NEWS AND NOTES

Proceedings of the Brain Storming Session on ‘Surface Water and Groundwater Resources of Kerala: Management Issues, Policies, Future Strategies’. Subhajyoti Das** (E: subhajyoti_das@hotmail.com), E. Shaji (E: shajigeology@gmail.com), A.P. Pradeep Kumar (E: geo.pradeep@keralauniversity.ac.in), and K.R. Sooryanarayana (E: soorybhat@gmail.com) **Corresponding author.

Kerala lying between N. latitudes 8°17’30” and 12°47’40”, and E. longitudes 74°51’57” and 77°22’00”, forms a 590 km N-S belt which can be divided into three linear topographic divisions: the coastal plains covering 10% of the total area, midland regions 42% and hill ranges or highland 48%. Though the state is known to be water surplus with more than 3000 mm rainfall, there is considerable imbalance in the availability of fresh water resources in space and time precipitating water crisis in many parts of the state. Hence, the Department of Geology, University of Kerala (under the auspices of Current Trends in Earth Systems Sciences CT-ESS 2018-19) in association with Geological Society of India, Bangalore organised a Brain Storming Session on ‘Surface Water and Groundwater Resources of Kerala’ on 15 March 2019 in the University of Kerala, Trivandrum, which was also a part of the Diamond Jubilee celebrations of the Society. The objective of the workshop was to bring out the resource potential and development status with special stress on resource management issues, strategies & policy directives for future water resource development planning in Kerala.

Inaugural session: Dr. V.P. Mahadevan Pillai, Vice Chancellor, Kerala University (second from left) releasing Abstract volume. Others (L-R); Subhajyoti Das, Dr. R.B. Binoj Kumar and Dr. E. Shaji.

After the welcome address Dr. E. Shaji, Department of Geology, briefly apprised the delegates about the background of the brain storming session. While inaugurating the seminar, Prof. V. P. Mahadevan Pillai, Vice-Chancellor, University of Kerala ceremonially released the ‘Abstracts Volume’, and stressed the need for water conservation in the state. Dr. R. B. Binoj Kumar, Head, Department of Geology in his presidential address touched upon the status and need of hydrogeological research in water resource development and management as crucial for water security in the state, Subhajyoti Das of Geological Society of India informed that although Kerala is endowed with plenty of water resources, but high runoff, water pollution and geological set up limit per capita water availability, which too dwindles over time due to increasing water demand. In addition, there is significant loss of freshwater through submarine discharge along its long coast line. Integrated management or conjunctive use of all available water resources, and economic use of water hold key to the water security in future.

The Brain Storming Sessions were organized with several key note poster presentations followed by interactions of delegates comprising water managers, scientists, engineers, economists, planners and academicians. Highlights of the deliberations are briefly presented below.

RESOURCES POTENTIAL AND DEVELOPMENT

Surface water

Kerala has 44 rivers, - 41 flowing westwards and the rest eastwards. The rivers are all under stress due to encroachments, river bed mining, discharge of untreated municipal and industrial effluents being source of pollution. The average annual discharge from the catchments of all the 44 rivers within the state is estimated at 70,323 MCM of which the utilizable potential is 42,700 MCM. The estimated water requirement by the year 2021 would be of the order of 48,600 MCM (irrigation 28,900 MCM, domestic & industrial uses 7500 MCM, salinity control 7200 MCM and improving ‘karilands’: removal of toxicity, 5000 MCM). There is thus a shortage of 5800 MCM. In addition, some amount of freshwater is needed as environmental flows to maintain functioning of its hydro-ecosystem. Hence, “the state should have definite plans to utilize the fresh water health adopting efficient measures such as mitigation of flooding during monsoon, prevention of water pollution and improvement of the water quality, improvement of water use efficiency, prevention of unscientific land use changes, creation of water awareness, rainwater harvesting and also the wise and efficient use of freshwater resources” (V.P. Dinesan, Centre for Water Resources Development & Management, Kohikode).

