5.0 General

During the past several decades, groundwater quality has emerged as one of the important and confronting environmental issues. Attention on water contamination and its management has become a need of the hour because of far reaching impact on human health. And the development of agriculture is a key factor in the economic development of a country like India, as the agriculture is the main source of sustenance for the majority of the population in the country and contributes 46% to the gross national product. The work carried out with reference to the problem identified and the tasks carried out in this direction are discussed in the earlier chapters. In this chapter the work carried out is summarized for the benefit of any reader of this volume. Section 5.1 contains the summary. During the various stages of the work a number of inferences were drawn and the important conclusions are presented here in section 5.2. As research is an unending process there exact scope for improvement to the solutions provided for any problem. Keeping this in view with the experience gained during various stages of the investigation certain suggestions are made for further study. These aspects are presented in section 5.3.

5.1 Summary

With a concern to provide useful information to the planners with regard to suitability of water supply for the fifty five mandal headquarters of Prakasam District that have been chosen, the study objectives have been defined. Subsequently in order to achieve the objectives identified, a research problem was defined (sections 1.4.1 and 1.4.2).

In order to solve the problem defined through appropriate methodology, literature review has been carried out, the outcome being fixing the scope of the problem and realization of
various tasks to be carried out (section 2.3). Further, the literature review has enabled the identification of the methodology to be adopted at various phases of the investigation. The methods have been followed during the literature review for the determination of groundwater quality over the study area. In the methodology, section 3.1 describes the sample collection and physico-chemical analysis for eight important water quality parameters. A number of indices have been developed to summarize water quality data in an easily expressible and easily understood format. In the present study, two types of indices WQI and Nemerow’s pollution index (NPI) are developed by using the analyzed water quality data as described in methodology (sec 3.2). WQI is generated by weighted arithmetic index method. And NPI is calculated by Nemerow’s pollution index. And in section 3.4 of methodology carried out the irrigation suitability study for the selected area based on EC, SAR and RSC.

Thus during the present study, the following field studies have been taken up for justifying the above suitability.

1. Measurement of latitude and longitude are of the stations using GPS.
2. Collection of water samples in pre and post monsoon seasons from the selected stations.
3. Eight important physico-chemical properties for potability and seven other parameters for irrigation are analyzed for water samples using standard methods prescribed by APHA.

The results from the water quality studies are analyzed by considering fifty five stations of Prakasam District. The study also enabled to identify the stations with different categories of water quality as per WQI and identify the pollution causing parameters with NPI.

Finally GIS software 9.3 version has been applied in the present study at various stages of the work as a decision supporting system. Towards this purpose, thematic maps for various water quality parameters, WQI map and NPI pollutants have been developed using Arc GIS software 9.3.
5.2 Conclusions

1. In the present study, from analysis of pre and post monsoon data, and the average values obtained it has been inferred that certain parameters like Calcium, Magnesium, Total hardness, TDS have increased and remaining parameters like pH, Chlorides, Fluorides, Nitrates show decrease in concentration. The reason can be attributed to increase in concentration as a result of greater leaching and decrease in concentration as a result of dilution.

2. The final output has been given in the spatial representation of groundwater quality in the study area of Prakasam District. The analysis indicates that the groundwater of the study area needs some degree of treatment before consumption. The study helps to understand the quality of water as well as to develop suitable management practices to protect the groundwater sources.

3. A few of the stations like pamuru, Hanumantunipadu, Kanigiri, Donakonda, Markapuram, Kandukuru, Balikurve and Marturu stations found to be high fluoride concentration more than permissible value of 1.5 mg/l given by BIS and may lead to diseases like dental fluorosis and skeletal fluorosis with a long run usage. Hence require special treatment, in the above stations to make them potable. The treatments may be such as Reverse osmosis, Distillation, Activated alumina, BC-Carbon and Nalgonda technique.

4. Out of fifty five groundwater stations in the study area, ten stations namely Giddaluru, K.K.Mitta, Kanigiri, Jarugumalli, Podili, Ballikurva, J.panguluru, Naguluppalapadu, Ongole (west) and kuruchedu stations shows nitrate concentration more than 45 mg/l and may cause blue baby disease for infants. Hence an alternative source of water supply may be choosen.

5. The water quality status is assessed through Weighted Arithmetic Index method. WQI values of groundwater samples analyzed for pre and post monsoon seasons depict that there exists a narrow change in the WQI values which is not very significant with reference to potability and groundwater quality. Long-term trends
in overall index values will be difficult to calculate until a few more years of data are collected. Trends over a longer period can be assessed for individual water quality variables.

6. As per WQI scale, the selected groundwater stations are classified from excellent to very poor and in certain areas even unsuitable for drinking. Highest value of WQI (265.87) is observed at Kandukuru and minimum value of WQI (15.87) at Yerragondapalem.

7. The parameters causing pollution at each station in the study area have been identified through Nemerow’s Pollution Index (NPI). The most significant pollutants present in the study area observed are Fluorides, Nitrates and Total Dissolved Solids.

8. The results of the present study revealed that Electrical Conductivity (EC) of the samples varied from 0.41 to 7.86 dsm$^{-1}$, Sodium Adsorption Ratio (SAR) of the samples varied from 0.38 to 35.19 (moles L$^{-1}$) and Residual Sodium Carbonate (RSC) of the samples varied from -32.16 to 7.97meL$^{-1}$.

9. As per CSSRI classification, out of fifty five stations, thirty five stations have been found to be good in quality for the purpose of irrigation. Under the category of Saline waters, six stations are come under Marginally Saline (B1) category, two stations are in Saline (B2) category and five stations are in High SAR Saline (B3) category. While classifying the water with respect to Alkali category, no station is identified under Marginally alkali (C1) category and three stations are in Alkali (C2) category. Four stations are observed in Highly Alkali (C3) category. In general, the waters were of Ca-Na-Mg type with the dominance of HCO$_3$ and CO$_3$ in case of good quality waters. The poor water quality belonged to categories of B1, B2, B3, C1, C2 and C3, which are either having accumulation of salts (high EC) or high Sodium adsorption ratio (SAR) or Residual Sodium Carbonate (RSC). It can be concluded that Irrigation with Saline waters (B1, B2
and B3 Category) and Alkali waters (C1, C2 and C3 category) may create the problem of salinity/solidarity to soils if irrigated for a long period.

10. Thematic maps for spatial distribution of water quality parameters in the study area, WQI and NPI are generated by Arc.GIS software 9.3.

11. The spatial distribution maps have been generated on the basis of EC, SAR and RSC for different categories of groundwater samples using Arc GIS software 9.3.

12. The spatial distribution map for different classifications of groundwater in the study area has been generated on the basis of Central Soil Salinity Research Institute (CSSRI) classification.

5.3 Scope for further study

With the experience gained during the investigation carried out and also taking into consideration some of the constraints the following aspects have been suggested which have a potential for further study.

1. The water quality assessment studies carried out does not include bacteriological analysis. A study by including this would give rise to better results in assessing groundwater quality of the district.

2. The water quality assessment studies carried out for more number of years which would give rise to better results in assessing groundwater quality of the district.

3. The water quality assessment studies through WQI can be carried out for irrigation, recreation and industrial purposes also.

4. The water quality assessment studies can also be carried out with some other indices like vulnerability index etc.

5. This study can also be carried out for groundwater modeling.

6. This study can also be carried out for land use land cover application through GIS software.