

Chapter – V

Summary

Groundwater is a vital natural recourse. It forms the core of the ecological system. Ground water is the key source of fresh water to use in agriculture, industrial and domestic purposes. It led to an increase in the demand for water supply which is met mostly from the groundwater. Various important parameters that control groundwater chemistry are geochemical processes, regional geology, seasonal variations, environmental issues and land use patterns. Surface water is the other source of water extensively used for agriculture and irrigation purposes. Quality of the available fresh water sources is being declined day by day due to urbanization, industrialization, anthropogenic activities, climate change and manmade activities. India is one among the developing countries is vulnerable to scarcity of fresh water. Ground water levels are getting depleted rapidly. Rapid growth in population and agricultural needs are responsible for it. Climate change, elevated earth temperatures, depression in rainfall and shift in monsoons etc were said to be the reasons for the decline of the groundwater tables in India.

Being a resident of Vizianagaram district, the author has made an attempt to probe into the assessment of quality of ground and surface waters of Champavathi river basin. Champavathi River is one of the rivers that flow through the district. Ten villages on the river basin were chosen for ground water quality assessment. Two reservoirs constructed across the river were selected for assessing the surface water quality. From each of the village five sampling stations were chosen. In total fifty sampling stations were selected for analysis. The experimentation was carried out for eleven seasons such as August 2010, December 2010, April 2011, August 2011, December 2011, April 2012, August 2012, December 2012, April 2013, August 2013 And December 2013. Physico chemical parameters includes pH, EC, TDS, TH, Ca (II), Mg (II), Na (I), K (I), Fe (II), chloride, nitrite, phosphate, fluoride, total alkalinity were analyzed for the water samples collected from the chosen villages and the two reservoirs. Heavy metals such as Al (III), Si (IV), Cr (VI), Cd (II), Mn (II), Ba (II), Ti (III), V (V), Hg (II), As (III), Pb (II) and Sr (II) were analyzed using ICP method for the ground and surface waters. All the methods for analysis were adopted from APHA standards. The results obtained were compared with IS standards. Water quality of the ten villages and two reservoirs for drinking purpose was assessed by computing WQI values. A software program in JAVA script

was developed by the author to compute WQI values. Assessing the quality of the water of the two reservoirs was carried out by computing irrigation water quality parameters such as SAR, RSC, %Na and Mg-hazard. The study further gains importance after bifurcation of the combined Andhra Pradesh into the state of Telangana and Andhra Pradesh. Andhra Pradesh has become the main focus for various national and international organizations to establish their firms and institutions.

The observations are summarized as below

- pH of the groundwater samples analyzed from the selected villages was within the standards prescribed by IS i.e., 6.5-8.5. In the villages Aaguru and Mentada a pH of 9.4. It was observed that the ground water is alkaline nature of the water.
- Electrical conductivity of the ground water samples analyzed was found to be higher than the acceptable limits prescribed by IS. It was found that the values EC were beyond the permissible limits for the water of the villages Saripalli, Nadipalli and Konada. As the villages are located in the proximity of the shoreline, the reason for increased EC can be attributed to intrusion of salt water into the fresh water aquifers.
- Total dissolved solids (TDS) for the ground water samples analyzed was found to be beyond the acceptable limits prescribed by IS. The highest values of TDS were found in the villages which are near to the shoreline.
- Total hardness of water for the samples analyzed was beyond the acceptable limits indicating that the water is hard in nature.
- The concentration of calcium and magnesium in the groundwater was beyond the acceptable limits. Highest values of magnesium were found in those villages which are located very close to shoreline than those of the villages situated away from the shoreline. This infers the mixing of salt water into the fresh water aquifers of the villages.

- Except in three seasons such as August 2010, December 2010 and April 2011 in all the other seasons under study the concentration levels of sodium were within the standards prescribed.
- The concentration of chloride in villages under study was within the standards prescribed by IS. In the villages Nadipalli and Konada the concentration of chloride was found to be beyond permissible limits. The reason can be attributed to salt water mixing.
- The concentration of iron in the ground water of all the villages was found to be well within the prescribed standards.
- In all the seasons under study and in all the villages the groundwater has the highest concentrations of phosphate. The reason may be attributed to the contamination of ground water with seepage and sewage from household.
- The concentration of nitrite in the ground water of all the villages under study was found to be well within the prescribed limits in Andra, Aaguru, Mentada Gajapathinagaram and Seetharampuram villages. The same for Nellimarla, Saripalli, A T Agraharam, Nadipalli and Konada was approaching the higher limit prescribed. This infers contamination of groundwater by seepage and sewage.
- Fluoride concentration in the groundwater of the chosen villages advanced towards the upper limit of the standards given. Alkaline pH, alkalinity of water, lower concentration of iron may be responsible for increase in fluoride in groundwater.
- In all the villages, in most of the seasons total alkalinity of the water was beyond the acceptable limits stipulated.
- The following are trends observed in the groundwater of the selected area

