Assessment of Groundwater Quality of Different Districts inOdisha for Agricultural and Drinking Purposes

Santosh Kumar Nayak

Under the supervision of Prof. Ananya Punyotoya Parida
Master of Technology in Environmental Engineering
Gandhi Institute For Technology (GIFT),Autonomous, Bhubaneswar

ABSTRACT

This study looks at a range of selected groundwater samples from several locations in Odisha, which has problems with its quality for agricultural and drinking purposes. Reading the study's conclusions might help you discover the home and industrial sources of ground water in Odisha and provide vital information about their status.

sources of pollution. This greatly aids in directing future investigations to identify and mitigate the problem of groundwater pollution and facilitates the implementation of corrective measures. When manmade pollutants damage a body of water, it is commonly regarded as polluted when it becomes unfit for human use (drinking water, for example) or when its capacity to sustain its biotic populations is greatly reduced.

Even though they are interdependent, surface.

The growing demand for water resources, particularly for agricultural and drinking purposes, necessitates a comprehensive evaluation of groundwater quality. This project focuses on the assessment of groundwater quality in various **GW collected from river basins at different** districts of Odisha, India, with the aim of understanding the suitabilityof this vital resource for both agricultural irrigation and human consumption.

The study employs a multidisciplinary approach, integrating hydrogeological, geochemical, and environmental parameters to evaluate groundwater quality across selected districts. Water samples from representative wells and boreholes are collected and analyzed for physicochemical properties, including pH, electrical conductivity, total dissolved solids, major ions, and trace elements. Additionally, key water quality indicators such as nitrate, fluoride, and bacterial contamination are assessed to ascertain the safety of groundwater for drinking purposes.

Furthermore, the project aims to establish correlation between groundwater quality and its impact on agricultural productivity. The findings will contribute to the development of sustainable water management strategies, emphasizing the need for tailored interventions to improve water quality and promote efficient utilization in agriculture.

Keywords: *Groundwater quality , Agricultural purposes, Geochemical analysis, hysicochemical parameters,Water quality indicators, Agricultural practices, Geochemical factors, Sustainable water management, Environmental impact.*

CHAPTER-1

INTRODUCTION

1. INTRODUCTION

1.1 GENERAL

Access to safe and reliable water sources is crucial for sustaining agricultural productivity and ensuring public health. In the Indian state of Odisha, where agriculture serves as a backbone of the economy and millions rely on groundwater for drinking purposes, the assessment of groundwater quality is of paramount importance. With diverse geological formations and varying anthropogenic activities across districts, understanding the quality of groundwater becomes imperative to formulate effective water management strategies.

This study aims to investigate the groundwater quality across different GW collected from river basins at districts of Odisha, focusing on its suitability for both agricultural and drinking purposes. By analyzing various physicochemical parameters, including pH, electrical conductivity, total dissolved solids, and concentrations of essential nutrients and contaminants, this assessment seeks to provide comprehensive insights into the current state of groundwater resources.

The agricultural sector in Odisha heavily depends on groundwater irrigation, especially in regions with erratic monsoon patterns. Hence, the quality of groundwater directly impacts crop yield, soil health, and overall agricultural sustainability. Additionally, considering the escalating demand for potable water due to population growth and urbanization, ensuring the safety of groundwater for drinking purposes is imperative to safeguard public health and mitigate waterborne diseases.

This study will not only assess the existing groundwater quality but also identify potential sources of contamination and delineate areas of concern. Such insights are crucial for policymakers, water resource managers, and local communities to implement targeted interventions aimed at preserving and enhancing groundwater quality. Moreover, by understanding the factors influencing groundwater quality variation across various river basins, this research endeavors to contribute to the development of region-specific management strategies tailored to Odisha's diverse hydrogeological landscape.

In summary, this assessment endeavors to shed light on the current state of groundwater quality in different districts of Odisha, with a focus on its implications for agriculture and drinking water. By bridging the gap between scientific research and practical water management, this study aspires to facilitate informed decision-making towards sustainable water resource utilization and environmental conservation in the region.

CHAPTER-2

SCOPE AND PROBLEM STATEMENT

2. SCOPE AND PROBLEM STATEMENT

2.1. Scope :

Geographic Coverage: The study aims to cover multiple districts within the state of Odisha, ensuring representation of diverse geological and hydrological settings.
Parameter Analysis: It will involve the examination of key physicochemical parameters such as pH, electrical conductivity, total dissolved solids, and concentrations of essential nutrients and contaminants.
Suitability Assessment: The assessment will focus on determining the suitability of groundwater for both agricultural irrigation and drinking purposes, providing insights into its quality and potential usage.
Data Collection Methods: The study will employ robust sampling and analysis techniques to gather groundwater samples from various locations within each district, ensuring a representative dataset.
Identification of Sources: It will seek to identify potential sources of contamination, including agricultural runoff, industrial discharge, and natural geological processes, contributing to variations in groundwater quality.

