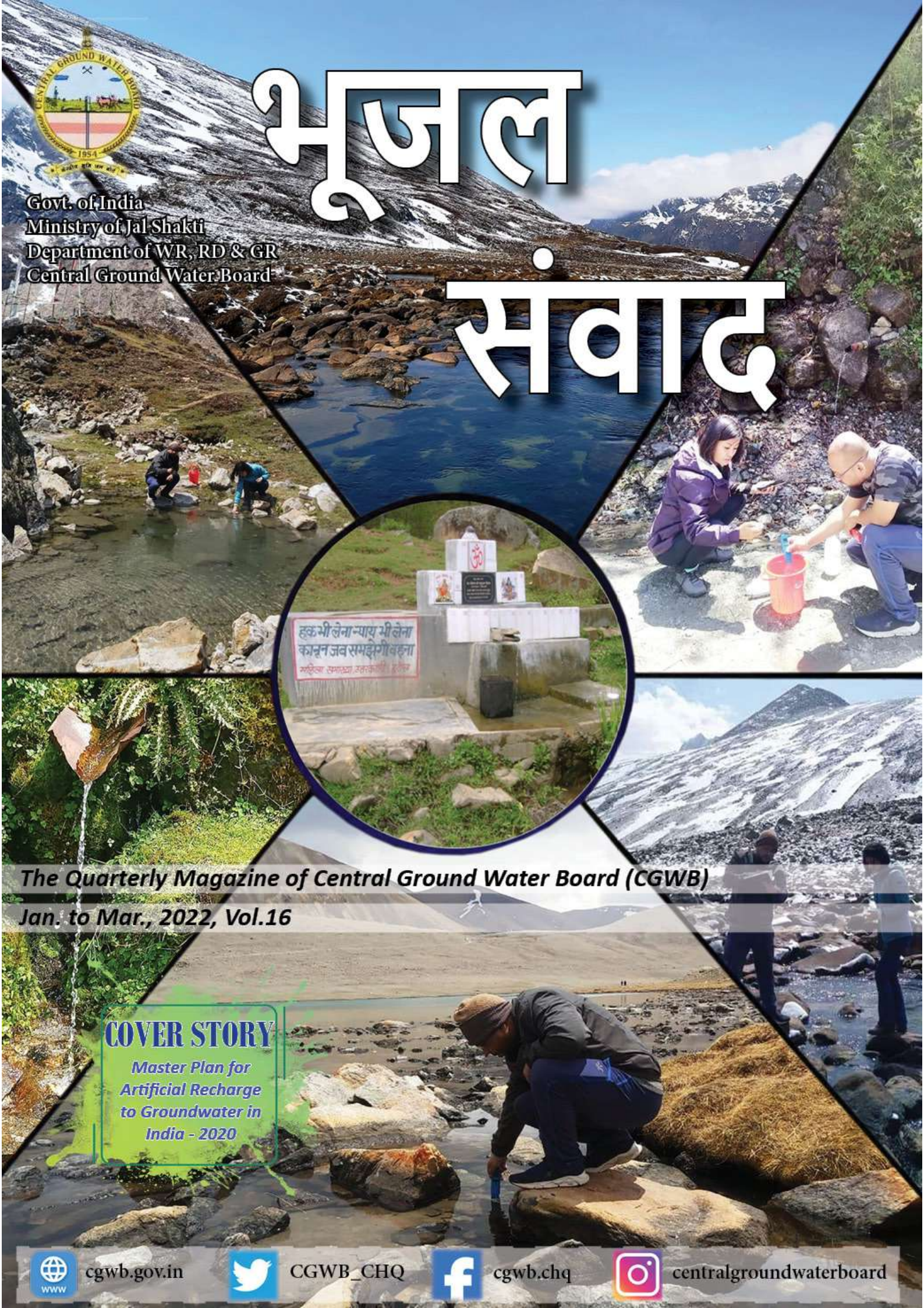
# भूजल संवाद

Govt. of India
Ministry of Jal Shakti
Department of WR, RD & GR
Central Ground Water Board




*The Quarterly Magazine of Central Ground Water Board (CGWB)*

*Jan. to Mar., 2022, Vol.16*

## COVER STORY

*Master Plan for Artificial Recharge to Groundwater in India - 2020*

cgwb.gov.in CGWB_CHQ cgwb.chq centralgroundwaterboard

# भूजल संवाद

The Quarterly Magazine of
Central Ground Water Board
Dept. of Water Resources,
River Development and
Ganga Rejuvenation,
Ministry of Jal Shakti, Govt. of India

**Vol. 16 (Jan. to Mar. 2022)**



## Editorial office

Media Cell,
Central Ground Water
Board (CGWB), Bhujal Bhawan,
Faridabad, Haryana 121001.
Email: mediacell-cgwb@gov.in
Phone: 01292477109

## Cite this document as

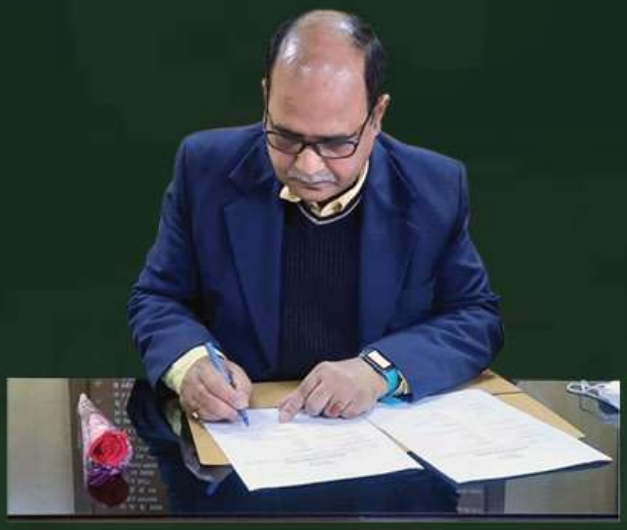
CGWB (2022), Bhujal Samvad,
Vol. 16, Central Ground Water
Board, DoWR, RD & GR, Ministry of Jal
Shakti, Govt. of India

# CONTENTS



**Cover Photo:** Springs of Sikkim and Uttarakhand. **P.C.** CGWB, ER, Kolkata and CGWB, UR, Dehradun.

# MESSAGE



I'm pleased to introduce this new volume of Bhujal Samvad. A new column "Success story of NAQUIM" has been introduced from this issue onwards wherein "Case studies on Rajgir Springs in Bihar" has been included in this issue.

A special article on 'Master Plan for Artificial Recharge to Groundwater in India' with Implementation Plan, Artificial Recharge Structure details and the Cost estimates is included in the 'Cover story' section. Study of Potential Toxic Element in Groundwater and their Health Risk Assessment in Kolkata Metropolitan Area is part of this issue in 'Report' section.

It is a matter of immense pride to state that CGWB represented at India Pavilion in Dubai Expo which was inaugurated by Sh. Gajendra Singh Shekhawat, Hon'ble Minister, MoJS, GOI and also in this quarter one major MoU is signed between CGWB and GSI on Ground water contamination, and these two are covered under 'In Focus' Section.

The Pathshala Section contains techniques to obstruct the flow of water in a stream to create storage with the help of Bridge cum Bandharas structures.

Do communicate your thoughts, feedbacks and ideas with us to make Bhujal Samvad a success through our social media pages or send email to our editorial office (mediacell-cgwb@nic.in).

We are eager to hear from You!

Sh. Sunil Kumar

Chairman, CGWB

# In Focus

## Sh. Sunil Kumar takes over as the new Chairman of Central Ground Water Board

**Sh. Sunil Kumar** took over as the 29th Chairman of Central Ground Water Board, DoWR, RD & GR, Ministry of Jal Shakti, Government of India on 1st February, 2022. He took over the charges from the outgoing Chairman, Dr. Nandakumaran P.


Sh Sunil Kumar is an alumni of University of Roorkee (now IIT, Roorkee) and did M.Tech in Applied Geology in 1985. He started his career in Central Ground Water Board in 1987 as Scientist (Junior Hydrogeologist) and has handled wide range of responsibilities in various capacities in different parts of India including leadership positions as Regional Director, Rajiv Gandhi National Ground Water Training and Research Institute, Raipur, Chhattisgarh and Director (Administration) at Headquarters. In 2018, Sh Sunil Kumar has joined as Member and subsequently he has held the key position in Administration & Human Resources as Member (HQ) and then Member (CGWA). In February 2022, he has taken over as the Chairman, Central Ground Water Board, Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, Government of India.

