A Case Study of the Effect of Seawater Intrusion on the Water Quality Index of the Indian Southeastern Coastal Region

R. Chandrasekhar, Y. Satyanarayana, Ch. Ramakrishna, L. Vaikunta Rao, Jaspreet Kaur, and Surinder K. Mehta*

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ABSTRACT: Safe and clean acceptable quality of water is essential for the survival of life. There are severe problems with the insufficient availability of safe groundwater for human consumption. The present study aims to evaluate the groundwater quality in the coastal area of Srikakulam district, located in the extreme northeastern direction of Andhra Pradesh in India. The study area spreads over an area of 130 km^2. In this study, groundwater is the major source for drinking and irrigation purposes. A total of 20 bore well (BW) groundwater samples were collected with a distance of 5 km each during the period of the premonsoon and monsoon seasons of 2020. This study investigates the importance of groundwater quality in some areas of the coastal villages in the Srikakulam district. The overall water quality condition is explained with various physicochemical parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), total alkalinity (TA), calcium (Ca^{2+}), magnesium (Mg^{2+}), fluoride (F^-), chloride (Cl^-), nitrate (NO_3^-), sulfate (SO_4^{2-}), sodium (Na^+), potassium (K^+), and turbidity. The water quality is assessed on the basis of the water quality index (WQI) method. The physicochemical results are compared to the water quality standards of the World Health Organization (WHO), 2012, and the Bureau of Indian Standards (BIS), 2012. The correlations between the values have been presented for various parameters. The water quality index (WQI) ranged between 11.56 and 61.27, the highest value recorded at M. Ganguwada and the lowest at Bandaravanipeta. The analytical results showed that around 90% of the samples are extremely hard in their nature and that their Na^+ and Cl^- concentrations are also higher. It indicates that the coastal region is influenced by seawater intrusion.

KEYWORDS: groundwater quality, water quality index (WQI), seawater intrusion, seawater mixing index (SMI), physicochemical parameters
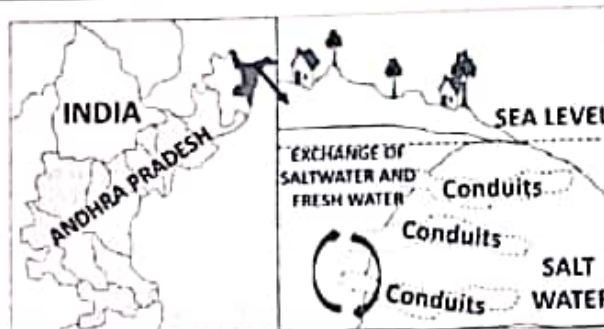
1. INTRODUCTION

Water is one of the natural sources and is an asset on Earth with every life depending upon its availability. Groundwater is an essential and vital component of our life support system. The most important and largest storage of groundwater is drinkable for the human populace.[1] Regularly, around 33% of the human population is utilizing groundwater for drinking purposes.[2-4] In India, around 60% of the groundwater is used for irrigation requirements, and 85% of the groundwater is used for drinking and domestic requirements.[5] Recently, in the coastal areas, groundwater utilization has increased to meet the water demand for industrial and irrigation uses.[6] The development of financial systems and urbanization is noticeably increasing the demand for groundwater. The inadequate availability of surface water and over-utilization of groundwater are leading to a gradual decrease in the quantity and quality of groundwater. The drinking water quality of groundwater is necessary for human health. The groundwater quality and anthropogenic activities have a comprehensive impact on climate variability and climate change.[7,8] Low resistivity standards propose saltwater, whereas high values propose freshwater. Subsurface resistivity depends on many factors such as the water content, rock type, soil type, salinity, and mineralization of groundwater.[9]

Most of the groundwater in coastal regions has the constant threat of saltwater.[10] All over the world, the coastal regions are affected by seawater intrusion; mostly coastal regions are affected by the intermixing of seawater with fresh ground-

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ASSESSMENT OF GROUNDWATER QUALITY IN COASTAL ZONE MANDALAS OF SRIKAKULAM DISTRICT BY USING PRINCIPAL COMPONENT ANALYSIS

R. Chandrasekhar[1], L. Vaikunta Rao[2],

[1] Research Scholar, Department of Chemistry, Institute of Science, GITAM (Deemed to be University), Visakhapatnam, Andhra Pradesh, India.

[2] Associate Professor, Department of Chemistry, GITAM (Deemed to be University), Visakhapatnam, Andhra Pradesh, India

ABSTRACT

This study is designed to focus on the assessment of groundwater quality within the rural coastal Mandals of (Kaviti and Etcherla Mandals) in Srikakulam district, Andhra Pradesh, India. Kaviti Mandal belongs to the Uddanam area. Groundwater is a major source for drinking and agricultural purpose of these Mandals. A total of 20 water samples were collected from these two Mandals in a single sampling campaign in Aprial 2020. To analyze 16 water quality variables and apply the principal component analysis (PCA) to explore the parameters in change for the main variability in water quality variance for two Mandals groundwater. And to identify the source of pollution. The PCA results displayed the four significant main components and combined explained in Kavity at 76.2 % and in Etcherla at 85.9 % of the variances Specifically followed by forming activities, seasonal effects, geological effects, and domestic sewage discharge effects represent 32.9 %, 19.9%, 13.1 %, 10.2 % and 20.9 %, 14.7 %, 9.7 % respectively, of the total variance of water quality in both Mandals. The results of PCA replicated a good look at the water quality monitoring and understanding of the groundwater.

Key words: Coastal area Groundwater (CGW), Water quality, Principal Component Analysis (PCA), physicochemical parameters.

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1. INTRODUCTION

Groundwater is a very important renewable natural resource on earth and a safe provision of potable water sources for urban and rural areas. (Ghezelsofloo and Ardalan, 2012; Wakode et

GROUNDWATER QUALITY MONITORING IN A COASTAL AREA USING WATER QUALITY INDEX AND PRINCIPAL COMPONENT ANALYSIS: A CASE STUDY OF SRIKAKULAM DISTRICT INDIA

R. Chandrasekhar*

Department of Chemistry, Institute of Science, GITAM University,
Visakhapatnam, Andhra Pradesh, India.

L. Vaikunta Rao

Associate Professor, Department of Chemistry, GITAM University,
Visakhapatnam, Andhra Pradesh, India

*Corresponding Author

ABSTRACT

The major objective of this study was to evaluate the groundwater quality in the coastal area of Srikakulam district, Andhra Pradesh, India. Groundwater quality is assessed by the Coastal Ground Water Quality Index (CGWQI) and groundwater pollution monitoring by using a key method is principal component analysis (PCA) this methodology determines the suitability of groundwater for drinking. Groundwater samples were collected from 20 Bore Wells in July 2019. The collected samples were analyzed for physicochemical and biological parameters such as pH, electrical conductivity, total dissolved solids, total alkalinity, total hardness, calcium, magnesium, chloride, Sulphate, nitrate, potassium, sodium, fluoride, Iron, and dissolved oxygen, biological oxygen demand was analysed as well as we're used to determining WQI and PCA. The obtained results are used to integrate the correlation matrix and pipeline plots, and compared with the water quality standards of (WHO) and (BIS) 2012. The WQI values range from 36 to 96. It shows a very poor quality unsuitable for drinking. The analytical results of the groundwater of the study area are recommended that regular monitoring is required, and some treatment before being used for utilization.

Keywords: Groundwater quality parameters, Coastal area, Coastal Ground Water quality index (CGWQI), Principal component analysis (PCA).