ABSTRACT

Demand for water has been constantly increasing as population increases. However, global freshwater supplies are restricted to finite 2% of total available water. In India, groundwater resources play a very critical role in meeting the ever increasing demand of the agricultural, industrial and domestic sectors. Many cities in India experience water shortage and the authorities are not able to provide adequate quantity of protected water, particularly in summer or periods of monsoon failure. During these periods, the aquifer of the peri-urban areas or villages acts as a source, and a huge amount of water is transferred to the city formally and informally.

Chennai, one of the major metropolitan cities in India is facing an acute water crisis because of the growth in the domestic and industrial sector. Surface water is the major contributing source to the city water requirements, which is highly inadequate. The deficit is met by draining and transferring the groundwater through tanker supply as well as packaged water supply particularly from peri-urban villages. Development of groundwater for commercial purposes without any quantification and recharging activities have all impacted the land, water and on people in peri-urban villages. It has resulted in the lowering of water levels, deterioration in water quality and a decreasing trend in agriculture and agriculture related employment opportunities as a peri-urban village is already stressed due to urbanization
impacts. With this background, the present study of transdisciplinary research was taken up with the objective of examining groundwater market, its role in meeting the demand, different actors involved and village level survey for assessing the socio-economic impacts in peri-urban areas. Further, this social issue has been analyzed with technical components such as land use changes, assessment of groundwater balance, hydrochemical analysis, and mapping of groundwater potential in order to meet out the gap identified in the literature survey.

Mambakkam miniwatershed in Kancheepuram district of Tamil Nadu, India, located South of Chennai city was selected for conducting the study. The aerial extent of the study area is 224 km$^2$. The characterization of the groundwater market and its quantification (quantity of marketed water), the present status of the groundwater and agriculture have all been analyzed with collected primary data (by conducting frequent field surveys, stakeholders meetings, focus group discussions and interviews) and secondary data.

Land use maps were prepared for 2004 and 2008, using satellite data. The Survey of India Toposheets 66D/1 and 5 were used to delineate the drainage and road networks. Remote sensing data in the form of satellite imageries of IRS P6 LISS III + PAN of 2004 and IRS P6 LISS IV MX of 2008 were used for land use mapping. As per the GEC-97 methodology,
groundwater recharge was estimated based on the groundwater level fluctuations and specific yield approach. In order to study the hydrochemistry and hydrogeology of the aquifer in the watershed, water levels and samples were collected from June 2009 to June 2010 and two sets of observations fall in pre monsoon periods and one set of observation falls in post-monsoon period. For the identification of the groundwater potential zones in Mambakkam mini watershed, Remote Sensing and GIS techniques were widely used.

Village level comparative survey was conducted to analyse the issues of groundwater market and its implication, agriculture and on peoples’ livelihood in two selected peri-urban water marketing villages of Perumbakkam and Ponmar. The strategy of selecting samples was mainly based on farming and non-farming households, with the duration of their total number of years of living in the particular village (i.e. recent settlers or long term settlers). Stratified random sampling technique has been chosen for selecting the respondents for the study. As many as 186 households from Perumbakkam and 82 households from Ponmar were selected and the sample survey, which ensured to cover all the settlements in the villages to know the socio-economic implications due to the groundwater market.

As the demand for marketed water increases, the degree of commercial extraction is also expected to increase in the peri-urban villages.
The land use analysis shows that about 25% of the total area under the category of agricultural land, waste land and water bodies has been changed to either settlements or industries.

From the groundwater balance analysis, the stage of development of the Mambakkam mini watershed is categorised as semi critical (i.e. where the groundwater resource assessment shows that the stage of development is more than 70% but less than 90%). The hydro chemical analysis of the study reveals that the groundwater in the Mambakkam mini watershed is hard to very hard, fresh to brackish and of an alkaline nature.

The groundwater potential assessment indicated that most of the water marketing villages are located in the moderate potential area and it calls for a proper monitoring and regulation of the commercial extraction of groundwater to prevent the vulnerabilities of the aquifer in future. The study to assess the techno-socio-economic implications proves that prevailing peri-urban informal groundwater market has induced further stress on the land, water, agriculture and the people in addition to the effect of urbanization.

Many water scarce cities in India as well as South Asia exhibit characteristics similar to Chennai such as population growth, limited access to fresh water, informal water suppliers etc. This suggests that the insights and solutions developed for the prevailing peri-urban groundwater market in Chennai may be extended to other places.