Widely travelled, Sh Sunil Kumar has versatile experience of working in various facets of ground water management which includes Ground Water Survey, exploration, estimation of ground water resources, sustainable development and management of ground water, Artificial recharge to ground water. He worked as an expert in Remote Sensing and GIS application to ground water studies and Geostatistics. Sh. Sunil Kumar has been closely involved in strategy formulation for courses conducted in Rajiv Gandhi National Ground Water Training & Research Institute. He has chaired/attended various national & international conferences & workshops. He has number of National and International publication at his credit. He has also headed various inter-ministerial committees and member of National committees / Task Force. He has played a key role in framing policies on various ground water issues.

***CGWB family heartily welcomes Sh. Sunil Kumar as the Chairman of the Board.***

## CGWB represented at India Pavilion in Dubai Expo

Sh Gajendra Singh Shekhawat, Hon'ble Minister, MoJS, Govt of India has inaugurated Water Gallery at India Pavilion in Dubai Expo 2020. The Indian delegation held a Bilateral Meeting with Deputy Minister of Envn and Water (KASA) led Malaysian delegation. Dr. Bhushan Lamsoge, Scientist has represented Central Ground Water Board.

# In Focus

## संसदीय राजभाषा समिति बैठक

पटना में माननीय संसदीय राजभाषा समिति ने केंद्रीय भूमि जल बोर्ड, मध्य पूर्व क्षेत्र, पटना के साथ निरीक्षण बैठक की। इस दौरान समिति ने मंत्रालय एवं विभाग के वरिष्ठ अधिकारियों की उपस्थिति में हो रहे राजभाषा हिंदी के कार्यों का अवलोकन किया।


## MoU between CGWB & GSI

Signing of MoU between Central Ground Water Board and Geological Survey of India on Ground Water contamination.

## Duty amidst Extreme climatic condition

Central Ground Water Board carrying out Ground Water Exploration at Draba drilling site, Poonch District, Jammu and Kashmir amidst heavy snowfall.

## पुरस्कार और सम्मान

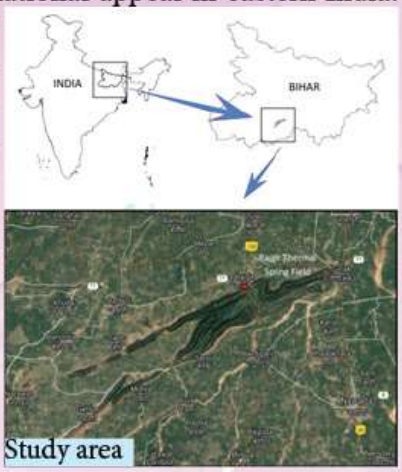
केंद्रीय भूमि जल बोर्ड, दक्षिण पूर्वी तटीय क्षेत्र, चेन्नई को वर्ष 2020–2021 के दौरान राजभाषा के प्रगामी प्रयोग में श्रेष्ठ निष्पादन के लिए केंद्रीय सरकार कार्यालय (लघुतर) की कोटि में तृतीय पुरस्कार प्राप्त करने पर शील्ड एवं प्रमाण पत्र प्रदान किया गया है।

# Success Stories of NAQUIM studies

## Aquifer Mapping studies for reviving the diminishing discharge of Rajgir group of thermal springs, Eastern India

*Dr. Indranil Roy and Sh. S.N.Dwivedi, CGWB*

**Introduction:** Rajgir— a town in the Nalanda district of Bihar State, India— widely known for its glorious history and immense religious importance, is a tourist destination of international appeal in eastern India. The widely known thermal springs of Rajgir are an important attraction for the tourists thronging to this place from different parts of the globe. The hot springs of Rajgir are part of the Rajgir-Monghyr belt of hot springs and fall within the East Indian Achaean Geothermal Province. During April 2016, a marked decrease in the discharge of the Rajgir hotsprings was reported in the media, following which a detailed investigation was carried out by Central Ground Water Board, as part of the Aquifer Mapping Programme upon the request of the State of Bihar to ascertain the reasons for diminishing discharge of the hot springs and suggesting possible measures for restoration of the discharge. of hot springs in and around Rajgir Area, Nalanda district, Bihar



Study area

## Geological and Hydrogeological set up:

**Geological set up:** The area is part of mid-Ganga basin and shows several inliers of isolated hillocks and ranges surrounded by alluvial plains of the Ganges. Rajgir hills, having highest point at 388 m amsl, lie within a flat topography of ~70 to 80 m amsl. The NE-SW trading Rajgir hill exhibits a sudden increase in elevation with a relief difference of ~300 m.

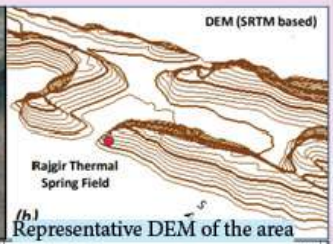
Weathering resistant quartzites forms the ridge part and central valley is occupied by phyllites. Scarp faces are present in the upper elevations. At lower elevations, around the base of the hills, a gentler slope is present depicting change in lithology. Several fault system crisscross the hill range. In fact, two major boundary faults form the margin of the hill range. Several other cross faults perpendicular to boundary faults exist. Many joints traverse the quartzite. Earlier studies has opined that the hot springs issuing from the quartzites are probably fed by percolation from these joints.

**Geological set up:** Hydrogeologically, the area is underlain by two distinct types of formation belonging to Quaternary and Precambrian age. The Quaternary formation constitutes the plains adjoining Rajgir hills and comprises the alluvial deposits of various grades of sand, clay, and silt. This formation gradually widens towards north and ultimately merges with Gangetic alluvium.

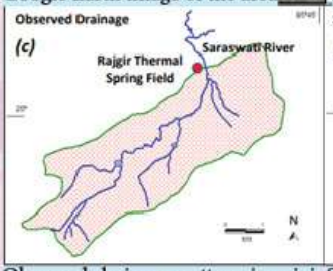
## Distribution of Hot Springs in Rajgir

The Rajgir group of thermal springs are historically known spring in and around Rajgir town along the northern periphery of Rajgir hills. An ephemeral stream, locally known as Saraswati Nala, passes through a gap in northern part of the Rajgir hill and divides it into two parts locally known as Vaibhara hill (western part) and Vipula hill (eastern part). There are more than a dozen springs on either side of the Saraswati nala, along the foot of the Vaibhara and Vipula hill. All the springs issue out of fissures or joints in the quartzites. The width of the joints often exceed 1 ft. The Western sub group consists of eight kunds which are fed by four natural spring sources and

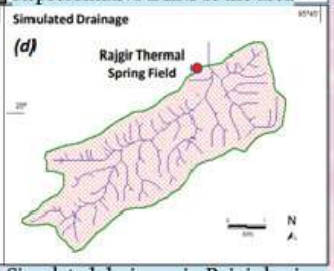
Google Earth image of the area



Representative DEM of the area



Observed drainage pattern in rajgir basin



Simulated drainage in Rajgir basin

# Success Stories of NAQUIM studies

the Eastern sub group consists of seven kunds fed by five natural spring sources. The prominent springs in the western group including the Saptdhara, Kashi dhara and Brahmkund. In the eastern group the prominent ones are Makhdumkund and Suraj Kund. A natural water body known as Pandu Pokhar lies to the north of the western group of springs. A prominent fault occurs along the northern boundary of the Rajgir hill.

## Investigations carried out

An integrated approach involving hydrogeological, geophysical, chemical and isotopic techniques were employed for detailed hydrogeological mapping of the area to study the cause of the diminishing discharge of the Rajgir thermal springs and chalk out strategies for its possible restoration. Methodology adopted for investigation included the following;

- Groundwater temperature mapping in the vicinity of the thermal springs at 61 locations from sources like Tube Wells ( TW), Hand Pumps (HP) and Dug Wells (DW)
- Geophysical investigation (Vertical Electrical Sounding, VES) and Electrical Resistivity Tomography ( ERT) was carried out to ascertain inferred lithological section and depth of occurrence of the shallow fracture zones
- Monitoring of Spring discharge and its comparison with historical records
- Hydrochemical Characteristics through major and trace element geochemistry for which
- samples were collected from thermal springs along with groundwater samples from TW, HP and DW, in and around Rajgir thermal spring area during May-June, 2016.
- In the study, 16 samples were analysed for Isotopic compositions of oxygen and hydrogen
- Analysis of Rainfall- Potential Evapotranspiration (PET) relationship has been carried out to ascertain the impact of deficit rainfall on the natural ground water recharge
- Groundwater regime monitoring was carried and compared with historical records to ascertain the secular decline in the groundwater levels in and around the thermal springs and its possible bearing on the spring discharge

