Chapter - 9

Summary and Conclusions
SUMMARY AND CONCLUSION

Freshwater for animal and human consumption is a delicate resource. The major sources of fresh water such as surface water and underground water is getting polluted due to ever growing population, release of untreated domestic, industrial wastes and the use of chemical fertilizers and pesticides for agriculture crops. The deviation of fresh water supply for domestic, agriculture and Industrial needs stretches the hydrological system to its limit.

The current examination is undertaken in order to appraise and to supervise the character variations in groundwater caused by natural and anthropogenic activities in the observation area. The study involved a multidisciplinary approach involving Physical, Chemical, trace metals, bacteriological \(E.Coli\) and nutrients parameters.

The ground water along on either side of Vrushabhavathi river stream was examined for a period of two years. The authors found seasonal differences among the different parameters at different study locations. Twelve nodal points were selected to collect four samples at each point along the above said stream. Overall forty eight groundwater points were selected and samples were collected from the study points. Some of the parameters were analysed on the spot and the remaining parameters were analysed in the laboratory within 24 hours following standard procedures of APHA and compared with WHO. The heavy metals were analysed using (AAS) atomic absorption spectrophotometer. Precautionary measures were taken to prevent contamination for \(E.Coli\) contamination.

The data generated during the study (physico - chemical parameters) were subjected to statistical analysis to find the interrelationship between the parameters. On the basis of Piper, USSL and Handa's classification the ground water was separated and the observations are summarized below:
1. Among the physico-chemical parameters studied, the mean values of pH reflected the water to be alkaline in post-monsoon season where as in the pre – monsoon and monsoon season the pH values were found around– neutral range. The study also indicated that most of the ground water samples exhibited the alkaline range. It showed positive correlation with Turbidity, EC, TDS, Cl, Total Hardness, Ca, Mg and Total alkalinity.

2. The turbidity values in the current investigation crossed the threshold limit in 8.3% of pre – monsoon and monsoon and 9.3 % in post monsoon season of ground water samples. It showed positive correlation with TDS, COD, Chloride, Fluoride, TH', Ca²⁺ and alkalinity in all the seasons of both the periods. The turbidity values showed negative correlation with K and DO. Variation of turbidity concentration in ground water samples of organic and inorganic matter was observed which related to the time taken for water to reach the aquifer through percolation process.

3. The electrical conductivity values showed that 1.04% of the samples belonged to good category, 3.81 % of the groundwater samples belonged to the permissible category, 33.33% of groundwater belonged to Brackish category and the remaining 61.8% of groundwater samples of all the seasons and study period were in the saline category. The Brackish and saline water is not preferred for the useful purposes. Similarly, the total dissolved solids were found in the fresh (52.08%) and brackish (47.92%). It showed a positive correlation to TDS, Cl', SO₄²⁻, NO₃⁻, TH, Ca²⁺, Mg²⁺, Na⁺ and Total alkalinity.

4. The dissolved oxygen of the groundwater samples from the study points was found potable. The examination showed that the values of DO in
pre-monsoon season was high compared to the DO values in the Monsoon and Post monsoon season. This can be attributed to the precipitation and surface water run off that increases the water table through percolation. The parameter was found uniformly with little difference in the study area. The DO showed a negative correlation to all the physico-chemical parameters except Chloride, Fluoride and Nitrate with very less significant positive correlation. The COD exceeds in 50% each in the pre monsoon and post monsoon season and 44% in the monsoon season. It was insignificantly positively correlated with chloride, fluoride, Total hardness, Calcium, Magnesium and total alkalinity.

