International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 851-856 www.ijaem.net ISSN: 2395-5252

Analysis of Ground Water Quality Using Water Quality Index in Machilipatnam Region, Krishna District

Mr. G. Sai Krishna[1], Abdul. Asif [2], A. Siddhardha [3], A. Anand Rao[4], D. Chandra Babu [5]

Assistant professor,S R Gudlavalleru Engineering college ,Student ,S R Gudlavalleru Engineering college,Student ,S R Gudlavalleru Engineering college,Student ,S R Gudlavalleru Engineering college,Student ,S R Gudlavalleru Engineering college,

Date of Submission: 15-04-2025 Date of Acceptance: 25-04-2025

ABSTRACT:
This Case study focuses on the status, challenges and management of underground water in, a town in Andhra Pradesh. India. The Study examines ground water quality availability & utilization, identifying issues such as Over-extraction, Contamination, & impact of agricultural & industrial activities. Water Sample analysis is Conducted to evaluate parameters like PH, Turbidity, Acidity and Alkalinity of water, Chlorides, Sulphates. These parameters will be compared against permissible limits set by the Bureau of Indian Standards (IS 10500:2012) to calculate the WQI and assess water quality suitability for drinking purposes. The findings highlight the urgent need for effective water treatment Solutions to ensure safe & Sustainable water usage for drinking & irrigation purposes. Recommendations will address improving water quality and promoting efficient management practices in the region.

Keywords: Ground Water Quality, Weighted Arithmetic Index Method, Water Quality Parameters.

I. INTRODUCTION

Water is an elixir of life. Life, prosperity, and civilization revolve around water in the whole world. The availability of a water supply adequate in terms of both quantity and quality is essential to human existence. Early people recognized the importance of water from a quantity viewpoint. Civilization developed around water bodies that could support agriculture and transportation as well as provided drinking water. But recognition of the importance of the water quality, developed more slowly. Early humans could judge the water quality only through the physical sense of sight, taste, and smell. The mean daily intake of water by man is estimated to be 3% of the body weight. Thus, water for drinking purposes must not contain harmful substances that causes adverse effects, but at the same time should be aesthetically acceptable to the consumer. The water covers about three quarters of our planet, and it is said to note that particularly in rural areas about 70% of the world population survive without clean water.

Water Quality Index

Water quality index provides a single number that expresses overall quality at a certain location and time, based on several water quality parameters. The objective of the water quality index is to turn complex water quality data into information that is understandable and usable by the public. A single number cannot tell the whole story of water quality there are many other water quality parameters that are not included in the index. However, a water quality index based on some very important parameters can provide a simple indicator of water quality. In general water quality indices incorporate data from multiple water quality parameters into mathematical equation that rates the health of water body with number.

Necessity of the study

Due to dumping of industrial wastes into streams, lakes, rivers not only the surface waters, but the ground water is also affected. This making water bodies the final resting place of various materials that cause water pollution as they contain harmful chemicals. Due to infiltration of surface water, the ground water is contaminating with

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 851-856 www.ijaem.net ISSN: 2395-5252

chemicals. Most of the people depended on groundwater for their drinking purpose. So, the health of people depends on consumption of water. If the water is polluted with chemicals, or if the water is not as per standards prescribed by WHO, ISI, ICMR, the health of people who consumed the contaminated water will be seriously affected. So, there is needed to take preventive steps to prevent the ground water contamination. The rapid growth of urban areas not only affecting the surface environment like deforestation, but it also affecting the groundwater quality due to over exploitation of resources and improper waste disposal practices. The rapid growth of industrialization not only affecting the surface environment, but it also affects the sub surface environment by polluting ground water. Hence, there is need to concern over the protection and management of groundwater quality considering the above aspects of groundwater contamination. As prevention is better than cure, the dumping of industrial wastes should be abandoned to reduce the ground water contamination.

STUDY AREA

The ground water sample at the following
10 location of Machilipatnam krishna district, Andhra Pradesh were Collected and the water quality status at those location were examined during this project.