## Salient findings

- The Rajgir group of thermal springs exhibits a temperature range of 32 °C to 43 °C. Based on temperature, the Rajgir group of springs may be classified as low-temperature thermal spring. However, the thermal springs of Rajgir group exhibit a remarkable consistency of temperature as exhibited by historical records. Historical temperature records of Brahma Kund shows a near constant temperature of about 42.7 for last 200 years. This indicates a very stable temperature in geothermal reservoir.
- Major ion geochemistry of groundwater reveals about its host rock, residence time, recharge area and source. Altogether nineteen (19) water samples were collected from Rajgir hot spring area and subsequently analysed for their major ion geochemistry. The hotspring samples are mainly characterized by relatively low field pH values (between 5.0 and 6.5) and TDS values in the range of 32 to 58 mg/L. HCO3 is the dominant anion and Ca is the dominant cation. The samples show elevated SiO2 values, compared to other ionic species, representing about 6-9 % of total mineralization. There is negligible presence of sulphate and fluoride has not been detected.
- Trace element concentration in the thermal borehole at Pandu Pokhara has been found intermediate between that of the local ground water and the hotspring possibly due to mixing of thermal water of the hotspring with that of the local groundwater.
- Application of Na-Li geothermometer indicates the reservoir temperature as 134°C
- Hot springs of Rajgir Area are structurally controlled. Geothermometry indicates maximum depth of circulation of about 3.6 km for the hot spring water.
- Presence of several fracture systems, parallel to the hill ranges act as possible channel ways for

# Success Stories of NAQUIM studies

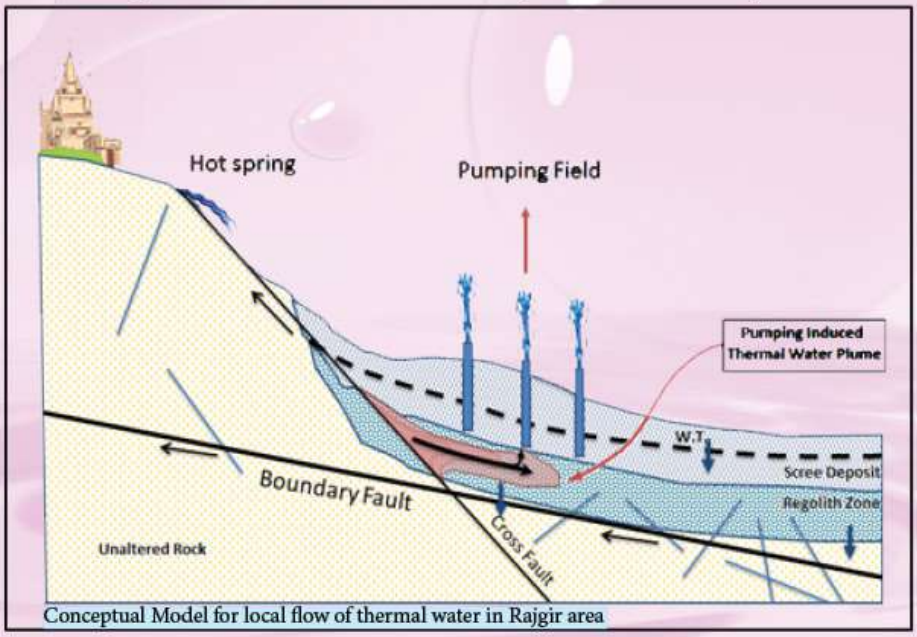
recharging the thermal systems.

- Alignment of the main fault plane and the cross faults were established during the study. GIS based proximity analysis of the temperature of groundwater indicates that main fault plane /conduit of thermal water may deviate from its expected alignment by 200 m.
- Change in flow / discharge variation is a seasonal phenomenon and the discharge of the hotspring at Rajgir peaks only after September.
- Secular fall in water level in the area has adversely affected the spring discharge .
- Analysis of the PET-Rainfall relationship indicates that whenever the total rainfall in the area goes below 850 mm or monsoon rainfall deficit exceeds by about 300 mm, discharge of Rajgir spring may dwindle and would impact the discharge of the hotsprings in the following year.
- Energised Pumping in the immediate vicinity of the hotspring has offset the flow hydrodynamics .

## Local Flow Model

Following the detailed study, a local scale hydrodynamic model has been perceived to explain the process of diminishing discharge in hot springs in relation to pumping in nearby area. The model perceives that regolithic zone in places pervades the fault zone which is actively involved in transporting the thermal water. However, even after alteration, the fault zone retains its structure and the maintain its flowing condition due to its artesian condition, instead of diffusion and losing head, by the pressure of overlying groundwater column. Deposited silica on wall of the pre-existing fault plane from high silica thermal water may create membrane separating the two flow domains. With this situation at hand, if the overlying aquifer is pumped, hydrostatic equilibrium is disturbed and when downward pressure is exceeded by upward pressure of the thermal water, a plume is formed and a flow towards pumping well takes place. This plume becomes a permanent feature as the holding structure is breached and the pumping well becomes permanently thermal. However, if pumping stops for longer duration and overlying area is re-saturated with groundwater, a change in temperature may be observed.

Investigations made at few borewells constructed at Pandu Pokhar area in the immediate vicinity of the hotspring support the above model of the local flow system. The borewells were reportedly constructed down to a depth of 35 m within the weathered zone. These are essentially gravel packed wells in which the underlying hard rock formation has not been punctured. It was also been reported that initially these wells were discharging normal water and only after some time it was found that thermal water was being pumped from these wells. Further, during the present study, the groundwater samples from these boreholes showed similar water chemistry and stable isotope ratio with that of thermal water, though temperatures are at lower side compared to temperatures measured at discharge points of the springs.



Conceptual Model for local flow of thermal water in Rajgir area

# Success Stories of NAQUIM studies

## Strategy for restoration of the hotspring discharge

- It is recommended to designate the zone around the hotsprings upto a distance of 300 m from the hills (200m core zone with 100 m buffer zone) as sensitive zone and eliminate any energized pumping in this zone. At places depending upon the alignment of the faults the width of the zone will vary up to 500 m from the hills. This measure is to protect the flow path of the thermal water from any pumping induced flow perturbation;
- Creation of water conservation and harvesting structures should be taken up to maintain the favourable hydrodynamic scenario in the area. Contour trenches ( 2 m deep and 1.5 m wide) with bottom half filled with filter media may be constructed parallel to each other at a gap of 15 to 20 m wherever land parcels are available.
- The surface water body at Pandu Pokhar located to the north of the western group of springs is a natural recharge source in the area sited just over the boundary fault. It has hydrodynamic significance towards maintaining a constant head in the area. However, it was found that to increase the pond's water holding capacity, the pond has been lined at the bottom with impermeable material. This measure has disconnected the natural water body from local hydrogeological regime. The lining must be removed to restore the natural hydrodynamic state. Natural water-bodies in the area may be rejuvenated to augment natural recharge in the area
- Discharge and temperature monitoring should be carried out at regular interval, preferably on weekly basis. The measure may be implemented by construction of permanent monitoring station.

The Government of Bihar has implemented the recommendations made by CGWB by imposing restrictions on groundwater pumping in the designated area which has resulted in partial restoration of the discharge of the hotsprings.

## Acknowledgement

This is a summarised account of the report of the special study carried out under the Aquifer Mapping Programme by the authors along with other team members from CGWB, MER Patna. The authors express their sincere gratitude to the Chairman and Members of CGWB for providing guidance and support in carrying out the field work. The analysis of the stable isotope under the study was carried out at PRL Ahmedabad which is gratefully acknowledged. Support provided by the Water Resources Department, Government of Bihar during the field work is gratefully acknowledged.

# Report

## Potential Toxic Elements in Groundwater and Their Health Risk Assessment in Kolkata Metropolitan Area (KMA), India

*Dr. Suparna Datta, CGWB*

**Introduction:** With the increasing demand for freshwater and heavy pumping of groundwater, the hydrogeological system may get altered in regions with low natural topographic gradients, such as deltas and floodplains beneath these urban clusters. Poor sanitation, improper disposal of domestic and industrial effluents and inadequate water supply lead to the input of sewage water into the groundwater and making it unfit for human consumption. The present study focused on an integrated approach to survey the groundwater quality of Kolkata, one of the densest populated megacities of Asia concerning the distribution and co-occurrence of major ions, trace elements (Chromium, Lead, Copper, Arsenic, Manganese, Iron, Zinc) and the radioactive element uranium

To study the effect of co-occurrence of multiple metals in groundwater, the application of health risk assessment techniques have been applied in order to understand the risk of exposure to heavy metals and other harmful pollutants. It facilitates evaluating the risks of exposure at various concentrations of contaminants with reference to certain standard values ratified by World Health Organization (WHO) and United States Environmental Protection Agency (USEPA).