Groundwater

In Kerala State about 62% of population of Kerala depend on groundwater for domestic purposes. It is also an important resource for irrigation. The aquifers are broadly classified into two categories viz. (1) low yielding (<25 m³/day) consolidated crystalline formations with secondary porosity (fissures and fractures) and (2) moderate to high yielding unconsolidated sedimentary formations with primary porosity. Geologically 88% of the state is underlain by crystalline rocks of Archaean age devoid of primary porosity which do not permit any significant groundwater storage. A majority of the dug wells in the hilly highland areas and mid land regions dry up in peak summer. However, deep seated fractures. within 200 m in the charnockites and migmatites yield copious water. The Tertiary sedimentary aquifers, Vaikom and Warkali beds form potential water yielders in the state. Porous Laterities of wide spread occurrence and Alluvium in the coastal area are extensively developed by dug wells and filter point wells for domestic and irrigation needs. The dug wells get dried up during the...
summer months, causing seasonal water scarcity which affects public water supply. The groundwater irrigated area too increased from 2,012 to 122,478 hectares during 1960-2017. The ever-increasing demand of water has propelled pressure on aquifer systems in the state as reflected in a steady increase in the number of semi-critical blocks over the years (2009 to 2017) which may lead to “over-exploited” conditions in near future. While the annual utilisable groundwater resource is 5.21 BCM, the stage of groundwater development has touched 50% (as on 2017). “Groundwater management system must aim to balance the demand and supply in a sustainable manner. Supply side measures should be aimed at increasing the extraction of ground water depending on its availability. Demand side measures may be aimed at controlling, protecting and conserving available resources” (K.R. Sooryanarayana, Central Ground Water Board).

Submarine Groundwater Discharge
Submarine Groundwater Discharge (SGD) is the groundwater flux from land to sea through coastal aquifers. There is substantial loss of fresh water through coastal aquifers. There are very good potential zones of perennial SGD through the phreatic medium of coastal aquifers. These zones offer potential sites for exchange of dissolved materials between the land and ocean. The processes and components of submarine groundwater discharge (SGD) and management options of the coastal aquifers of Kerala having SGD need to be properly studied and understood. Measures should be adopted to minimise SGD without affecting saltwater-freshwater balance, and protect it from pollution. (D. S. Suresh Babu, National Centre for Earth Science Studies).

Water Quality
During summer months with dwindling flows the rivers turn polluted with pesticide residues from agricultural fields, industrial effluents and sewage causing “fish kills” in places. But the quality improves in monsoon months. Downstream of Periyar river is one of the most vulnerable hotspots of industrial pollution in the world.

Groundwater quality is generally good except in pockets as in Alleppey and Palghat districts. High concentrations of Fe and NO$_3$ are reported from different parts of the state. Also high fluoride concentration is reported in groundwater of Palghat district. Salinisation/freshening of Tertiary aquifers through cation exchange and chemical reactions is also reported in Kuttanad area (V. Kunhambu and N. Vinaychandran, Central Ground Water Board).

RESOURCE MANAGEMENT ISSUES

Providing uninterrupted supply of freshwater remains a challenge before the water managers owing to high population density in the state, a rapid economic growth and human interventions in the past 4-5 decades drastically reducing the natural resilience of almost all water-bearing systems like hills, forests, wetlands etc. Many of the traditional freshwater sources in the state are producing only low yields or have become unproductive during summer months when most of the irrigation and drinking water requirements are to be met. Hydel power has to be generated, salinity intrusions have to be arrested. Although a unit of land in Kerala receives 2.5 times more rainfall than the national average, the same unit land has to support about four times more population, in addition to sustaining a rich and diverse biological stock. “The Critical Zone – i.e., the zone extending from tree top to the aquifer bottom - of Kerala is undergoing dramatic changes due to rapid rate of economic growth, environmental degradation, unscientific water use and urbanisation. Lack of adequate knowledge on the status of the freshwater resources, environmental

Hydrogeology of Kerala (Source: Geol. Soc. India Mem. No. 69, page 71).
threats and mitigation measures is a major setback challenging sustainable use and/or conservation of the resources for future generations” (D. Padamal, NCESS). Further, unlike other water resource regions of India, the Kerala region, with steep gradient of the landscape drastically reduces the residence time of rain water, making most parts of Kerala water stressed. Hence, the “general slogan in Kerala ought to be to reduce the water foot print of all activities. Smart agriculture and indoor farming need adoption. Recycling of wastewaters should be made mandatory”. (K. P. Thrivikramaji, Department of Geology, University of Kerala).

Participatory Model
Integrated water resources conservation and management with public participation holds key to sustainability and equity of of the resource. ‘Vattatha Uravakkay Jalasamrudhi’ as implemented by Kerala State Land Use Board (KSLUB) in Kattinakada area, Trivandrum district is one such replicable participatory model to mitigate the water scarcity problem. A volunteer force, ‘Jalamithrams’ were trained by Suchitwa Mission and Youth Welfare Board in mass awareness programmes, planting of seedlings, digging rain water pits, protecting ponds and streams using coir geotextiles, rejuvenation of ponds and streams, artificial recharging of wells, digging of 300 plus new farm ponds, inland fisheries in renovated ponds, water quality testing etc. The project also includes drawing of water from the abandoned granite quarries and routing the supply to a recharge pit in a manner that facilitates gravitational flow of water. The water level in the wells with recharging facility, has improved and has become perennial. (A. Niamuddin, Land Use Commissioner, Kerala State Land Use Board.).