1. Housing Board
2. Valandapalem
3. Camelpeta
4. Chittipalem
5. buddalapalem
6. Bandar Kota
7. Koneru center
8. Kalenkapeta
9. Naveenmetal colony
10. Tallapalem

WATER QUALITY INDEX[WQI]

Water quality index is a quality rating, reflecting the effect of each water quality parameter on the overall water quality. In general water quality indices incorporate data from multiple water quality parameters into mathematical equation that rates the health of water body with number. Water quality index provides a single number that expresses overall quality at a certain location and time, based on several water quality parameters. The objective of the water quality index is to turn complex water quality data into information that is understandable and usable by the public. water quality index provides a single number (like a grade) that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an index is to turn complex water quality data into information that is understandable and useable by the public.

WEIGHTED ARITHMETIC INDEX METHOD:

The Weighted Arithmetic Water Quality Index method is a rating reflecting the composite influence different water quality parameters. It classifies water quality according to the degree of purity and provides a comprehensive picture of the quality of surface /ground water by using the most measured water quality variables. The steps in calculating the Weighted Arithmetic Water Quality Index as given as follows.

S NO:	LOCATION	pH	NITRATES	SULPHATES	CHLORIDES	ALKALINITY	TOTAL HARDNESS	CALICIUM	MAGNESIUM	TOTAL DISSOLVED SOLIDS	ELECTRICAL CONDUCTIVITY
1	HOUSING BOARD	7.55	5	15.36	120.53	35	115	60	55	1100	2.134
2	VALANDAPALEM	7.33	10	84.48	120.53	10	87	40	47	4700	2.004
3	CAMEL PETA	7.10	5	184.32	397.04	15	82	36.67	45.33	6500	2.073
4	CHITTIPALEM	7.62	5	76.8	39.70	25	58	13.33	44.67	5700	0.7353
5	BUDDALAPALEM	7.56	50	199.68	99.26	30	95	23.33	71.67	1700	2.767
6	BANDAR KOTA	7.30	50	16.90	347.41	45	191	83.33	107.67	3600	5.879
7	KONERU CENTER	7.05	30	199.68	141.80	20	149	73.33	75.67	2500	2.880
8	KALENKANPETA	7.89	40	161.28	226.88	15	120	30	90	900	3.690
9	NAVEENMETAL COLONY	7.75	10	23.04	95.72	10	58	26.67	31.33	2500	1.140
10	TALLAPALEM	7.70	15	19.96	72.3	20	64	20	44	1000	1.585

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 851-856 www.ijaem.net ISSN: 2395-5252

The Quality Rating Scale (Qi) for each parameter is calculated using the formula

$Q_i = V_a - Vi$

V,–Vi

Were,

Va = Actual value of water quality parameter obtained from the data

V_i= Ideal value of water quality parameter (For pH=7

)

Vs= Recommended standard value of the parameter according to IS 10500-2012

The Proportionality Constant (K) is calculated as

$$K = \frac{1}{\sum \frac{1}{Vn}}$$

The Unit Weight (Wi)for each parameter is calculated using the equation

$$W_i = \frac{K}{V,}$$

pH

pH is a method of expressing Hydrogen Ion Concentration, which determines the water is acidic or alkaline in nature. The pH of natural waters ranges from 6.5 to 8.5.Deviation from the neutral pH value 7.0 is the result of interaction between acids and bases. The pH value in the study area range from 6.8 to 7.8.

Electrical Conductivity (EC)

The reason that the conductivity of water is important is because it can tell you how much dissolved substances, chemicals, and minerals are present in the water. Higher amounts of these impurities will lead to a higher conductivity. Pure water is not a good conductor of electricity. Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases.

Nitrates:

Nitrate contamination occurs in surface water and groundwater, leaching into the soil and from there into the water supply from various sources. Irrigation water containing fertilizers is a common culprit as are septic systems, wastewater treatment plants, dairies and natural conditions. Drinking water that has high levels of nitrate can cause health effects such as: Methemoglobinemia or "blue baby syndrome," which results from nitrate decreasing the blood's capacity to carry oxygen, especially in infants who receive baby formula mixed with water containing nitrate above 10 mg/L.

Total Dissolved Solids:

The Bureau of Indian Standards (BIS) fixes the upper limit of TDS in drinking water at 500 ppm. Crucially the standard also mentions that in case no alternative source of drinking water is available, then this upper limit can be relaxed to 2,000 ppm. High concentration of TDS in the groundwater sample is due to leaching of salts from soil and also domestic sewage may percolate into the groundwater, which may lead to increase in TDS values.