Alkaline pH- higher alkalinity- high fluoride

Alkaline pH- low concentration of iron- high fluoride

Low concentration of iron- high phosphate- high fluoride

High TH- high Ca- high Mg-Higher EC

From all the above data in the variation of magnitude of the results obtained it is inferred that groundwater of the selected area is not potable.

- WQI values were computed using a JAVA software program developed by the author. From the values obtained it was found that the ground water of the villages is unfit for human consumption as the water is rated “poor” in its quality (Riazzuddin and Chatterji). The major components responsible for higher values of WQI are calcium, magnesium and phosphate in the groundwater.
- From the WQI values of the two reservoirs, it is concluded that the water of the two reservoirs, Andra and Denkada anicut is suitable for human consumption. The WQI values computed were found to be in the range of 25-50 for the two reservoirs. On comparison with the literature data, it was found that the water of the two reservoirs is fit for drinking and agricultural purposes.
- Irrigation water quality parameters such as SAR, RSC, % Na and Mg hazard were computed for the water of the two reservoirs. It was found that all the parameters computed were found to be well in accordance with the standards. This implicates that the water of the two reservoirs is fit for irrigation.
- Heavy metal analysis was also carried out for the groundwater and surface water (reservoirs) using ICP technique. All the metals analyzed were found to be below the detection limit of the method employed. This concludes that the water of the villages and reservoirs under study was free from heavy metal contamination.
- From Pearson correlation matrix data, the magnitudes of liner correlation coefficient infer a strong positive correlation between TDS-EC, TH-Ca, TH-

Mg, TDS-Cl, Mg-Cl, Na-Cl and Na-EC. The same trends were observed in all the seasons under study.

- Phosphate has a positive correlation with calcium and fluoride.
- The variation of EC is highly correlated with chloride, sodium, potassium and magnesium. It indicates that the water in the vicinity of Champavathi River is highly influenced by these variables. The concentrations of chloride, magnesium, sodium and potassium ions results in higher EC and TDS of the water samples.
- For all the seasons in the four year period of study, chloride in the water was found to have a positive correlation with pH, EC, TDS, TH, Ca (II), Mg (II), Na (I) and K (I). Among all these variables strong positive correlation is observed between Cl-Mg (0.8). The second highly correlated parameter with chloride is sodium (0.6). Nitrite was found to be highly correlated with calcium.
- Fluoride in the water has a positive correlation with calcium in all the seasons under study. Phosphate also has a positive correlation with fluoride in the water. This is a consequence of weathering processes and dissolution of fluoride minerals.
- Among the fourteen parameters analyzed, EC, TDS, TH, Ca (II), Mg (II), total alkalinity, phosphate were found to be beyond the tolerance limit prescribed. Remaining parameters were within the limits. The parameters which are beyond the tolerance limits are solely responsible for the poor quality of water when computed by WQI.

From all the above mentioned observations the author implicates that the ground water of the villages under study, though found to be free from heavy metal contamination, is poor in their quality. Higher concentration levels of phosphate were found in groundwater may be due to the mixing of seepage into it. With respect to the hardness of water data, it was concluded that the groundwater is hard in nature and not suitable for human consumption without treatment. The WQI data of the groundwater also supports the same.

A land of 5320 hectares was being made fertile in the district of Vizianagaram by the water of the two reservoirs. From the analysis reports of the water and the irrigation parameters and WQI values computed, it was found that the water of both the reservoirs is suitable for agricultural, drinking and irrigation purposes.

The software developed for the computation of WQI was found to be accurate, simple and easy, the advantage being an object oriented language, gives the researcher the easiest way possible for calculating the values of WQI.

Future scope of the study

The author's present study is limited to physico-chemical characterization, seasonal variation of the same, heavy metal analysis, water quality index and assessment of its suitability for human consumption, for the chosen ground and surface waters of the river basin. Bacteriological studies give a better insight on the suitability of water for human consumption. By applying "Artificial Neural Networks" model one can predict the integral quality of water. Speciation studies of the parameters helps in better understanding the causes for deterioration of quality of water and gives a path way for remedial measures.