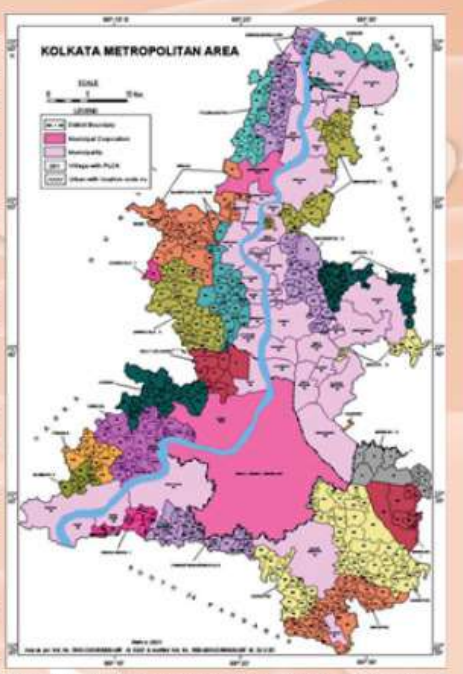



Figure 1: Administrative Map of KMA

**Study Area:** Kolkata Metropolitan Area (KMA) is located in the Southern Gangetic Part of West Bengal. It lies within the latitudes of 22°19'42.13" to 23°01'10.77" North and longitudes of 88°02'47.47" to 88°34'48.25" East, encompassing an geographical area of 1,851 sqkms (Including the extent of the major drainage of Hugli River and 1,819 sqkms, excluding the expanse of this major drainage). It is the 8th largest urban agglomeration in the World and 3rd in rank in India and the only one in the Eastern and North.

**Trend of Ground Water Level in KMA:** Akin to the other major cities in the world, the accelerated usage of ground water resources in KMA started with the increase in urban population. Due to the imbalance in withdrawal of more and more ground water in excess of replenishment there has been an adverse effect on ground water regime in KMA. Declining trend of water level has been noticed to the tune of 0.33 m/yr at the core of the trough and 0.11 m/yr at the periphery.

## Ground Water Quality

- The interpretation of Piper's trilinear diagram reveals that the major facies having water type as Ca-Mg-HCO3 is 45.4%, Ca-Mg-Cl is 16.3%.
- However, 20% water sample was found in Na-Cltype, which indicate interaction of brackish surface water bodies with the ground water system at water mixing zones.

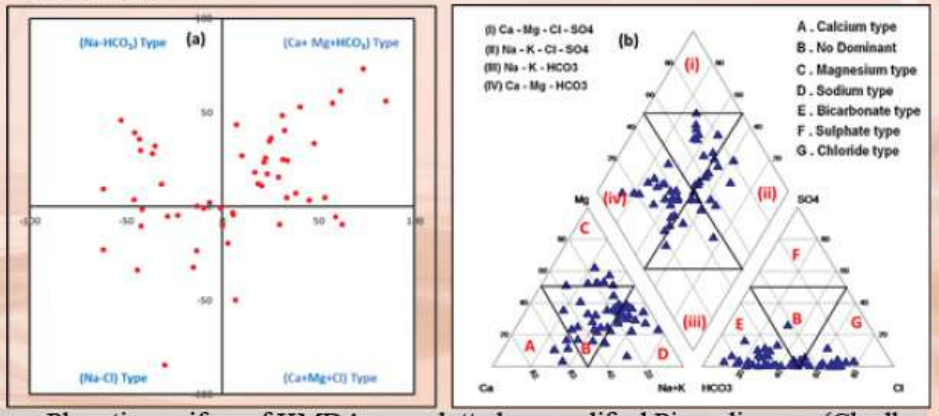



Figure 2: (a) Groundwater samples from Phreatic aquifers of KMDA area plotted on modified Piper diagram (Chadha, 1999), (b) Piper trilinear diagram for hydrogeochemicalfacies

**B) Co-occurrence of Uranium and other Trace Metals and Health Risk Assessment in Groundwater of KMA**

- All the samples were found to be within the prescribed standards as per WHO, 2012 for Uranium (Table 3).
- Zinc and Arsenic contamination have been revealed in few pockets of KMA with maximum values of 21.1 mg/L and 16.8 µg/L respectively.
- More than 50% samples were found to be contaminated with Iron having maximum concentration as high as 8.6 mg/L.
- 41.3% samples were evidenced as contaminated with manganese beyond Permissible Limit and 37.9% samples exceeded the Acceptable Limit as per BIS, 2012.

**Table 3 : Spatial Variation of Radioactive Uranium and other Trace Metals in KMA**

| Constituent | Permissible Limit | Acceptable Limit | Max | Min | Samples Beyond BIS (2012) Permissible Limit (%) | Samples beyond BIS(2012) Acceptable Limit (%) |
|---|---|---|---|---|---|---|
| Cr (mg/L) | 0.05 | 0.05 | 0.031 | BDL | - | - |
| Mn (mg/L) | 0.1 | 0.3 | 5.52 | 0.003 | 41.3 | 37.9 |
| Cu (mg/L) | 0.05 | 1.5 | BDL | BDL | - | - |
| Zn (mg/L) | 5 | 15 | 21.1 | 0.1 | 10.3 | 3.4 |
| As (mg/L) | 0.01 | No relaxation | 0.017 | BDL | 6.8 | - |
| Pb (mg/L) | 0.01 | No relaxation | 0.004 | BDL | - | - |
| U (mg/L)* | 0.03 | No relaxation | 0.008 | BDL | - | - |
| Fe (mg/L) | 1 | No relaxation | 8.6 | BDL | 56.4 | - |

** The values for Uranium have been compared with the standards by WHO (2012)*

**C) Human health risk assessment**

To assess the extent of exposure and risk posed to population in the study area due to the consumption of uranium and other potentially toxic elements in groundwater, the non-carcinogenic risk assessments was carried out (Carcinogenic elements were in very low concentration).

**Non carcinogenic risk assessment**

There are three primary pathways for exposure of uranium and other contaminants to humans which include: direct ingestion via drinking water and other food stuffs; inhalation via mouth and nose; and dermal contact through skin **[Sharma et. al. 2021].** This is obvious that, ingestion is the most significant pathway of exposure, particularly through groundwater. So, the present work aims to assess the non-carcinogenic risk posed due to exposure of uranium and other potentially toxic elements through the ingestion of groundwater. The assessment was undertaken for two vulnerable population groups, i.e. adults (70 years) as well as children (10 years) in terms of the Chronic Daily Index (CDI) **[USEPA 1999].** The Hazard Quotient (HQ)

was also calculated to evaluate the extent of harm being produced by ingestion of the toxic elements in human body via water consumption **[USEPA 1999].** Furthermore, the Hazard Index (HI) was also calculated to assess the overall non-carcinogenic risk posed by all toxic elements under investigation in groundwater for both population groups **[USEPA 1999].** If the values of HQ and HI > 1, then humans are more vulnerable to develop non-carcinogenic health issues and if HI<1, then the users have a low risk for the occurrence of non-cancerous health problems from this source **[Singh et al. 2018].** The following equations were used to estimate the ingestion rate of uranium and other potentially toxic elements via groundwater:

$$\text{CDI (in mg/ kg /day)} = \frac{\text{EC X DWI X EF X ED}}{\text{LE X BW}} \qquad \text{HQ} = \frac{\text{CDI}}{\text{RfD}} \qquad \text{HI} = \sum \text{HQ}$$

| Particulars | | Adults | Children | Reference |
|---|---|---|---|---|
| EC | Element concentration | Concentration of PTE in mg L-1 | | |
| DWI | Daily intake of water | 3.45 L day−1 | 2 L day−1 | **Sharma et al. 2021** |
| EF | Exposure frequency | 365 days year−1 | 365 days year−1 | |
| ED | Exposure duration | 70 years | 10 years | |
| LE | Life expectancy | 25,550 days | 3650 days | |
| BW | Body weight | 73 kg(Indian standard person) | 32.7 kg | |
| RfD | Reference dose | RfD (in mg kg−1 day−1) values for Zn(0.3), Fe(0.7), Cu (0.040), Mn(0.014), Cr(0.003), As(0.003), Pb(0.0035), Cd(0.001), Hg(0.0003) and U (0.00423) | | **[USEPA 2015, Wu et. al. 2009].** |

**D) Potential risk assessment for human health**

On analysis of CDI values, it was observed that there was highest consumption of Zn followed by Mn, As, Cr and U through ingestion of groundwater. It was also found that children were more vulnerable to exposure of these elements via groundwater and may be at higher health risks as compared to adults. HQ signifies the metal risk for health on human due to its intake through water. The risk analysis showed that both the population groups were prone to high risk due to consumption of Mn in groundwater as the HQ value is significantly greater than 1, which indicated that water is unsafe for human consumption as it may cause several health issues including damage of lungs and heart as well as causes allergies.

