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ASSESSMENT OF GROUND WATER QUALITY IN VIJAYAWADA CITY, ANDHRA PRADESH, INDIA

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ABSTRACT- ***The current study is about water quality parameters of Vijayawada, Krishna district of Andhra Pradesh.This study is intended to estimate water quality Index (WQI) of study area using Weighted Arithmetic water quality index method. In this study the quality of water of study area is determined using the various physical-chemical parameters such as p^H , Total Dissolved Solids (TDS), nitrate, fluoride, iron, sulphate, Electric conductivity, total hardness, calcium, acidity, alkalinity.This study is to investigate the suitability of water for drinking purpose based on Water quality Index (WQI) estimated.Groundwater systems are dynamic and that is not available for drinking purpose in all regions of the world, so it is very Precious. The ground water samples were collected from different locations near prakasam barrage, Vijayawada-Andhra Pradesh. The water samples were analyzed to determine the concentration of chemical parameters to access ground water quality. The results showed that the concentration of hardness is very high in Nehru Nagar. So, the analysis reveals the ground water needs treatment before consumption of drinking water.***

As we all know water is one of the most natural and important resource for human being to survive on this earth. Groundwater properties vary spatially and temporally with number of factors. Urbanization andagriculture activities have a lot of impacts on the groundwater quality. The main objective of the project is to analyse the quality of ground water suitability for drinking purpose. In this work ten water samples were collected at different locations in the Vijayawada City. The quality of water of the study area is determined using the various physical-chemical parameters such as pH , Total Dissolved Solids (TDS), nitrate, fluoride, iron, sulphate, Electric conductivity, total hardness, calcium, acidity, alkalinity. The Water quality index is developed by using Weighted Arithmetic method. The results showed that the concentration of hardness is very high in these three places and calcium is high in Nehru Nagar. So, the analysis reveals the ground water needs treatment before consumption of drinking water. Water samples were collected from 10 bore wells in Vijayawada and developed the plan and methodology and applied for chosen problem. The ground water quality index against the IS 10500 (2012) specifications for drinking water and recommended the remedial measures to improve the groundwater quality.

INTRODUCTION

General

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 is a chemical compound and may occur in a liquid form or in a solid form or in a gaseous form. All these three forms of water are extremely useful to man, providing luxuries and comforts, in addition to fulfilling his necessities of life. No life can exist without water since water is as essential for life as air is. It has been estimated that two-third of human body is constituted of water. Water is essential not only for survival of human beings, but also for animals, plants, and all other living beings. Further, it is necessary that the water required for their needs must be good, and it should not contain unwanted impurities or harmful chemical compounds or bacteria in it. The precious ground water resources are now-a-days contaminated by varieties of man- made activities, which are inevitably coming up in the process of development. Ground waters are contaminated mainly due to infiltration of pollutants into the soil sub-strata. Site-specific characteristics such as soil type, depth of the aquifer, weather, season, and the recharge rate of an aquifer all influence the probability and severity of a particular contamination incident.

1.2 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.

1.3 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 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. The contaminated water is consumed by a species in food chain, it will seriously affect the higher species which are depending on it. 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.