Alkalinity:

The alkalinity refers to the measure of the capacity of the water to neutralize the acids. It can measure the bicarbonate, carbon dioxide, hydroxide ions, and carbonate naturally present in the water. The pH level of drinking water refers to how basic or acidic it is. The pH level refers to the hydrogen ions found in the water. It stands for 'potential of hydrogen.' The pH level of the water at normal drinking level, carbonate, and bicarbonate are the main contributors to its alkalinity.

Chloride:

Chloride is a naturally occurring element that is common in most natural waters and is most often found as a component of salt (sodium chloride) or in some cases in combination with potassium or calcium.

Sulphate:

Sulphate can be found in almost all natural water. The origin of most sulphate compounds is the oxidation of sulfite ores, the presence of shales, industrial wastes. Sulphate is one of the major dissolved components of rain. High concentrations of sulfate in the water we drink can a laxative effect whaen combined with calcium and magnesium, the two most common constituents of hardness.

Total Hardness

Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solutions. The principal hardness causing cations are calcium magnesium, strontimium, ferrous iron and manganous ions associated with bicarbonates, carbonates, chlorides and sulphates. Hardness is expressed in terms of equivalent CaCO3 concentration. In general, hard waters are originate in areas where top soil is thick and limestone formation are present. Soft waters are originate in areas where the top soil is thin and granitic rocks are principal constituent in the earth mantle.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 851-856 www.ijaem.net ISSN: 2395-5252

Calcium Hardness

The simple definition of water hardness is the amount of dissolved calcium and magnesium in the water. Hard water is high in dissolved minerals, largely calcium and magnesium. You may have felt the effects of hard water,literally,the last time you washed your hands.

Magnesium Hardness

Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solutions. The principal hardness causing cations are calcium magnesium, strontimium, ferrous iron and manganous ions associated with bicarbonates, carbonates, chlorides and sulphates. Hardness is expressed in terms of equivalent CaCO3 concentration. In general, hard waters are originate in areas where top soil is thick and limestone formation are present. Soft waters are originate in areas where the top soil is thin and granitic rocks are principal constituent in the earth mantle.

Remedial Measure Ion exchange:

Ion exchange is a water treatment method where one or more undesirable ionic contaminants are removed from water by exchange with another non-objectionable, or less objectionable ionic substance. This method adopted for the removal of sulphates, nitrites& other negatively charged ions.

Reverse osmosis:

Water is move under high pressure through a membrane. The membrane contains many microscopic pores that allow only water molecules to pass through, and as such, will stop nitrate and other inorganic chemicals such as sulphates, calcium, magnesium, and Total Dissolved Solids.

Biologica ldenitrification:

Biological denitrification is using denitrifying bacteria and microbes so that nitrate ions are converted into its elemental state of nitrogen. Nitrate can be removed by using a chemical material like ethanol. Besides special bacteria, photosynthetic algae can be used to remove nitrates from water.

Distillation:

In this process, contaminants are removed through evaporation. Water is boiled to produce vapours, which rises to the cool surface and then condenses back into the liquid form. This method is used to trat the waters having high amounts of Calcium and Magnesium.

De-ionisation(DI)System:

The water passes through a membrane with positive & negative electrodes, wherein positive ions detach themselves from the water and move towards the negative electrode, resulting in de-ionized water. Here, however, water is first passed through a RO system before it goes through the process of de- ionisation.

Activated carbon filtration:

Activated carbon filtration is a commonly used technology based on the adsorption of contaminates on to the surface of a filter. This method is effective in removing certain organics (such as unwanted taste and odours, micropollutants),chlorine, fluorine or randon form drinking water or wastewater.

SL NO	Location	WQI	Water Quality status	Grade
1	HOUSING BOARD	58.22	Poor	C
2	VALANDHAPALEM	55.87	Poor	C
3	CAMEL PETA	51.68	Poor	C
4	CHITTIPALEM	63.09	Poor	C
5	BUDDIALAPALEM	78.660	Very poor	D
6	BANDAR KOTA	99.30	Very Poor	D