Hazard Index (HI) values for all elements in groundwater were obtained by the summation of HQ values of all elements. HI for adults and children were found to be 67.43 and 87.27, respectively, which are significantly greater than the desirable limit (1). This may lead to high non-cancerous risk for both the population groups through consumption of water in the study area. Furthermore, it was also seen that risk was more for children which may be due to their lesser body weight and more susceptibility in comparison to adults.

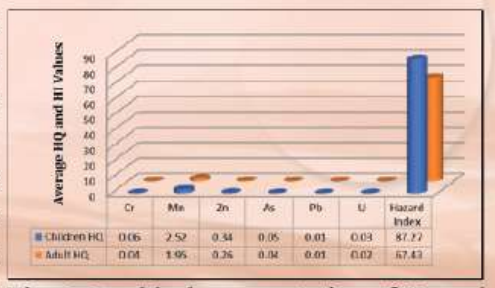



Fig. 3 Graphical representation of Hazard Quotients (HQs) and Hazard Index (HI) values for Manganese, Uranium, Arsenic and other PTEs for both adults and children in KMA

## CONCLUSION

In this study, the concentrations of physicochemical parameters and PTEs have been assessed in ground water of Kolkata Metropolitan Area (KMA). It was found that the concentrations of Zn, Mn, Fe and As in ground water exceeded the BIS guidelines. Owing to the high Mn concentration, there was high non-carcinogenic risk (HQ >1). The study indicates the possibility of human exposure to PTEs and the severity of health risks associated with the use of PTEs-contaminated groundwater for drinking purpose in case of both adults and children. Children were found to be more vulnerable in comparison to adults.

### Way forward

- The existing water bodies and drainages, which have got silted or obscured, over time due to urbanization, may be salvaged, repaired, renovated and restored.
- Clusters having high rise apartments may be given additional attention for proper demand and supply management, including reuse of treated sullage water through properly maintained STPs.
- Industrial pockets, within the KMA area may be monitored with a much denser spatio-temporal resolution in terms of quality and quantity.
- Adaptation of Roof top rainwater Harvesting in large complexes and scientific as well as bio based management of wastes.

# Pathshala

## BRIDGE CUM BANDHARAS (BCB)

CGWB, Central Region, Nagpur

The Bridge cum Bandharas are structures designed to obstruct the flow of water in a stream to create a storage in upstream side and also have pathway (bridge) on the top of the dam (bandhara) to facilitate the pedestrian access across the stream to attend the works in their agricultural fields.

## BRIDGE CUM BANDHARAS IN WARDHA & AMRAWATI DISTRICTS, MAHARASHTRA

Central Ground Water Board has taken up the construction of five Bridge cum Bandharas (BCBs) as pilot project at five sites namely Sarwadi, AjraPhata, Deoli, and Jamni in Wardha district and Tiwasa, Amrawati district in eastern region of Maharashtra State. The villages located in the upland areas of IInd order streams are entirely dependent on ground water resources for their drinking and agricultural requirements. The erratic rainfall in the area, the high run off because of hilly nature of the terrain and inherent heterogeneity of hard rock aquifers create a severe water availability problem. Every year by the end of March ground water sources get exhausted and abstraction structures become dry ensuing even drinking water scarce.

To address the water availability problem of the villages, it was envisaged that if the runoff rate is checked and a defined storage created in the near by stream by constructing a check dam along with deepening and widening (by restoration of stream channel morphology to the magnitudes prevalent in old village level maps available), the area may be relieved of the persistent stress of drinking water scarcity.

However, a policy was conscientiously formulated with compulsive measures that water spill over the stream's channel shall not be allowed with water flow and storage to be maintained within limits of the stream channel. It was made a mandatory part of the check dam structural design. This was adopted to avoid submergence of the area in the upstream parts of the check dam and resultant socio economic problems.

A pilot project was initiated for technology demonstration of automatic radial gates & rubber dam on bridge cum bandharas at five villages in Wardha & Amrawati districts of Maharashtra State, assuming that the automatic functioning of the gates and structural design to be the vital elements to fulfil the objectives while effectively maintaining compliance to **"No Water Spill Over and No Submergence Policy".**

For enhancing the life /capacity of structures desiltation of the stream channel in upstream and downstream sides must be carried out periodically. Stream channel must be maintained free of any waste material, this would enhance the recharge potential of the projects.

Tiwasa project: Automatic Gates (Radial)

Tiwasa project: Automatic Gates in open position

Jamni project with Automatic Gates

Jamni project: Automatic Gates in open position

Sarwadi project: Automatic Gates in closed position,

Deoli project: Automatic Gates in open and closed Position

## Salient Features and design of Bridge Cum Bandharas in Maharashtra

| Project Village Name | Taluka/ District | Stream name | Catch-ment area (Km2 ) | Lowest river bed level (mtr) | Full Reser-voir level (metre)/ Length of Water spread at FRL(km) | High flood Level (mtr) | Pier top/ RCC bridge level (mtr) | Storage capacity at FRL (m3) |
|---|---|---|---|---|---|---|---|---|
| Tiwasa | Tiwasa/ Amravati | Pingli | 31 | 296 | 299/1.71 | 300.01 | 300.50/ 300.50 | 20,947 |
| AjraPhata | Samudra-pur/ Wardha | Local nala | 41.2 | 211.50 | 215/1.12 | 216.92 | 217/ 217.3 | 28,295 |
| Sarwadi | Karanja/ Wardha | Jamb river | 5.75 | 428.40 | 431/1.23 | 431.22 | 432.50/ 432.50 | 18,538 |
| Jamni | Selu / Wardha | Wagh-adi nala | 4.88 | 246 | 249/1.66 | 250.84 | 250.50/ 250.50 | 30530.5 |
| Deoli | Deoli/ Wardha | Yashoda river | 94.20 | 244.50 | 247.50/ 3.134 | 249.65 | 249/249 | 402263 |

Type of Regulating Structure and no. of Gates

- **Tiwasa** : Automatic Gates (Radial)/ 07nos Automatic Radial Gates.
- **AjraPhata**: Rubber Dam (with 2 Rubber dam (Water filled).
- **Sarwadi** : Automatic Gates (Radial)/ 03 nos Automatic Radial Gates.
- **Jamni** : Automatic Gates (Radial) /03 nos Automatic Radial Gates.
- **Deoli** : Automatic Gates(Radial)/9 Automatic radial gates.

Ajraphata project with Rubber Dam (Water filled)

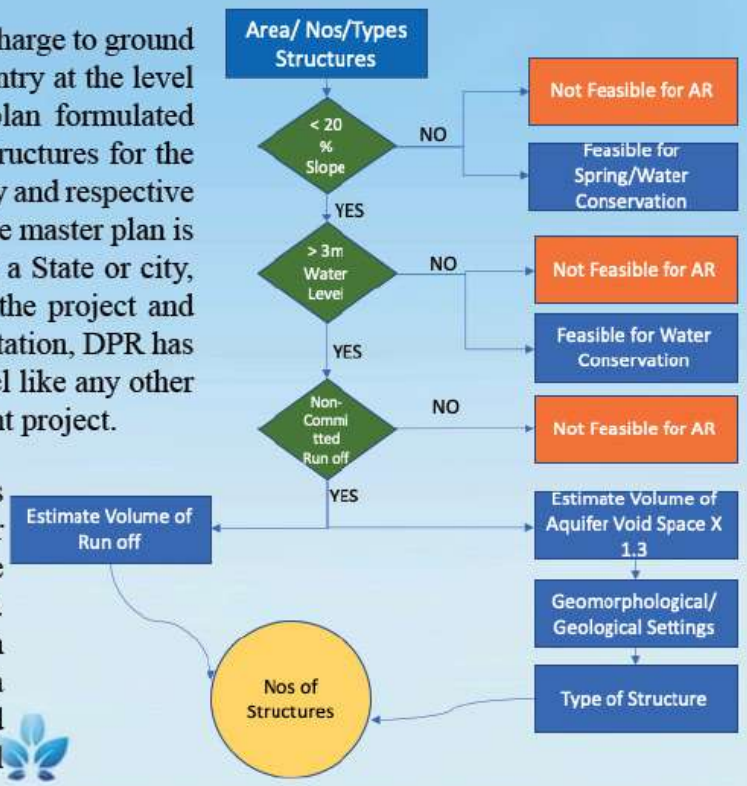
Sarwadi project: Automatic Gates (Radial)

# Cover Story

Dr. S.Suresh, CGWB

## Master Plan for Artificial Recharge to Groundwater in India - 2020

The revised master plan for artificial recharge to ground water has been made for the whole country at the level of district/Block. The plan is macro plan formulated to work out the feasibility of various structures for the different terrain conditions of the country and respective estimated cost. Hence, the revision of the master plan is like any other master plan prepared for a State or city, which brings out the broad outline of the project and expected investments and for implementation, DPR has to be prepared at an implementable level like any other water supply project or city development project.




