Chapter 9

Summary and Conclusion
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Water is nature's most wonderful, abundant and useful compound and it is the basis of life. Without a properly functioning water supply, it is difficult to imagine productive human activity, be it agriculture or forestry, livestock and trade or industry.

The quality of water is of uppermost importance compared to quantity in any water supply and especially for drinking purpose. The quality of water is getting deteriorated due to industrialization, urbanization, anthropogenic activities and indiscriminate use of pesticides which run off with water and contaminate water bodies. Ground water provides one half of all the fresh water used worldwide. It occurs in a variety of ways depending upon the depth below land surface, rock type and topography. Three important aspects of ground water related to the 'Hydrologic balance' are the storage capacity of rocks for ground water, the rate of movement of ground water and chemical quality. The quality of water is assessed on the basis of physico chemical and biological parameters in order to provide the complete spectrum of information to its usefulness for municipal ,commercial, industrial ,agricultural and domestic water supplies.

The present investigation was undertaken in order to assess and monitor the quality variations in the ground water caused by natural and anthropogenic activities in the study area. In this study, a multidisciplinary approach has been adopted involving the major physico chemical and biological parameters and trace metals.
The study on the ground water quality of Tiptur taluk for a period of two years has revealed variations among the different parameters seasonally at different study locations. For the analysis of ground water, 50 sampling sites were selected. The study includes the collection of water samples following the random sampling method. Few parameters were analyzed at the spot and the remaining parameters were analyzed in the laboratory within 24 hours as per the standard methods. The trace metals analysis was made by the standard methods using atomic absorption spectrometer (AAS). The biological parameter *E. coli* was also estimated.

The interrelationship between the various physico-chemical and biological parameters in the ground water has been evaluated. Further, the ground water was classified on the basis of Handa’s and USSL classifications. In the study, the following observations were made.

The mean values of temperature varied from a minimum of 26.6°C to a maximum of 27.6°C during the period of study showing seasonal variations.

The mean pH value was found to be slightly alkaline in all the seasons. It also revealed that most of the water samples exhibited a near neutral pH.

It was revealed that the alkalinity in summer, rainy and winter season was 512.1 mg/l, 563 mg/l and 493 mg/l respectively. The observed values of alkalinity showed an increasing trend from summer to rainy and decreased values in winter season. This may be due to increased water table.

Electrical conductivity showed that 40% of the samples belonged to fresh category and 36% brackish category, remaining 8% belonged to good and 16% saline category. Further, it has been observed that electrical conductivity exhibited an increasing trend in winter season compared to summer and rainy season. This may be due to the fact
that during winter the dissolution of minerals, salts and other soil constituents increase as a result of increased ground water table.

In the present study, as per observed TDS concentration, 86% of the samples fall under fresh category and 14% under brackish category. Further, it has been observed that TDS values exhibited an increasing trend in winter as compared to summer and rainy seasons. This is due to the dissolution of more quantity of constituents of soil particles as ground water table increases during winter season.

Turbidity mean values are 1.53, 1.7 and 1.63 NTU respectively in summer, rainy and winter season. It was also revealed that there was an increasing trend in turbidity during rainy season compared to summer and winter season. This is due to percolation and infiltration in rainy season.

Total hardness showed that 18% of samples in summer, 18% in rainy and 24% in winter season exceeded the permissible limit of drinking water standards (600 mg/l, BIS 1998). In the present study it was also observed that 98% samples belonged to very hard category and 2% of the samples belonged to hard type. It showed positive correlation with calcium, magnesium, chloride and sulfates. Along with total hardness, calcium and magnesium concentration was well within the permissible limit of drinking standards.

In the present study, chloride concentration mean values were 152.45 mg/l, 142.5 mg/l and 132 mg/l respectively in summer, rainy and winter season. It was also found that chloride values were within the BIS drinking water standards. Chloride showed significant correlation with sodium and nitrate.

Fluoride mean values were 0.73 mg/l, 0.71 mg/l and 0.75 mg/l showing an increasing trend in winter season as compared to summer and rainy season. The observation also showed seasonal variations. In the study, fluoride values were well
within the drinking water standards. The ground water of this area is free from fluoride toxicity.

In the present study, 4% of samples in summer season, 6% in rainy season and 18% in winter season exceeded the permissible limit of drinking standards of 45 mg/l of BIS (1998). This increase in concentration of nitrate in the ground water during winter season compared to summer and rainy season is due to domestic sewage seepage and agriculture run off after rainy season which reaches the ground water table by percolation and infiltration.