5. The total hardness values obtained in the present pursuit showed that 50%, 38% and 52% of groundwater samples crossed the excessive limits of BIS (1998). The average values of total hardness were 537.75, 587.85 and 581.32 mg/L in the monsoon, pre – monsoon and post – monsoon seasons respectively. The observed values shows an increasing trend in the post monsoon season. This increasing trend may be due to percolation. The total hardness showed a positive correlation with EC, TDS, Chloride, Sulphate and Nitrate. Along with Total hardness, the calcium and magnesium concentrations also exceeded the groundwater samples in 15%, 11% and 20% for calcium in pre-monsoon, monsoon and post monsoon respectively. 6.25%, 5.21% and 6.25% of groundwater samples in the current investigation crossed the permissible limits of BIS (1998).

6. The recorded values of chloride ion concentration in the current investigation (avg. values) has shown an increasing trend from monsoon to pre - monsoon and pre – monsoon to post – monsoon. This is due to the percolation of soil and anthropogenic activity. The BIS (1998)
permissible limit for chloride is 250 mg/L. In the current investigation, it is found that 12%, 23% and 24% of the water samples crossed the permissible limits in the monsoon, pre-monsoon and post-monsoon seasons respectively. However the values were well within the excessive limits of BIS (1998) of drinking water standards.

7. The fluoride concentration was within the permissible limits of BIS (1998) throughout the study. Whereas Nitrate concentration was recorded as high as 189.3, 185.25 and 205.63 mg/L in the pre monsoon, monsoon and post monsoon seasons respectively. The authors observed that 53.15% of total groundwater samples in the pre monsoon season, 40.63% of water samples in the monsoon season and 48.96% of groundwater samples in the post monsoon season crossed the acceptable values of BIS (1998) for drinking water standard. The nitrate ion is positively correlated with EC, TDS, $SO_4^{2-}$, TH and Ca. The excessive concentration may be due to anthropogenic activities in the study area.

8. Among the estimated trace elements, 2.083 % of the groundwater samples in pre monsoon and post monsoon season have crossed the permissible limits of drinking water standards of BIS (1998). In the monsoon season only one samples has crossed the limits of BIS (1998) with respect to iron. The authors recorded 1, 2 and 3 groundwater samples above the permissible limits of BIS (1998) for the element lead in pre monsoon, monsoon and post monsoon season respectively. Only one groundwater sample have crossed the permissible limits of BIS (1998) throughout the study period with respect to cadmium.

9. The trace elements such as zinc, chromium and nickel were within the permissible limits of BIS (1998) throughout the study period. The concentration of the element Cu have found above the permissible
limits in Pre monsoon and post monsoon season by 1.0417%, whereas in monsoon all the samples were within the permissible limits of drinking water standards.

10. The present investigation has revealed that the 9.38% of groundwater samples in the pre monsoon season, 18.75% of groundwater samples in monsoon season and 22.91% of groundwater samples in the post monsoon season were contaminated by the bacterial E.Coli.

**Significance of Results:**

- The results obtained from experimental data shows that major physico-chemical parameters exhibited an increasing trend in the post monsoon season compared to the other seasons. This is due to the dissolution of minerals and solutes in soils during the discharge of ground water through precipitation i.e. the increase of groundwater table in the post monsoon season.

- An increasing trend in the post monsoon season was observed in TDS concentration to that of pre monsoon and monsoon season. This may be due to dissolution of more amount of constituents of soil particles as ground water table increases during post – monsoon season.

- The dissolved oxygen values showed a decrease trend from post monsoon to monsoon and monsoon to pre monsoon season. This trend is due to the fact that during post monsoon season, the dissolution of minerals and salts of soil increases by utilizing dissolved oxygen and increase in groundwater table.

- The hardness in the current findings shows that, 50% of groundwater samples in pre monsoon season and 52% of groundwater in post
monsoon season have higher concentration than the prescribed standards of BIS.

✓ The present study revealed that 15% of the water samples in the pre monsoon, 11% of the water samples in the monsoon and 20% of the water samples in the post monsoon season have crossed the acceptable limits of BIS (1998) for drinking water standards for calcium.

✓ During the investigation the authors found 40.63% to 53.15% groundwater samples crossed the acceptable values for nitrate concentration in different season.