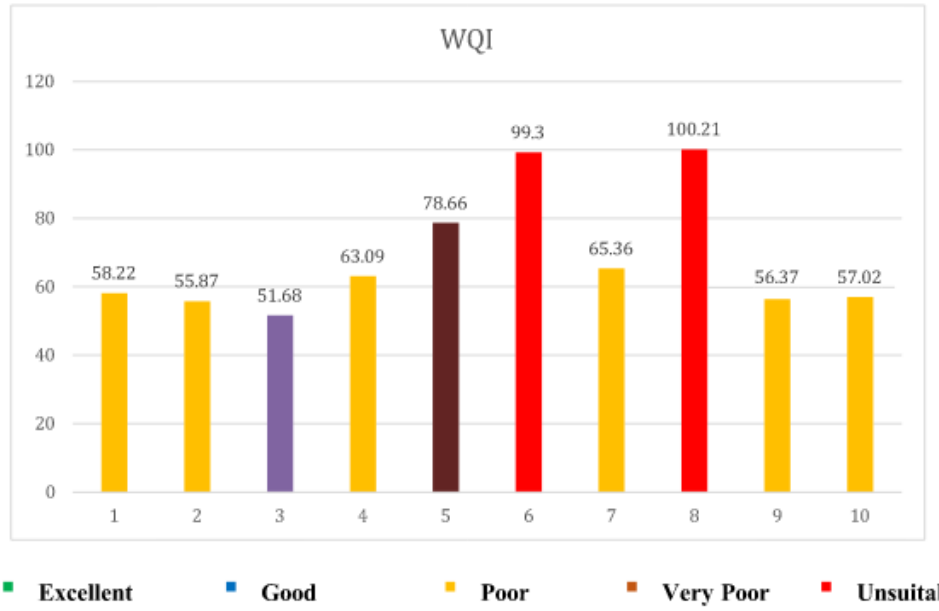
International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 851-856 www.ijaem.net ISSN: 2395-5252

7	KONERU CENTER	65.36	Poor	C
8	KALENKAPETA	100.21	Unsuitable	E
9	NAVEENMETAL COLONY	56.374	poor	C
10	TALLAPALEM	57.02	poor	C

Water Quality Status

WQI	0 -25	26 -50	51 -75	76 – 100	>100
Waterqualitystatu s	Excellent	Good	Poor	VeryPoor	Unsuitable
Grade	A	B	C	D	E

Water Quality status for the Tested Water Sample



II. CONCLUSIONS

- The water quality in and around Machilipatnam is of major concern due Transform into Corporation of Andhra Pradesh and several development activities are being taken up.
- The water quality for drinking purpose in and around Machilipatnam city is examined by collecting water samples at 10 different locations.
- The Water Quality index at the observed 10 locations along with the physiochemical properties are determined.
- The results reveal that maximum value for WQI is 101 at kalenkanpeta observed at and minimum is observed at 51.68 at Camel Peta.
- From the results the groundwater is unsuitable for drinking at the following locations i.e kalenkapeta . From the results the groundwater is of very poor quality at the following locations i.e buddalapalem, bandar Kota and at 7 locations the quality is observed poor i.e Housing board, Valandapalem, chitttipalem, Koneru center,Tallapalem, Naveenmetal,Camel peta colony locations it is observed as poor.
- Electrical conductivity, Sulphate, Total hardness, Calcium hardness, Magnesium hardness is more at the locations, we recommend the reverse osmosis, distillation, activated carbon filtration methods to treat the water at those locations.

REFERENCES

[1]. C. R. Ramakrishnaiah, C. Sadashivaiah G. Ranganna "Assessment of Water Quality Index for the Groundwater in Tumkur Taluk, Karnataka State", ISSN: 0973-4945 E-Journal of Chemistry 2009, 6(2), 523-530, December 2008.

[2]. Hanumantha Rao.C, Koteswara Rao, M, Kalyan.T Groundwater "Quality Assessment for Drinking Purpose in Vijayawada Region, Andhra Pradesh, India.''ISSN:2249-8958, volume 8 issue-5, June 2019

[3]. IS 10500: 2012 - Drinking water specifications (second revision) by Drinking water sectional committee FAD 25.

[4]. K. Yogendra and E.T. Puttaiah "Determination of Water Quality Index and Suitability of an Urban Waterbody in Shimoga Town, Karnataka" Proceedings of Taal2007: The 12th World Lake Conference: 342-346, April 2015

[5]. M.Sujatha, T. Satyanarayana, P. Bramhaji rao, SS.Asadi , "Assessment of groundwater pollution a case study from Bandar town, Krishna district Andhra Pradesh, India",ISSN:2321-1156, October 2019.

[6]. WHO Guidelines for Drinking water Quality, Fourth Edition incorporating the first addendum ISBN 978-92-4-154995-0.