit, Gouri Sankar Bhunia, and Partha Pratim Adhikary

10

Field-based spatio-temporal monitoring of hydrograph network stations to predict the long-term behavioral pattern of groundwater regime and its implications in India: A review

Anadi Gayen

CENTRAL GROUND WATER BOARD, EASTERN REGION, KOLKATA, DEPARTMENT OF
 WATER RESOURCES, RIVER DEVELOPMENT AND GANGA REJUVENATION, MINISTRY OF
 JAL SHAKTI, GOVERNMENT OF INDIA, INDIA

Contribution
 by INC-IAH
 Members



INC of IAH

HQ. c/c Central Ground Water Board, Bhujal Bhawan, NH-IV, Faridabad – 121001

E: ashok.kumar@inciah.com

www.inciah.org