ABSTRACT

Water is one of the essential elements for the origin, existence and sustenance of life on Earth. It is regarded as the raw material for civilization. Water is a precious natural gift and is an important renewable resource on the planet Earth. The continuous circulation of water between the different spheres of the environment constitutes the hydrological cycle. Due to urbanization and industrialization together with the lack of wisdom to live in harmony with nature, has led to the deterioration of quality of water thus resulting in water pollution. The reasons for water pollution can be identified as municipal, industrial, agricultural and miscellaneous sources such as septic tank leakages, salinity intrusion in coastal aquifers etc. Therefore water pollution is defined as any degradation in natural water quality making the water unfit for intended use. Hence suitability of water for various purposes needs to meet different quality standards. Due to inadequate availability of surface water, groundwater remains the only option to supplement the ever increasing demand of water. Groundwater is the ultimate and most suitable fresh water resource for human consumption, as well as for agricultural and industrial uses in many regions all over the world. Thus water quality varies with intended use.

Groundwater usually contains high total dissolved solids concentration. However water is regarded fresh only when total dissolved solids concentration is less than 1000 ppm which makes it suitable for drinking. Certain parameters such as Nitrates, Fluorides also prove to be deleterious to human health. The well waters are expected to contain more dissolved salts of the sodium, calcium and magnesium and their use in
irrigation results in the increase of the salinity of the soil and thereby the loss of fertility. Further, the presence of accumulated amounts of high concentration of carbonate and bi-carbonates of alkali or alkaline earth metals, turn to be responsible for the dispersion of soil particles that ultimately reduces porosity of the soil and thereby the loss of fertility. Contamination of groundwater has been occurring for many centuries, the current concern for control of water pollution and for maintenance of high quality water supplies has stimulated an interest in the protection of groundwater resources from contamination. Prevention of pollution in groundwater is a critical task in effective groundwater management. Once the groundwater has been polluted, its quality cannot be restored by arresting the pollutants from the source. It therefore becomes imperative to regularly monitor the quality of groundwater.

Andhra Pradesh is one of the 28 states of India, situated on the country's south eastern coast. It is India's fourth largest state by area and fifth largest by population. Andhra Pradesh is bordered by Maharashtra, Chhattisgarh and Odessa in the north, the Bay of Bengal in the east, Tamil Nadu to the south and Karnataka to the west. The Prakasam District of Andhra Pradesh occupies an area of 17,626 km² and has a population of 3,059,423 of which 15.28% are urban. It is the largest in area among the coastal districts. The average rainfall in the district is 616mm as of 2001 Census. This district lies between 15°0'-41'-24” to 16°0'-00'-36” Northern latitude and 79°0'-56'-24” to 80°-17'-56” Eastern longitude. The average elevation is 10m (30ft). It is bounded on the north by Guntur and Mahaboobnagar Districts. On the south by Cuddapah and Nellore Districts, on the east by Bay of Bengal and on the west by Kurnool Districts. The district headquarters is located at Ongole. The district is drained by Gundlakamma, Manneru, Musi and Paleru rivers. Red loamy, black cotton and sandy loams are the predominant soils in the District forming 51%, 41% and 6% respectively over the total area of the District. The black cotton soil is widely prevalent in 16 Mandals of Ongole division. The red loams are predominant in parts of Kandukur and Markapur divisions largely covering 19 Mandals. Sandy loams prominently exist in the Mandals of Chirala, Vetapalem, Chinaganjam and Ulavapadu where Cashew Plantations and Casurina are being widely grown because of the suitability of soil. In Prakasam District the sea breeze renders the climate moderate both in winter and summer seasons in the coastal areas of
the district. In the non-coastal areas of the district the heat in summer is severe especially in the tracts of upland areas and adjoining hills. The Maximum temperature is usually recorded in the months April, May and June. The District receives its rainfall mostly and predominantly from South West as well as North-East monsoons. The agricultural activity in the district is deplorable owing to gambling of monsoons and unreliable rainfall and much dependence on tanks and wells for irrigation.