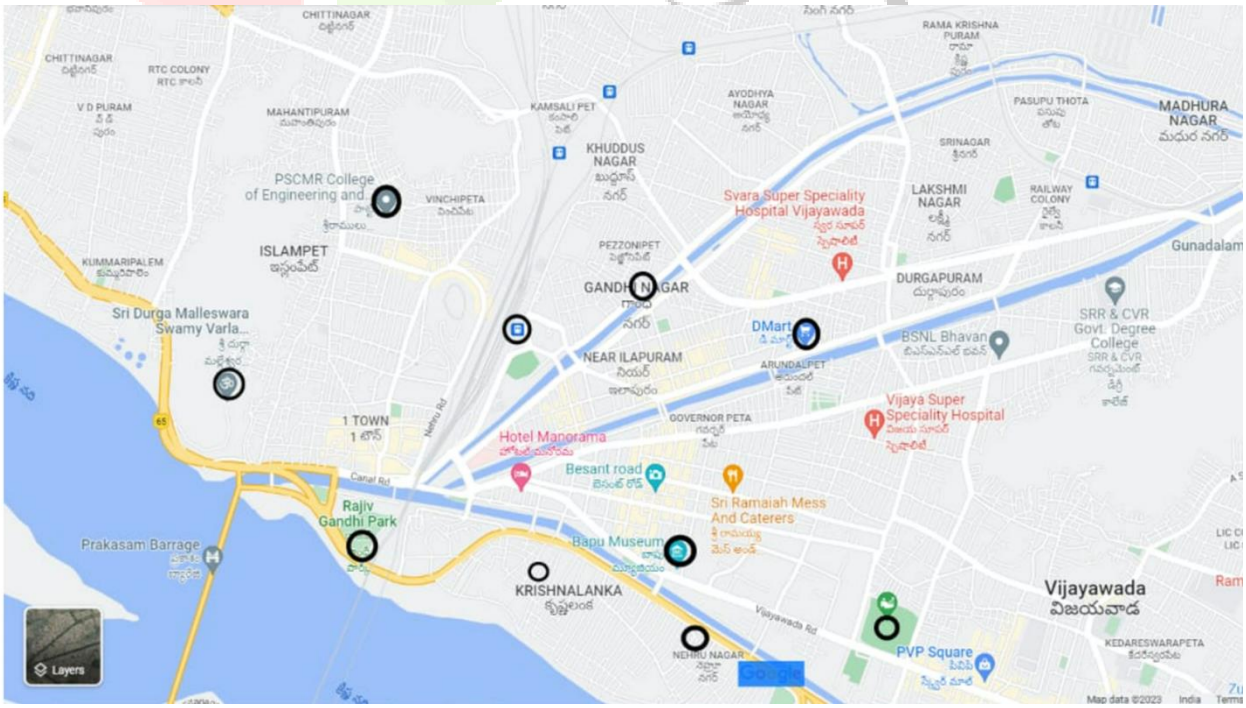
1.4 Objectives of the Study

The present study was intended to calculate Water quality index in Vijayawada city, Andhra Pradesh, India to ascertain the quality of water for drinking purpose. This project deals with study on the influence of environmental parameters on the water quality of water body. There are several ways to assess the quality of water as deemed fit for drinking, irrigation, and industrial use. In this study water quality index was determined on basis of various physico-chemical parameters like pH, electrical conductivity, total dissolved solids, total alkalinity, total hardness, total dissolved solids etc.

1.5 Study Area

The ground water samples at the following 10 locations of Vijayawada region, Andhra Pradesh were collected and the water quality status at those locations were examined during this project

1 Rajiv Gandhi Park
2 Railway station
3 Nehru Nagar
4 Durga devi Temple
5 Potti sri ramulu college
6 Gandhi Nagar
7 D mart
8 Krishna Lanka
9 Bapu Museum
10 PVP square



LITERATURE REVIEW

Introduction

This chapter presents a literature review related to water quality analysis. It highlights the work of various authors, including their studies, findings, and recommendations.

Review

Groundwater is used for domestic and industrial water supply and irrigation all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Rapid urbanization, especially in developing countries like India, has affected the availability and quality of groundwater due to its overexploitation and improper waste disposal, especially in urban areas. WQI is defined as a rating reflecting the composite influence of different water quality parameters. WQI iscalculated from the point of view of the suitability of groundwater for human consumption. The objective of the present work is to discuss the suitability of groundwater for human consumption based on computed water quality index values.