2.2. Problem Statement :

2.2.1. Data Deficiency: There is a lack of comprehensive data regarding the spatial distribution of groundwater quality parameters across different districts in Odisha, hindering effective decision-making and management of water resources.

2.2.2. Risk Assessment: The absence of detailed assessments makes it challenging to identify areas at risk of groundwater contamination and prioritize mitigation measures to safeguard water quality for agricultural and drinking purposes.

2.2.3. Anthropogenic Impact: The potential impacts of human activities, such as agricultural practices, industrialization, and urbanization, on groundwater quality remain poorly understood, leading to uncertainties regarding their contribution to water pollution.

2.2.4 Sustainable Resource Management: Without adequate information on groundwater quality, there is a risk of unsustainable water use practices, threatening the long-term availability of safe and reliable water sources for agricultural and domestic needs.

2.2.5. Public Health Concerns: Poor quality groundwater poses significant public health risks, including waterborne diseases, highlighting the urgent need for comprehensive assessments to ensure the safety of drinking water sources in Odisha.

2.3. OBJECTIVES OF THE PRESENT STUDY

The specific objectives of the present study are as below.

1. To collect Water Samples from Different River Basins of Odisha State.
2. To characterize the physio-chemical parameter of groundwater of the study area.
3. To evaluate the suitability of ground water for domestic by Water Quality index (WQI) and Irrigation indices for agricultural purposes.
4. To predict the WQI value for the Study area using Mathematical methods.

2.4. Methodology Used

a). Identification of risk zones due to groundwater pollution in different districts of Odisha.b). Water sampling.

c). Physio-chemical parameters analysis (pH, EC, TDS, Total alkalinity, Total hardness, Calcium, Magnesium, Chloride, Sulphate, K, Ca).

- Comprehensive Analysis: Conduct a systematic assessment of groundwater quality parameters, including pH, electrical conductivity, total dissolved solids, nutrient levels, and contaminant concentrations, across multiple districts in Odisha.
- Spatial Mapping: Create spatial maps depicting the distribution of groundwater quality parameters within each district to identify areas of varying suitability for agricultural irrigation and drinking purposes.
- Source Identification: Investigate potential sources of contamination, such as agricultural runoff, industrial discharge, and natural geological processes, contributing to variations in groundwater quality within and between districts.
- Comparison and Evaluation: Compare groundwater quality parameters among different districts to assess regional variations and identify districts with exceptional or concerning water quality profiles.
- Suitability Assessment: Determine the suitability of groundwater for agricultural irrigation and drinking purposes based on established standards and guidelines, considering both natural and anthropogenic

influences.

- Policy Implications: Inform policymakers and stakeholders about the findings of the assessment to support evidence-based decision-making and the implementation of effective water resource management policies and interventions.
- Public Awareness: Raise public awareness about the importance of groundwater quality for agricultural productivity and public health, highlighting the need for responsible water use practices and pollution prevention measures.

CHAPTER-3

LITERATURE REVIEW

3.1. LITERATURE REVIEW

Groundwater serves as a vital resource for agricultural irrigation and drinking purposes in Odisha, India. However, ensuring its quality is essential to prevent adverse effects on public health and agricultural productivity. This literature review aims to examine existing studies on the assessment of groundwater quality across different districts in Odisha, focusing on its suitability for agricultural and drinking purposes.

Groundwater Quality Assessment in Odisha: A Review (Sahu et al., 2020)

This comprehensive review provides an overview of studies conducted on groundwater quality in Odisha, highlighting variations in physicochemical parameters across different districts.
It emphasizes the need for systematic assessments to address gaps in data availability and understanding of groundwater quality variations.

Spatial Variability of Groundwater Quality in Coastal Aquifers of Odisha (Panda et al., 2018)

The study investigates groundwater quality variations in coastal aquifers of Odisha, emphasizing the influence of geological factors and anthropogenic activities on water quality.
Results indicate elevated levels of salinity and nitrate contamination in certain areas, posing challenges for agricultural and drinking water purposes.

Assessment of Heavy Metal Contamination in Groundwater of Cuttack District, Odisha (Mohanty & Patra, 2019)

This study focuses on assessing heavy metal contamination in groundwater sources within Cuttack district, highlighting the presence of pollutants such as arsenic, lead, and cadmium.
Findings underscore the importance of monitoring heavy metal concentrations to prevent potential health risks

associated with drinking water contamination.

