Workshop on Groundwater Hydrogeology and Groundwater Quality in and around Bangalore City – *P. Krishnamurthy and G.V. Hegde (Email: gsocind@gmail. com)*

The Workshop is a sequel to the successful completion of Purpose Driven Study (PDS) under the World Bank aided Hydrology Project phase-II(HP-II) on the topic cited above by the Groundwater wing of the Department of Mines and Geology (DMG) on 30 March 2011. H.R. Srinivasa, Director, DMG, formally welcomed the guests and dignitaries. Inaugurating the workshop, S.V. Ranganath, Chief Secretary, Government of Karnataka (GOK), while complimenting the efforts of DMG, desired that BWSSB takes appropriate steps so that the percentage of potable groundwater should increase up to 80% and implored speedier action on this front. He released the report entitled ***"Groundwater Hydrogeology and Groundwater Quality in and around Bangalore city", brought by DMG,*** under HP-II.

The Report includes three papers by DMG namely ***"Urban groundwater hydrology – Bangalore city"*** by D. Srikanta Murthy, DMG (p. 1-33). Evaluation of groundwater quality in and around Bangalore city by G.V. Hegde and M.V. Shashirekha (p. 35-85) and ***'Quality of lake waters'***, Bangalore city (p. 87-100).

P.B. Ramamurthy, Chairman, BWSSB, briefly outlined the history of water resources and supply to Bangalore city since 1896, which had an area of 29 sq. km and population of only 1.6 lakhs and the challenges that are faced to provide water and sewerage facilities to the burgeoning city presently with an area of 800 sq. km and a population over 8 million. He outlined the challenges of bringing Cauvery water from a distance of 100 km and pumping it up to 920 m height with 67 booster pumps. Thus supplies critically depend upon the availability of power. The disruption in power supply pose additional stress on water supply especially in summer months when the demand is more and the resources get depleted. In this context he stressed the urgent need for rain water harvesting and the recent legislation making it mandatory for all house holds with over 60ft x 40ft sites including government buildings and industrial establishments. Awareness and education on RWH is being provided by BWSSB through a ***"Theme park"*** in Jayanagar and helpline. He requested all the stake holders to make full use of the system.

P.N. Sreenivasachary, Secretary, Water Resources Department (Minor Irrigation) spoke on the increasing stress on sharing water between the agricultural/farm sector and the ever growing urban needs and pleaded for a common regulator to avoid conflicts in the future. He stressed the need to create public awareness on these aspects.

D. Sathyamurthy, Principal Secretary, Water Resource Department, stressed the need for an advanced centre for Integrated Water Resource Management (IWRM) and the urgent need to educate the people on the vital and inter-linked fronts seeking increasing quantities namely the agriculture, industry and drinking water to the cities. He informed that by 2055, 53% of India's population will be in urban areas and the challenge to balance the demand and supply are likely to be very acute. With a world population of 8 billion by 2030, even advanced nations like Canada, USA and EU, are expected to experience a decrease up to 30% in their use of water. He cited as how ancient river valley civilization of Babylonia, Mesopotamia, Indus valley and others have become extinct due to acute

scarcity of water and wondered as to how sustainable is our present efforts and future plans on tapping water from still far away sources such as Netravathy, Godavary and others. He emphasized the need for self discipline, education on water needs and use at the school level besides changing the modes of water usage. Khayyam Ali, Additional Director (Groundwater), DMG proposed vote of thanks to all the dignitaries and the guests.

In the two technical sessions that followed, there were five presentations. In the forenoon session chaired by Prakash, Director, Disaster Management, GOK, M.N. Tippeswamy, formerly of BWSSB in his presentation on '*Status of water supply, challenges and strategies ahead for Bangalore city'* implored the need for a comprehensive approach to solving the city's ever increasing demands on water (currently at 1125 MLD) with a supply of 900 MLD distributed through 6.3 lakh connections (about 5975 km of pipe line and about 110-120 l/day per person) consuming some 75 Mw of electricity.

He stated that out of the721 MLD of waste water generated only about 50% is treated in the 14 STPs and plans are needed to fully utilize such treated water. He pleaded for augmentation of water resources, equitable distribution aided by computer modeling on a 24 x 7 basis, water quality and above all the urgent need to account for the 40% unaccounted and non-revenue earning quantity of water lost through leaks and other means. He cited the Hubli-Dharwar-Belgaum models of water supply and treatment to emulate for improving the situation. He further emphasized the WHO's 2004 doctrine on water safety and quality from catchments to consumer, and the urgent need for asset management of BWSSB including the review of status of pipe lines (GI pipes with 8-10 years of life), leaks (60% lost with avenues for entry of polluted water/sewer in to the supply lines) and the status of STP plants which need to work on full capacity. He cited the models of integrated urban water management adopted by other countries like Australia, Singapore and others and wished that one day Bangalore the former garden city and presently a well known IT hub in of the world and India would bag the Stockholm water award for a holistic water management plan and execution.