SANJIB DAS et al.:

WQI has been computed to assess the suitability of groundwater of six different parameters for drinking purposes in and around Kolkata region. In this paper, eighteen groundwater samples were collected and accordingly analysed at the laboratory of School of Water Resources Engineering, Jadavpur University during the period of January 2011 to December 2012. About 17% is under the category of excellent so far drinking water quality is concerned followed by another 17% which exhibits good category. This paper concludes only six groundwater samples can be treated as drinking standard. It may also be opined that about 66% of groundwater sample are not fit for drinking due to obtaining lesser WQI value i.e., WQI $\leq$ 80. It may also be reflected those two parameters particularly chloride and hardness are found to be higher compared to permissible level resulting TDS value at higher order owing to saltwater intrusion which might take place in the vicinity of eastern and southern part of Kolkata.

C. R. RAMAKRISHNAIAH et al.:

The WQI for 269 samples ranges from 89.21 to 660.56. Almost ninety nine percent of the samples exceeded 100, the upper limit for drinking water. The high value of WQI at these stations has been found to be mainly from the higher values of nitrate, total dissolved solids, hardness, fluorides, bicarbonate, chloride etc. in the groundwater. About 63.5% of water samples are poor in quality. In this part, the groundwater quality may improve due to inflow of freshwater of good quality during rainy season. Magnesium and chloride are significantly interrelated and indicates that the hardness of the water is permanent in nature. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also needs to be protected from the perils of contamination.

K. YOGENDRA et al.:

A study was intended to calculate Water Quality Index (WQI) of an urban waterbody, Gopishettykere, in Shimoga town, Karnataka. K. Yogendra et al Analyzed for 13 physicochemical parameters by following the established procedures in the year 2008. From the foregoing observations of the physicochemical parameters, it can be concluded that the water body shows the characters of eutrophication. Low dissolved oxygen, high bio-chemical oxygen demand and high nitrate concentrations indicate the eutrophic status of the water body. A relatively higher concentration of chlorides and sulphates also indicate the unsuitability of water for domestic use. Hence,

application of Water quality index technique for the overall assessment of the water quality of a water body is a useful tool.

WHO ORGANIZATION:

According to it about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the source. It therefore becomes imperative to regularly monitor the quality of groundwater and to device ways and means to protect it Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. It thus, becomes an important parameter for the assessment and management of groundwater.

Sample Collection and Method of Analysis:

VALUES OBTAINED:

TESTS CONDUCTED	*S-1*	*S-2*	*S-3*	*S-4*	*S-5*	*S-6*	*S-7*	*S-8*	*S-9*	*S-10*	*RANGE*
PH	*7.86*	*7.88*	*7.97*	*8.5*	*7.5*	*7.9*	*8.2*	*7.7*	*8.3*	*7.8*	*6.5-8.5*
NITRATE (mg/l or ppm)	*5*	*10*	*10*	*0*	*5*	*15*	*0*	*5*	*0*	*10*	*10*
FLUORIDE (mg/l or ppm)	*0*	*0*	*0*	*1*	*1.5*	*0*	*2*	*0*	*0*	*1*	*4*
IRON (mg/l or ppm)	*0*	*1*	*3*	*0.3*	*0*	*3*	*0*	*0*	*0.1*	*0*	*0-3*
SULPHATE (mg/l or ppm)	*69.12*	*67.58*	*118.3*	*123.4*	*52.9*	*98*	*110*	*82.5*	*76*	*94*	*250max*
ELECTRIC CONDUCTIVITY (Micro seimens)	*660.69*	*700.3*	*974.9*	*875.4*	*690.2*	*903.5*	*752.8*	*842.5*	*662.8*	*940.3*	*2500*
TOTAL HARDNESS (mg/l or ppm)	*223*	*245*	*366*	*133*	*152*	*112*	*163*	*192*	*148*	*119*	*300*
CALCIUM (mg/l or ppm)	*158.3*	*90*	*115.62*	*78*	*62.8*	*119.2*	*63*	*94*	*113*	*82.4*	*150*
ACIDITY (mg/l or ppm)	*40*	*3*	*14*	*27*	*24.5*	*26*	*12*	*6*	*3*	*9*	*50*
ALKALINITY (mg/l or ppm)	*4*	*5*	*10*	*7*	*12*	*17*	*15*	*20*	*8*	*11*	*20-200*
TDS (mg/l or ppm)	*58.4*	*70*	*4.7*	*65*	*82.3*	*112*	*128*	*55*	*78*	*89*	*50-150*