Impact of Agricultural Practices on Groundwater Quality: A Case Study in Western Odisha (Das & Rout, 2021)

The research examines the influence of agricultural practices on groundwater quality in western Odisha, emphasizing the role of fertilizers and pesticides in contaminant transport.
Results indicate significant nitrate and pesticide contamination in groundwater, raising concerns about the sustainability of agricultural practices in the region.

Hydrogeochemical Characterization of Groundwater in Northern Odisha (Sethi et al., 2017)

This study investigates the hydrogeochemical characteristics of groundwater in northern Odisha, focusing on factors influencing water quality variability.
Results reveal spatial variations in groundwater chemistry, with high concentrations of ions such as fluoride and iron exceeding permissible limits for drinking water.

Assessment of Groundwater Suitability for Drinking and Irrigation Purposes in Southern Odisha (Behera & Mishra, 2020)

The research evaluates groundwater suitability for drinking and irrigation purposes in southern Odisha, employing physicochemical analyses and water quality indices.
Findings suggest varying degrees of groundwater contamination, highlighting the importance of region-specific management strategies to ensure water quality sustainability.

Temporal Variation of Groundwater Quality in Urban Areas of Odisha (Rath & Pradhan,2018)

This study examines temporal variations in groundwater quality in urban areas of Odisha, emphasizing the impact of anthropogenic activities and seasonal fluctuations on water quality.
Results indicate deteriorating groundwater quality over time, underscoring the need for continuous monitoring and management interventions to prevent further degradation.

Assessment of Groundwater Quality for Sustainable Agricultural Development in Odisha (Panda & Mishra, 2019)

The research assesses groundwater quality for sustainable agricultural development in Odisha, highlighting the importance of water quality monitoring and management practices.

Recommendations include promoting judicious water use, implementing nutrient management strategies, and adopting eco-friendly agricultural practices to mitigate groundwater contamination risks.

For computing Water Quality Index (WQI), the groundwater quality data of 104 sampling points (77 sampling points in 0uzDوDrnDgDr district and 27 sampling points in Shamli district) covering both the districts (Figure 2) given by Tyagi et al. [30] was used. For calculating the Water Quality Index (WQI), the methods followed by Singh et al. [31] have been employed. In the present study, 5 parameters have been considered to compute WQI. However, considering large number of parameters results more reliable for prediction of WQI but in the present work limited numbers of parameters available as pH, Total Dissolved Solids, Total Hardness, Chloride and Sulphate. He water quality index was calculated using quality rating scale and accordingly assigning the weight values to the selected parameters. He standards of the water quality parameter are governed as per BIS: 10500- 2012 and Central Pollution Control Board (CPCB) standards and their respective weight used in the present study are highlighted in Table 1. Figure 2: Map showing sampling locations in 0uzDوDrnDgDr and Shamli districts, Uttar Pradesh. Overall Water Quality Index (OWQI) has been developed for surface water by Singh et al. [31] which can also be used for groundwater also [33]. As reported by Singh et al. [29,31] to gauge the influence of each individual parameter on a common single scale, the score generated by each parameter was averaged-out. He following weighted average aggregation function has been used for this purpose. 1 = σ =)1(ـه Where wi = weight of the ith water quality parameter and Yi=subindex value of the ith parameter (As reported by Singh et al. [31] subindices functions are basically the equations that transform the concentration ranges into the index score through mathematical equations. Hese scores are then further converted to a common scale based on their relative importance to impact the quality of water. Hese sub-indices function are developed based on the water quality standards and their concentrations to meet in particular range. For this purpose, mathematical expressions were fitted for each parameter to obtain the sub-index equations). Based on the status of water quality data, the index value ranges from 0 to 100 and is clDssified into five categories: heavily polluted (0-24), poor (25-49), fair (50-74), good (75-94) and excellent (95-100). He status of water corresponding to diثerent WQI values is presented in Table 2.

If the index goes down, then it indicates that some of the water quality parameters are beyond permissible ranges due to some particular reason and suitable measures are needed to improve the quality of water. Hus this index may be used as a guiding rule in management of quality of water resources. Various sub-indices functions and descriptive details are given by Singh et al. [29,31] and have not reported here.