The scope of artificial recharge depends on the available sub surface space for recharge, water required for recharge and surplus water available for recharge. The volume of space available up to 3 m bgl or 5 m bgl depending on the criteria adopted in different States multiplied by the specific yield of the aquifers will provide the space available for recharge. Considering an efficiency of 60% or 75% as deemed fit in different States, the water required for artificial recharge has been worked out for each State. The surplus available for recharge after deducting the committed supply has been estimated for each State.

The different type of structures suitable for different terrain conditions and the use of different terminology for the similar structures in various States have resulted in more than 25 types of structures. In order to group different structures and bring in standardization, the structures were studied and grouped in to 10 groups and in the group "Others" all the uncommon structures are classified. About 75% of structures are towards RTRWH, while 17% is for "Others", with 3% for RS, 2% of structures are in the category of CD & Gabion structures and 1% under PT category. The unit cost of structure also is found varying within the States for different districts for some States, while in some States/UTs they have assumed a uniform rate. RTRWH accounts for 28% of cost, while "others" category is for 23% of cost and CD & PT account for 19% & RS for 07% of cost. The total cost for implementation of this revised master plan is Rs 133529.69 Cr, with Rs 96735.45 Cr (72%) for rural areas and Rs 36794.23 Cr (28%) for Urban areas.

There are many existing schemes and a new scheme is under preparation in respect of comprehensive measures for water conservation in select water stressed districts in the country, resulted out of Budget announcement of the Government, which can cater to the implementation of the revised master plan. No separate funding is required for executing the revised master plan. The different scheme can take the cue from the master plan and construct these structures as per the norms of the schemes. The execution of these structure may take a period of 10 years, if the existing schemes dovetail their activities for convergence towards water conservation.

# Cover Story

Owing to the over dependence on groundwater, both State & Central Government Agencies are dovetailing their activities towards water conservation. Consequently, construction of the artificial recharge structures has increased over the years. Further, the construction of structures also depends on the surplus water availability and hence it becomes imperative that geotagging of these structures is made and their functional status monitored. Hence, one Nodal agency is to be identified for each State/UT by the respective States /UTs, which will function as a focal point for the water conservation database and documentations.

## Implementation Plan

**Period** - 10 years

**Funding** -

- Existing schemes to be dovetailed to include water conservation/augmentation efforts
- EFC For comprehensive measures for water conservation in select water stressed districts- under preparation

**Community Participation** -

- Atal Jal
- RTRWH on individual houses

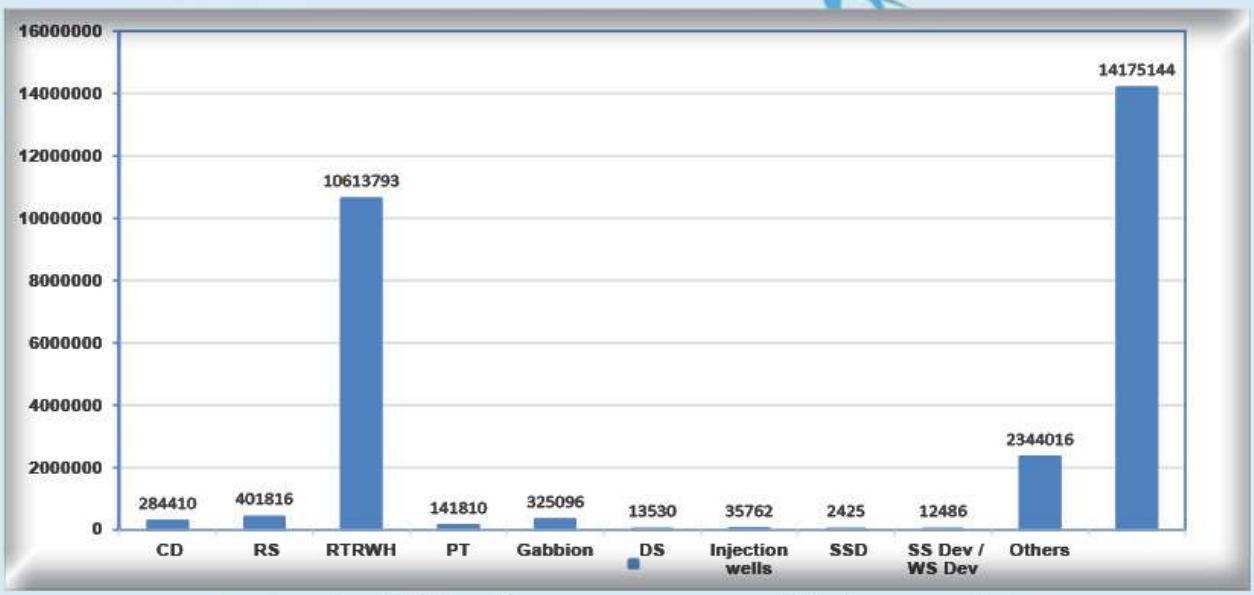
**Industry Participation** -

- Provision for RWH in lieu of extraction in OCS blocks.
- Treated water for AR only after ensuring WQ aspects.

**Documentation of Water Conservation Efforts** -

- Nodal Agency- for maintenance of database & documentation on WC

## AR Structures Details




Number of Artificial Recharge Structures proposed in the Master Plan

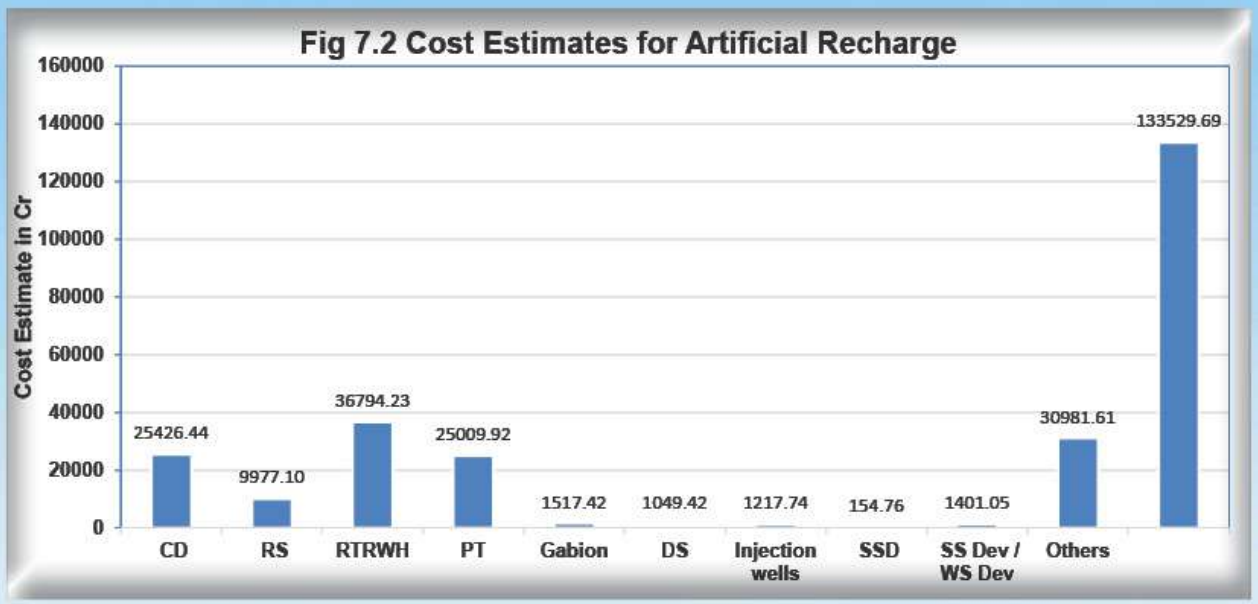
| CD | RS | RTRWH | PT | Gabbion | DS | Injection wells | SSD | SS Dev / WS Dev | Others |
|---|---|---|---|---|---|---|---|---|---|
| 2% | 3% | 75% | 1% | 2% | 0% | 0% | 0% | 0% | 17% |