Thus, the sustainable water resources development is possible only through integrated water resources management (IWRM) which needs a robust ‘Kerala Water Resources Information System (KWRIS)’. High quality and timely water data need to be built up to support planning and decision making. IWRM, too, may be used for improving data and knowledge management systems, including reliable monitoring systems (water level, water quality, water use) with adequate spatial and temporal coverage (Sudheer Padikkal, Irrigation Department, Govt of Kerala).

Climate Change Syndrome
Kerala is one of the states most vulnerable to climate change and global warming. Extreme events like droughts and floods are on the rise. But in Kerala prediction of such events and their impact, especially on water resources constitute a major challenge to decision and policy makers. The occurrences of drought at different temporal and spatial scales do not fit into the broad indices of standard Groundwater Drought Index (GWDI) due to the complexity of terrain, (Thomas Scaria, Ground Water Department, Kerala). Equally significant are the evidences of acceleration of hydrological cycle in the river basins of Kerala in understanding challenges of climate change, and formulating its mitigation technology. (Merin Mariam Mathew, National Centre for Earth Science Studies). Yet another significant finding from the assessment of Post-Flood (2018) groundwater scenario of Kerala, was that 95% of the rainfall was lost as surface runoff during heavy rainfall and the groundwater recharge did not improve despite high precipitation in a short span of time. (E. Shaji, Geology Department, Kerala University). ‘Predictive modeling and groundwater impact assessment’ – a case study in Vizhinjam, Kerala, India’ may be a potential tool in the climate change mitigation technology (Suresh Francis, Kerala State Remote Sensing and Environment Centre).

MANAGEMENT STRATEGIES
In the context of spatial and temporal variations in water availability, increasing water pollution and the steady increase in water demand over the years, the management action plans should be aimed at; enhancement of surface water and groundwater availability through water conservation and rainwater harvesting, mitigation of flooding during monsoon as also in lean periods, remediation and prevention of water pollution, utmost economy in water use, and lastly knowledge based efficient use of freshwater resources. Some of the strategic actions as highlighted during the deliberations are as follows.

- Water storage capability of all the natural and man-made systems must be enhanced to bridge the gap between demand and supply of the freshwater resources and improve the overall environmental health of the life sustaining ecosystems.
- As in many developed countries there should be adequate number of well-established/instrumented Critical Zone Observatories (CZO) in different ago-climatic zones to render our developments sustainable.
- Integrated water resources management involving surface water, groundwater and rainwater is essential for water security.
- A robust ‘KWRIS’ is a fundamental need for water resources management. The essential framework of KWRIS must have ‘Data Integration in One Authoritative System’, Development of Decision Support component for Water Management’ and ‘Integration with India-WRIS’.
- Groundwater management strategies should include water use efficiency (WUE) practices, post monsoon base flow harvesting, rainwater harvesting and water conservation practices, conjunctive use, ground water regulation, recycling and reuse of water etc.
- Construction of a series of check/vented dams along river and stream courses at strategic locations will help to utilize the non-monsoon base flow by storing water along the stretches of rivers and streams and also help in replenishing local ground water resources.
- Participatory model, ‘Vattatha Uravakkay Jalasamrudhi’, as implemented by Kerala State Land Use Board (KSLUB) may be replicated in other parts of Kerala to mitigate the water scarcity problem.
- Dynamic leadership, effective planning, proper coordination among departments & people’s representatives and active people’s participation should be ensured while executing the projects.
- The management options of coastal aquifers having SGD are (a) Optimum pumping of freshwater from potential coastal aquifers for potable use, (b) Pollution management in critical zones of eutrophication and/or algal blooms and (c) Continuous monitoring in sea with selected proxies (thermal imaging, salinity sensor etc).
- Coastal land zone of Kerala, need RO technology based domestic water supply.
- Prevention of contamination of water bodies and ground water sources through scientific disposal of waste, proper treatment and better sanitation
- Reduce water foot print of all activities.
- Proper catchment area treatment, protection of river banks and sustaining river morphometry should be ensured.

The session concluded with a vote of thanks to all delegates. The brain storming session gave an overview of the state’s water resources scenario and the need for water management to avert looming water crisis. The deliberations will render valuable guidelines to the State’s Water Policy.

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