Sulfate fluctuated between 8.5 mg/l to a maximum of 74 mg/l during the period of study. It is also revealed that the observed values were within the drinking water permissible limit (BIS).

In the study sites, the values of sodium and potassium were well within the drinking water standard limit (WHO), except for sampling location, S26, which showed higher values of potassium during the period of study.

The dissolved oxygen of water was found to be in the consumable range. Further, the value of DO decreased in winter season as compared to summer and rainy season.

In the present study, the mean values of BOD were 3.13 mg/l in summer, 3.06 mg/l in rainy season and 2.9 mg/l in winter season. BOD was within the permissible limit for drinking water standard (BIS).

In the examined water samples, 44-58% showed *Escherichia coli* contamination during summer and rainy season and 20% during winter season. This is due to contamination with faecal matter by human activity, animal bathing and also due to untreated domestic sewage and solid waste leachate into the ground water.
Trace metal distribution

In the present investigation, certain trace metals like Fe, Cd, Mn, Hg, Zn, Pb and Cr were studied. The observed result showed that iron concentration varied between a minimum of 0.03 mg/l to a maximum of 2.9 mg/l. It was also observed that 8% of the samples exceeded the limit of BIS and 20-40% were approaching the maximum value, but rest of the sampling locations were within the limit. Other trace metals Zn, Mn and Cr were within the permissible limit and Pb, Hg and Cd were below detectable level.

Conclusion

The overall analysis of ground water samples collected in and around Tiptur by taking 27 parameters, emphasize the following conclusions

- It was observed that the ground water was slightly alkaline.
- The ground water in Tiptur and its surrounding areas belongs to very hard category according to ground water classification.
- The estimated value of fluoride was well within BIS standards. Therefore, ground water of Tiptur town and its surrounding areas was free from fluoride toxicity.
- The values of the estimated nutrients and SAR were well within BIS standards. Hence, water can be used for small scale industries and agriculture.
- Bacteriological examination (E. coli) revealed that 45 to 50% of the samples in the study area were slightly contaminated (0 coliforms /100 to < 5 coliforms/100ml).
- In the present investigation, 4% of the samples exceeded the BIS limits of iron. The ground water in Tiptur town was free from other toxic metals like Cd, Hg, Cr, Pb, Zn and Mn.
- There was a significant correlation between physico-chemical parameters which was observed by adopting statistical method. In the study, WQI calculated,
interprets that ground water quality in Tiptur and its surrounding areas belongs to good category.

- Finally, it is concluded that, the ground water in Tiptur and its surrounding areas is good for domestic, small-scale industries and agriculture purpose. It is also suitable for drinking purpose after treatment.

Recommendations and Suggestions

The study revealed that Tiptur town and its surrounding villages have no adequate sanitary and drainage facilities. The concerned authorities must take appropriate steps in providing the necessary facilities to supply safe drinking water to the people of Tiptur taluk.

It is advised to avoid the entry of agricultural waste into the surface water. Prevention can be done by practicing contour cultivation, terrace farming, water spreading and chemical treatment runoff, bunding and strip cropping. Use of bio-pesticides is quite safe as they avoid water pollution.

In the present study, about 4% of the samples showed iron concentration above excessive limit of drinking standards. Device containing activated alumina absorbs iron from water. Such device can be installed on hand pumps to minimize iron in ground water before use. These type of devices are installed in West Bengal to remove excess iron in ground water.

Construction of percolation tanks, ponds and check dams across the major and minor perennial streams at geologically ideal locations are recommended to help the aquifer recharge and also surface water.

In the present study, 40 to 50% samples show contamination hence, treating water before drinking is necessary. Chlorination method can be used for disinfection. The ultra
violet rays of 200-280 nm wave length radiations have strong bacteriological action and also kill protozoa, spores, virus and even \textit{E. coli} at stronger doses or exposure time.

The entire area of Tiptur town should be provided with UGD facility.

There is a need of environmental awareness among people of Tiptur and its surrounding areas. This can be achieved by news papers, radio, TV, environmental orientation programmes and non government organizations (NGO’s).

\textbf{Suggestions}

The present investigation has revealed that there is much scope for further study in the field of ground water quality assessment and that is as follows:

- Assessment ground water recharge potential and rock –water interaction in the sub surface environment.

- Hydro chemical status of ground water in the study area.

- Assessment of heavy metal contamination and their biological aspects.

- Studies on ground water potential with respect to rain fall pattern.

- Ground water pollution and management of ground water in rural areas.

- Implementation rain harvesting structure in urban and rural areas.

- Role of ground water in agriculture and soil conservation.