CD- Check Dam, RS- Recharge Shaft, PT- Percolation Tank, DS-Desilting, SSD- Sub Surface Dyke, WS- Watershed

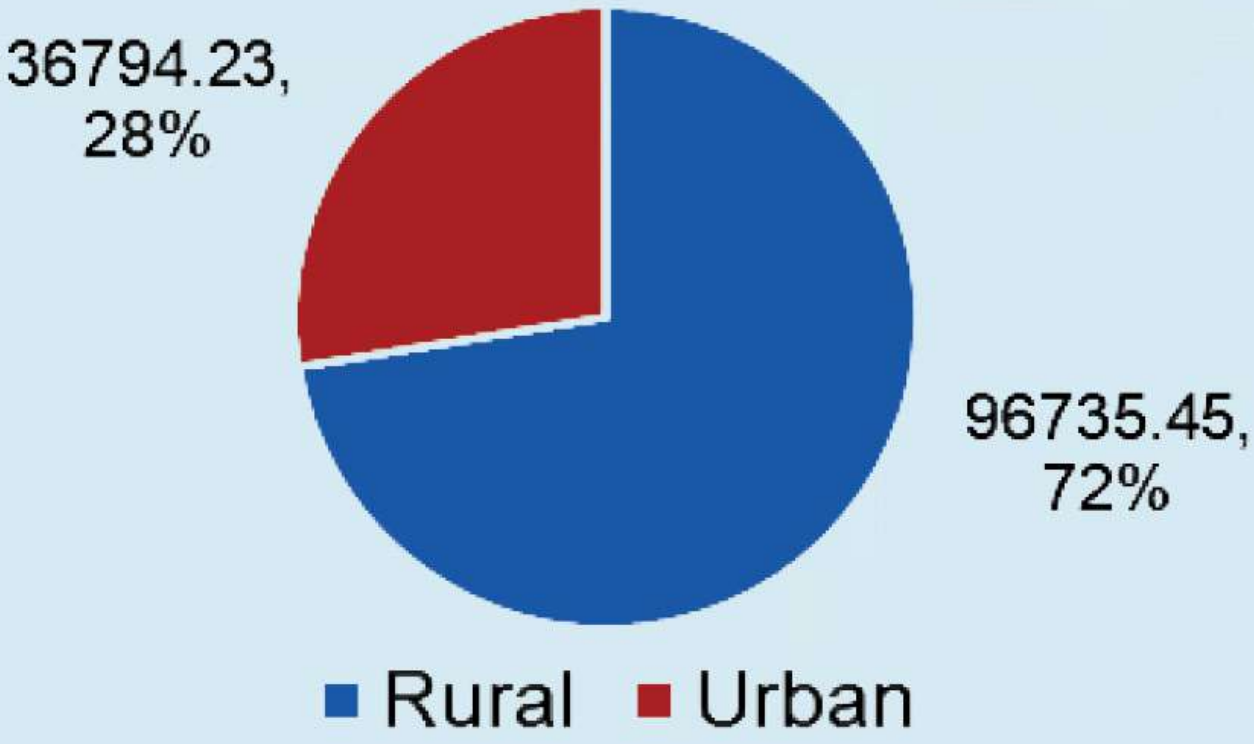
# Cover Story

## Artificial Recharge & Cost Estimates

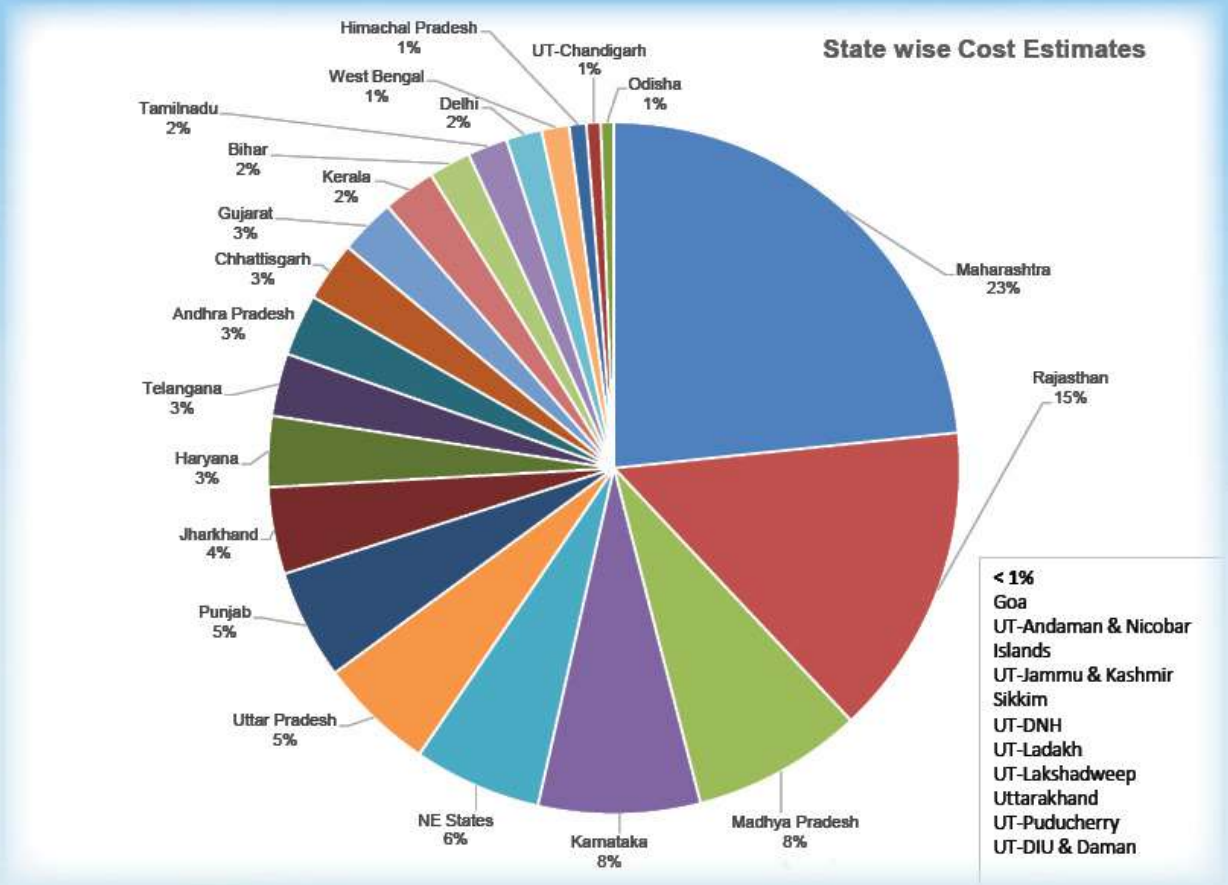
### Total Cost -1,33,530 Crores




| CD | RS | RTRWH | PT | Gabion | DS | Injection wells | SSD | SS Dev / WS Dev | Others |
|---|---|---|---|---|---|---|---|---|---|
| 19% | 7% | 28% | 19% | 1% | 1% | 1% | 0% | 1% | 23% |



## State wise Cost Estimates




- The master plan for artificial recharge to groundwater has been revised considering the existing data availability. Considering the technological advancement and parallel scientific studies of NAQUIM being taken up in the country, it is proposed to carry out next revision on a larger scale of 1: 10,000. With the large scale thematic maps, it would be feasible to have micro-levelinformation on area-specific feasible recharge structures&their location, which can be refined duringpreparation of Detailed Project Reports (DPRs) by the implementing agency in the state. The watershed approach is best fit for hard rock terrains, while the basin/sub basin approach is practically feasible for alluvial/ sedimentary terrain & in hilly terrains, springshed approach can be more appropriate for spring rejuvenation projects.