Assessment of the groundwater quality has always been important in the field of environmental quality management. The study areas in Prakasam District have a special significance and need great attention since groundwater is the only major source for domestic consumption and irrigation. The endeavor of the present study is to assess the groundwater suitability for drinking and irrigation pertaining to fifty five mandal head quarters of Prakasam Distinct, Andhra Pradesh, India. Suitability for drinking has been evaluated with reference to standards prescribed by Bureau of Indian Standards (BIS). Water Quality Index was derived by Weighted Arithmetic Index method. In addition the polluting parameters at each selected station are also assessed using Nemerow’s Pollution Index. The collected groundwater samples from fifty five mandal stations are also classified by representing salinity and alkalinity as per the criteria suggested by the Central Soil Salinity Research Institute (CSSRI), India. Base map of Prakasam District is collected from district collector office and sampling locations are taken using GPS. Arc GIS Software 9.3.is used for developing the thematic maps at various stages of this present work. To characterize the groundwater in the selected fifty five stations in Prakasam District, Andhra Pradesh, a qualitative survey is conducted for eight water quality parameters pH, Chlorides, Fluorides, TDS, Total Hardness, Calcium, Magnesium and Nitrates in pre and post monsoon seasons of 2009 and it is concluded that the temporal variability of water quality parameters is not much significant. Therefore it indicates that seasonal variability of the concentrations of water quality parameters is meagre due to scanty rainfall recorded during the year. For drinking suitability, the selected eight important water quality parameters such as pH, Chlorides, Fluorides, TDS, Total Hardness, Calcium, Magnesium and Nitrates are compared with standards laid by Bureau of Indian Standards (BIS). From the results, it is concluded that, some of the parameters like TDS, Chlorides, and Fluorides etc. possess high values and therefore
require treatment before consumption. Especially for fluoride polluted waters special treatment is required or the choice of alternative source of water supply is suggested (mineral water). The data base obtained from water quality testing is used as attribute data base for preparation of thematic maps showing distribution of various water quality parameters. The results of the water quality analysis work is presented in the form of maps which can be used for better understanding of the present water quality scenario of the study area.

Drinking suitability study is also extended to classify the groundwater in the study locations based on WQI. Water Quality Index is a very useful tool for communicating the information on overall quality of water. This is derived by Weighted Arithmetic Index method. The study indicates that the water quality varies from good to very poor and in certain stations even unsuitable for drinking. It is one of the most effective way to communicate information on water quality trends to policy makers to shape strong public policy and implement the water quality programs. The calculated Water Quality Index values are used as attribute data base for preparation of thematic map for showing distribution of various categories of water as per WQI. The developed thematic maps can be used for better understanding of the groundwater quality scenario of the present study area as per WQI for public policy makers. As per the study of Nemerow’s Pollution Index, it is observed that the principle pollutants are Chlorides, Hardness and the water is mineralized showing TDS concentration above 1000 mg/l mostly. The pollution causing parameters at each station are identified and the same is tabulated for ready reference. The identified pollution parameters at each station are selected as attribute data base for preparation of thematic maps for NPI are pollutants. The developed thematic maps as per NPI were used for assessing the pollution status of the study area and also used for better understanding of the present pollution status of the study area.

For irrigation suitability, the water quality parameters such as electrical conductivity (EC), cations (\(Na^+\), \(K^+\), \(Ca^{2+}\) and \(Mg^{2+}\)) and anions (\(CO_3^{2-}\), \(HCO_3^-\), and \(Cl^-\)) are analyzed and SAR and RSC are calculated. The results of the study revealed that EC of the samples varied from 0.41 to 7.86 dsm\(^{-1}\), SAR from 0.38 to 35.19 (mmolesL\(^{-1}\)), pH from 7.90 to 9.05 and RSC from -32.16 to 7.97 meL\(^{-1}\). The dominant cation present in groundwater samples of this region is \(Ca^{++}\) and in some cases \(Na^+\) is the dominant one.
The dominant anions are $\text{HCO}_3^-$, $\text{Cl}^-$ and $\text{SO}_4^{2-}$. Most of the samples are of Ca-Na-Mg type with the dominance of $\text{Cl}^-$ followed by bicarbonate and carbonate in case of good quality water. As per the classification adopted by Central Soil Salinity Research Institute (CSSRI), out of fifty five mandal stations, thirty five mandals are found to be of good quality for the purpose of irrigation. Under the category of Saline waters, six stations come under Marginally Saline (B1) category, two stations in Saline (B2) category and five stations in High SAR Saline (B3) category. While classifying the water with respect to Alkali category, no station is identified to be under Marginally alkali (C1) category and three stations are in Alkali (C2) category, four stations are observed in Highly Alkali (C3) category. Using Arc GIS Software, the thematic maps for spatial distribution of EC, SAR, RSC are prepared. And also the maps for different categories of groundwater at different stations as per CSSRI classification are prepared.