- The samples were collected from different locations in Vijayawada. And water quality analysis tests were held in laboratory.
- We conducted 11 tests the test are PH, nitrate,fluoride,iron ,sulphate ,electric conductivity, total hardness, calcium, acidity, alkalinity, TDS.The results thus obtained were compared with standards as per WHO.

CALCULATION OF WATER QUALITY INDEX (WQI):

The quality of water of study area is determined using the various physical-chemical parameters such as p^H , Total Dissolved Solids (TDS), nitrate, fluoride, iron, sulphate, Electric conductivity, total hardness, calcium, acidity, alkalinity

- Calculation of water quality index (WQI) is done by Arithmetic Index Method.
- The weighted arithmetic index approach is a simple and modified method which is a widely used water quality index for water analysis.
- As per the range of WQI table the samples were analyzed according to water quality weather it is fit for drinking purpose or it requires to be treated.

Water quality index level	Water quality status	Water quality grading	Possible uses
0-25	Excellent	A	Drinking, irrigation and industrial purpose
26-50	Good	B	Drinking ,irrigation and industrial purpose
51-75	Poor	C	Irrigation and industrial purpose
76-100	Very Poor	D	For irrigation purpose
>100	Unsuitable for drinking and fish culture	E	Proper treatment required for any kind of usage

INTRODUCTION:

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 (at 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. WaterQuality Index (WQI) is a tool developed by scientists to evaluate the quality of water in the streams and rivers. It summarizes large amounts of water quality data into a single score from 1 to 100.

Number of methods are there to calculate the Water Quality Index[WQI].Some of them are

1. Weighted Arithmetic Index Method
2. Canadian Council of Ministers of the Environment Water Quality Index [CCME WQI]
3. National Sanitation Foundation Water Quality Index[NSF WQI]
4. Oregon Water Quality Index
5. Nemerow Pollution Index (or) Row's Pollution Index

Weighted Arithmetic Index Method:

The Weighted Arithmetic Water Quality Index method is a rating reflecting the composite influence of 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

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

$$Q_i = \left[\frac{V_a - V_i}{V_s - V_i}\right] X100$$

Were,

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

V_i = Ideal value of water quality parameter (For pH=7 and DO=14.6 mg/L, all other parameters, it is zero)

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

• The Proportionality Constant (K) is calculated as

$$K = \frac{1}{\sum\left(\frac{1}{V_s}\right)}$$

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

$$W_i = \frac{K}{V_s}$$

• The Water Quality Index is calculated as

$$WQI = \frac{\sum Q_i W_i}{\sum W_i}$$

Sample calculations: -

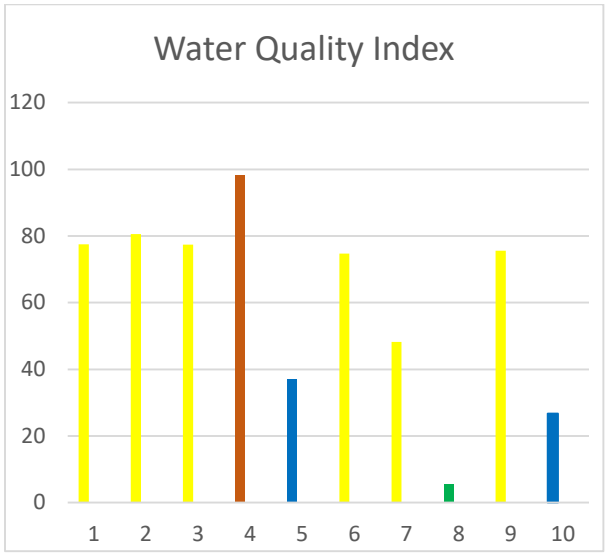
Proportionality constant:

$$k = \frac{1}{\sum \frac{1}{v_s}}$$

$$\sum \frac{1}{V_s} = \frac{1}{45} + \frac{1}{1.0} + \frac{1}{8.5} + \frac{1}{1} + \frac{1}{500} + \frac{1}{200} + \frac{1}{250} + \frac{1}{200} + \frac{1}{200} + \frac{1}{75} + \frac{1}{30}$$

$$\sum \frac{1}{v_s} = 2.207$$

$K = \frac{1}{2.207} = 0.453$



RESULTS AND DISCUSSIONS:

AREA OF SAMPLE	WiQi value
Rajiv Gandhi park	77.538
Railway station	80.608
Nehru nagar	77.356
Kanaka durga temple	98.35
Potti Sriramulu college	37.009
Gandhi nagar	74.638
D mart	48.325
Krishna lanka	5.581
Bapu museum	75.562
PVP	26.694

Excellent ■ Good ■ Poor ■ Very Poor

REMEDIAL MEASURES

5.1 Ion exchange:

Ion exchange is a chemical process to remove unwanted dissolved ions in water and wastewater. To remove the ions, they are exchanged with ions that have a similar charge. There are two groups of ions:

- Positively charged ions (cations)
- Negatively charged ions (anions)

When positive ions are exchanged during water treatment, the cations that come into contact with the ion exchange resin are exchanged with other positively charged ions available (usually sodium) on the resin surface. During anion exchange, negatively charged ions are exchanged with other negative ions on the resin surface, these ions are usually chloride ions. Anion exchange is important as the ions can remove contaminants such as nitrate, arsenic, sulphate, and fluoride.

5.2 Reverse osmosis:

Reverse osmosis is a water purification process that uses a semi-permeable membrane (synthetic lining) to filter out unwanted molecules and large particles such as contaminants and sediments like chlorine, salt, and dirt from drinking water. In addition to removing contaminants and sediments, reverse osmosis can also remove microorganisms – which you certainly do not want to drink. It gets water clean down to a molecular level, leaving only pure H_2O behind**.** Reverse osmosis differs from carbon filtration in that it can rid the water of up to 99.9% of all contaminants and sediments, or particles as small as .001 micron, whereas carbon filtration can only remove particles as small as 1 micron. Your local tap water could be award-worthy clean when it leaves the municipal plant but as it travels miles from the plant to your glass it could pick up a host of contaminants or it may have a naturally high number of total dissolved solids (TDS) in the water, so it would be best to get a reverse osmosis filtration system to safeguard that your water is contaminant-free.

5.3 Biological denitrification:

Many sources contribute to water's nitrogen load, including wastes from food processing and chemical processes, but most of the nitrogen found in wastewater is from urea, a product of urine. Biological denitrification is often used to treat liquid wastes from industrial-scale agriculture, for instance, poultry farms.

Biological denitrification takes place after nitrification, another process carried out by bacteria. It's the final step in the nitrogen cycle, a natural biological process by which nitrogen changes from one form to another.

Both nitrification and denitrification are important to biological wastewater treatment. In the nitrification step of the cycle, ammonia oxidizes into nitrites (NO_2) and nitrates (NO_3). The NO_2 and/or NO_3 then transform into nitric oxide (NO) and nitrous oxide (N_2O), which finally transform into gaseous nitrogen (N_2), which is fit for harmless discharge into the atmosphere. In the context of wastewater treatment.

5.4 Distillation:

In this process, contaminants are removed through evaporation. Water is boiled to produce vapour 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.

5.5 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**.**

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