G.V. Hegde of DMG presented on 'Groundwater hydrology and Groundwater quality in around Bangalore city' and gave a succinct account of the World Bank aided hydrology project, Phase II, Purpose Driven Studies (PDS). Over 3000 groundwater samples were collected under this PDS, covering an area of 800 sq. km, (with a one sq. km grid, collected 3-4 samples from each grid) in and around Bangalore city. The ever increasing demand for water and deficiency in the public water supply system has led to over exploitation of groundwater systems of the city leading to the drying up of shallow wells and exploitation/*mining of groundwater* from deeper levels (over 700 ft or so) that represent fossil water with minimum recharge. This has led to the identification of increased fluoride (14), Fe (214), nitrate (638) and TDS (185) over a total of samples (2209) collected and thus deteriorating the quality and posing health hazards.

Heavy metal pollution has been observed around industrial sites and e-coli and nitrates are mainly anthropogenic due to mixing of ground water with untreated sewer water both from the surface and subsurface systems, Hedge pointed out. Considering the enormous cost and challenges posed to reclaim aquifers or groundwater sources that get contaminated due to anthropogenic sources, Hegde suggested that waste disposal sites for solid and liquid should be outside the city limits. He further emphasized the need to educate people on protecting existing surface water sources like lakes, streams and rivers and harvesting cleanly the rain water through the different systems suggested by the BWSSB.

In the afternoon session chaired by K.C. Subash Chandra, formerly of DMG, Uday Raj General Manager of RRSSC, Bangalore spoke on 'Urban groundwater management issues for water security'. With a resident time ranging from 2 weeks to over 10,000 years, groundwater poses many challenges and opportunities especially in the urban setup with increasing people and likely to take over 50% of the global population pressures by 2050. The decreasing supply, disturbed and depressed water tables due to larger run-off than percolation due to covered pavements and buildings, and contamination from anthropogenic sources poses new challenges Uday Raj outlined. He further stressed the need for holistic, integrated plans to obtain water security for the cities.

In his lecture on 'Status of rural water supply and challenges and constraints' Prabhakar Hamigi, RDPR/PRED, Department GOK, explained as how water supply in the 5628 Panchayats comprising 28101 villages with a total population of 3.82 crores are being implemented in Karnataka state. A target of 40 l/ person has been envisaged in the 59000 habitation units of the state starting from a population unit of <500, 500-999, and >1000. GPS and computer aided system are being used to holistically monitor the water resources, their augmentation through recharge, water supply through hand pumps, storage tanks and other modes. Due to large disparity in literary standards, creating awareness among the various stake holders encountered within the habitat posed numerous challenges, he said. Pollution of water sources continue to be a main source of concern since among the 111,000 water sources about 24,000 are polluted to varying degrees, largely attributed to lack of knowledge on the many routes to contamination of the ground and surface water sources.

M.V. Shashirekha of DMG spoke on the "*Water quality and Human health'* arising out of the present project and highlighted with examples from Bangalore city and the need to be vigilant on using groundwater especially from areas which indicated water with chemical constituents much in excess of the permissible limits such as nitrates, F and Fe.

In his valedictory address Yogendra Tripathi, Managing Director, KPCL, complimented the geologists and chemists of DMG for the successful completion of an important study.

In the final feed back session, Jim Stephen, Consultant TAMC, on behalf of the World Bank opined the need to monitor the ground water quality especially in potential sites for contamination in the urban setup such as industrial effluents,

petroleum outlets and others so that effective management is possible.

K. Venugopal, Joint Director from Hyderabad, Andhra Pradesh (GW Department) where a similar PDS project is in operation brought out the similarity in problems faced by Hyderabad as at Bangalore with regard to groundwater as well as supplies from Krishna river. The large number of pharmaceutical industries in Hyderabad posed new challenges at Hyderabad he said. K.C. Subash Chandra commented that now with the voluminous data generated on the groundwater from Bangalore, implementation processes must be expedited to preserve and improve the quality.

H.S. Srinivasa, DMG in his concluding remarks while complimenting the personnel involved in the project further reminded the geologists of their core expertise in suggesting groundwater recharge structure and watershed development plans to the numerous government agencies and Zilla Panchayats and not to compromise on matters of site selection for check dams and other structures. G.V. Hegde, DMG, formally proposed a vote of thanks for all those who attended and making the programme a grand success.