# Social Media Highlights

Central Ground Water Board
22 March

World Water Day 2022 Celebration at Central Ground Water Board, Faridabad.
#SaveWater #WorldWaterDay #WorldWaterDay2022
Ministry of Jal Shakti, Department of Water Resources, RD & GR

Boost this post to get more reach for Central Ground Water Board.
Boost post

31 6 shares

Central Ground Water Board
20 March

Reports on Dynamic Ground water Resources of NCT Delhi 2020 and Yearbook 2020-21 presented to Secretary and Special Secretary, Govt of NCT Delhi at Delhi Sachivalaya by Officers of State Unit Office, CGWB, New Delhi
Ministry of Jal Shakti, Department of Water Resources, RD & GR

Boost this post to get more reach for Central Ground Water Board.
Boost post

अजीत सिंह छाबड़ी and 12 others 1 share

Central Ground Water Board
22 March

Plantation by Sh. Sunil Kumar, Chairman, Central Ground Water Board on the occasion of World Water Day 2022, with a theme Ground Water: Making the Invisible Visible at the premises of Bhujal Bhawan, Faridabad. #savewater #WorldWaterDay
Ministry of Jal Shakti, Department of Water Resources, RD & GR

Boost this post to get more reach for Central Ground Water Board.
Boost post

अजीत सिंह छाबड़ी and 40 others 3 shares

Central Ground Water Board
20 March

CGWB, Jaipur organised Tier III training course for students at C.T.A.E, Udaipur on Ground Water Resources and its Management . Local Ground water issues, resources and plausible management strategies were discussed in the programme.
Ministry of Jal Shakti, Department of Water Resources, RD & GR

Boost this post to get more reach for Central Ground Water Board.
Boost post

अजीत सिंह छाबड़ी and 23 others 1 share

Central Ground Water Board
14 March

Litholog preparation of Piezometer at Gopalon, dist. Fatehgarh Sahib, Punjab by officers of CGWB. Piezometer drilled up to a depth of 163 m and electrical logging was carried out by Uptron Logger up to 163 m. Lithology encountered was medium grained sand and clay. Ministry of Jal Shakti, Department of Water Resources, RD & GR

Central Ground Water Board
Send Message

Boost this post to get more reach for Central Ground Water Board.
Boost post

Gautam Arya, अजीत सिंह छाबड़ी and 32 others 2 shares

Central Ground Water Board
11 March

Sh Sunil Kumar, Chairman, CGWB has chaired Regional Directors' meeting at Bhujal Bhawan, CHQ, Faridabad.
Ministry of Jal Shakti, Department of Water Resources, RD & GR

Boost this post to get more reach for Central Ground Water Board.
Boost post

अजीत सिंह छाबड़ी and 42 others 4 shares

Boost post

अजीत सिंह छाबड़ी and 27 others

Central Ground Water Board
28 February

Ms. T.S.Anitha Shyam, HOD, CGWB, Bangalore alongwith other officers inspected the fixing of Protection Box on Piezometer prior to installation of DWLR at Kanakpura PZ, Karnataka
Ministry of Jal Shakti, Department of Water Resources, RD & GR

Boost this post to get more reach for Central Ground Water Board.
Boost post

अजीत सिंह छाबड़ी and 38 others 2 shares

# Social Media Highlights

**Top Tweet** earned 2,448 impressions

Field demonstration on suface geophysical survey carried out by Geophysicists of CGWB, Bhubaneshwar as a part of Tier-II training programme at Baripada, Mayurbhanj, Odisha.
@MoJSDoWRRDGR
pic.twitter.com/bEOZWAUN65

17 48

View Tweet activity View all Tweet activity

**Top Tweet** earned 2,294 impressions

आज पटना में माननीय संसदीय राजभाषा समिति ने केंद्रीय भूमि जल बोर्ड, मध्य पूर्व क्षेत्र, पटना के साथ निरीक्षण बैठक की। इस दौरान समिति ने मंत्रालय एवं विभाग के वरिष्ठ अधिकारियों की उपस्थिति में हो रहे राजभाषा हिंदी के कार्यों का अवलोकन किया।
@MoJSDoWRRDGR
pic.twitter.com/dEMkdkEPoe

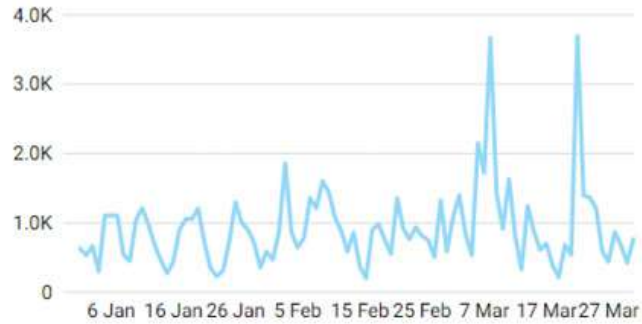
1 11 26

View Tweet activity View all Tweet activity

**Reach**

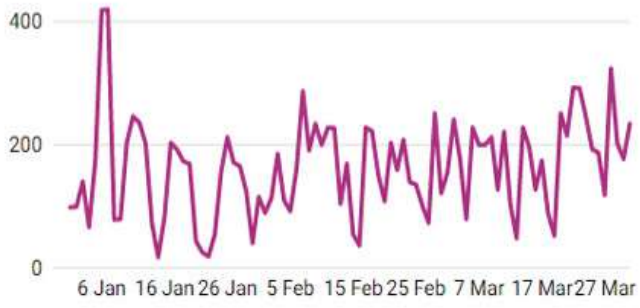
Facebook Page reach

23,321




Instagram reach

3,255 ↑ 69.1%




Your Tweets earned **132.6K impressions** over this **90 day** period

# Collectable







01 A new chapter in collaboration between CGWB and GSI. MoU signed for study on GW contamination.

02 Preliminary Yield Test conducted at Mudpar Exploratory well, Janjgir Champa disrict, Chhattisgarh having a Discharge of 21.20 lps.

03 Spring study conducted at Ultapani, Mainpat, Surguja district, Chhattisgarh.

04 Demonstrative Artificial Recharge Project site at Saton block, Raibareli District, Uttar Pradesh.

05 Ground Water Exploration at Draba drilling site, Poonch District, Jammu and Kashmir amidst heavy snowfall.

06 Ground water level Regime monitoring during the month of January

07 Plantation by Sh. Sunil Kumar, Chairman, CGWB on the occasion of World Water Day 2022.

# Collectable








01 Field study at Chromium sludge Dumping site @ Khanchandpur village, Rania Industrial Belt, Sarvakhera Block, Kanpur Dehat, Uttar Pradesh.

02 Scientists of CGWB, Hyderabad presented Aquifer maps and Management Plans of Jogulamba Gadwal district, Telangana to the District Administration.

03 Geophysical Survey at Bisi Baliposi Village, Barkote, Deogarh District, Odisha.

04 Presentation of NAQUIM report of Bhadradri Kothagudem, KB Asifabad, Mancherial, Karimnagar and Nirmal districts of Telangana State.

05 Public Interaction Programme at Deva Block, Barabanki district , Uttar Pradesh.

06 Ground Water Exploration at Sangote village, Cheneni block, Udhampur district, J& K.

07 Ground Water Exploration at Bhilauni, Pamgarh Block, Janjgir Champa District, Chhattisgarh. Well drilled upto a Depth of 31.30 m and discharge is 17 lps.

# Collectable








01 CGWB, Lucknow conducted Public Interaction Program at Bharawn block, Hardoi district, Uttar Pradesh.

02 CGWB, Hyderabad conducted Public Interaction Program for farmers on "GW Issues & Management in Jameelpet Village, Bibinagar Mandal, Yadadri Bhuvanagiri district, Telangana.

03 One week physical mode trainning program on Surface Geophysicial Techniques in Ground Water Prospecting at RGI.

04 Public Interaction Programme organised at Raipur Village, Lucknow alongwith NGO Prithvi Innovations.

05 Geophysicists of Central Ground Water Board, Lucknow conducting TEM Survey in Ahirauri Block, Hardoi, Uttar Pradesh.

06 Sharing of NAQUIM report of Dhubri district, Assam to the Deputy Commissioner Dhubri.

07 Soil Infiltration Test and measurement of soil conductivity, moisture and temperature carried out at Tanda Village, Bhitaura Block, Fatehpur , Uttar Pradesh.

# Collectable


01 Sharing of NAQUIM report of Darrang district to the Deputy Commisioner, Darrang district, Assam.

02 Vertical Electrical Sounding at Gopinath ki Dhani, Srimadhopur, Sikar, Rajasthan.

03 Litholog preparation of Piezometer at Nalvi, Shahabad, District.

04 Officers of CGWB, Guwahati & IA representatives visited the sites of GW Irrigation Schemes of Assam Phase II under PMKSY HKKP GW.

05 'Shramdaan' on the occasion of Swachhta Abhiyan by CGWB, CHQ, Faridabad at Badhkal Lake, Faridabad.

06 Regional Chemical Laboratory, CGWB, Kolkata completed NABL Renewal Assesment Audit as per ISO/IEC 17025:2017 through Remote Assessment.

07 Pre-monsoon Springs studies at Jampui Hills by Officers of CGWB, State Unit Office, Tripura.