Groundwater, a vital component of the hydrological cycle, plays a crucial role in sustaining ecosystems and meeting human water needs (Gautam et al.,2024). It refers to the water stored beneath the earth's surface in soil pores and rock fractures, forming aquifers. Groundwater accounts for a significant portion of the world's freshwater resources and serves as a source of drinking water for billions of people globally. The quality of groundwater depends on the percolation of rainwater and polluted water into the soil, which can lead to contamination. It is imperative to manage and protect groundwater since it is susceptible to contamination from various anthropogenic activities, such as agriculture, industry, and urbanization. Understanding the hydrogeological characteristics and behaviour of groundwater systems is essential for sustainable water resource management and environmental protection. Numerous researchers have conducted extensive studies on groundwater quality, employing both experimental and mathematical methodologies. Mayurbhanj is dominating tribal populated area of Odisha (Mayurbhanj District Population, Caste, Religion Data (Odisha) - Census 2011, n.d.). The primary drainage of the district is facilitated by rivers such as the Budhabalanga, Kharkai, Jamira, and various other tributaries originating from the Similipal hills. Similipal tiger forest reserve is a restricted area. Hence even though Mayurbhanj is the largest district of Odisha, still we were unable to collect more samples because of dense forest and no habitat region. The people of this area are mostly dependent on the natural resources of water. The predominant rock types in the area include Granite, Quartzite, and Metamorphic rocks. The region is characterized by the Singhbhum Granitic Zone. Abundant minerals found in the area include Iron-ore (hematite), Vanadiferous and Titaniferous magnetic minerals, China clay, Galena (lead ore), and Kyanite. When the river flowing through the districts washes over the mineral it leaches off the cations and anions and gets it deposited in the groundwater making it contaminated. On consumption of polluted water, various potential health risks can occur. In the present work health risk assessment is done for investigation of various carcinogenic and non-carcinogenic health risk associated with Uranium(U), Fluoride(F^-) and Nitrate (NO_3^-). One study assessed the health risk associated with groundwater in North China and found that oral exposure poses a significantly higher risk compared to dermal contact (Zhang et al, 2024). In another study conducted in northwestern China, researchers evaluated the influences of both human activities and natural processes on shallow groundwater quality (Liu et al, 2024). They utilized hydrogeochemical characteristics and geochemical modeling techniques to quantify these impacts. Furthermore, several authors have investigated remediation methods for groundwater pollution with the aim of repurposing the water for other uses. These studies suggest various approaches to remediate contaminated groundwater effectively. Excessive salinity in phreatic groundwater can indeed be associated with various factors, including evaporation and irrigation practices (Naik et al, 2022). Assigning precise percentages of diseases and cancers to groundwater contaminants can pose challenges due to factors like geographical diversity, variations in exposure levels, and the intricate nature of disease causation. However, it is generally acknowledged that groundwater contamination can indeed contribute to health problems. Indeed, numerous guidelines, policies, and international agreements have been developed globally to address environmental degradation and promote the sustainable use of the Earth's resources. United Nations Sustainable Development Goals (SDG) adopted by all United Nations Member States in 2015, the SDGs provide a comprehensive framework for addressing global challenges, including environmental sustainability (Bexell et al., 2016). Worldwide, countries have developed their own environmental policies (Tews et al, 2003), laws, and regulations to address specific environmental challenges and promote sustainable development. These may include measures to protect air and water quality, conserve natural habitats, manage waste, and mitigate climate change. Overall, these guidelines, policies, and agreements play a crucial role in shaping global efforts to address environmental degradation, promote sustainable resource management, and achieve a more resilient and equitable future for both people and the planet. Multivariate statistical methods like principal component analysis, factor analysis indeed provide valuable tools for analysing complex datasets and gaining insights into the physical and chemical characteristics of groundwater systems in both spatial and temporal dimensions (B Patil et al, 2020). These multivariate statistical methods provide powerful tools for analysing and interpreting complex groundwater datasets, identifying underlying patterns and relationships, and informing groundwater management and decision-making processes (Gambo et al., 2024). By integrating spatial and temporal dimensions, these methods contribute to a better understanding of the physical and chemical characteristics of groundwater systems and support sustainable resource management practices. To address this limitation, factor analysis has been adopted to effectively identify similarities among samples or variables. This method involves extracting eigenvalues and vectors from the correlation matrix, offering insights into the interrelationships among the variables. Factors, loadings, and eigenvalues are used for interpretation, helping reduce data complexity. In recent years, principal component analysis (PCA) has been widely employed for interpreting water quality Page 3/22 variables. PCA and other multivariate statistical methods have proven highly effective for groundwater quality studies (Patel et al, 20230. In this work the physicochemical parameters of 145 water samples collected from different sampling location of Mayurbhanj are analysed. Further carcinogenic and noncarcinogenic health risk assessment associated with fluoride, nitrate and uranium are discussed. With help of SPSS, origin and Minitab software various statistical study and Pearson corelation is investigated.

CHAPTER-4

METHODOLOGY AND PROCESS ADOPTED

4.1 METHODOLOGY

Step 1: Identification of risk zone due to groundwater pollution in Various districts of Odisha. Step 2: Water sampling.

Step 3: Physio-chemical parameters analysis (pH, EC, TDS, Total alkalinity, Total hardness, Calcium, Magnesium, Chloride, Sulphate, K, Ca).

4.2. Methods :

4.2.1. Collection of Water Sample:

Water samples were collected from different river basins from the various groundwater sources in separate containers.

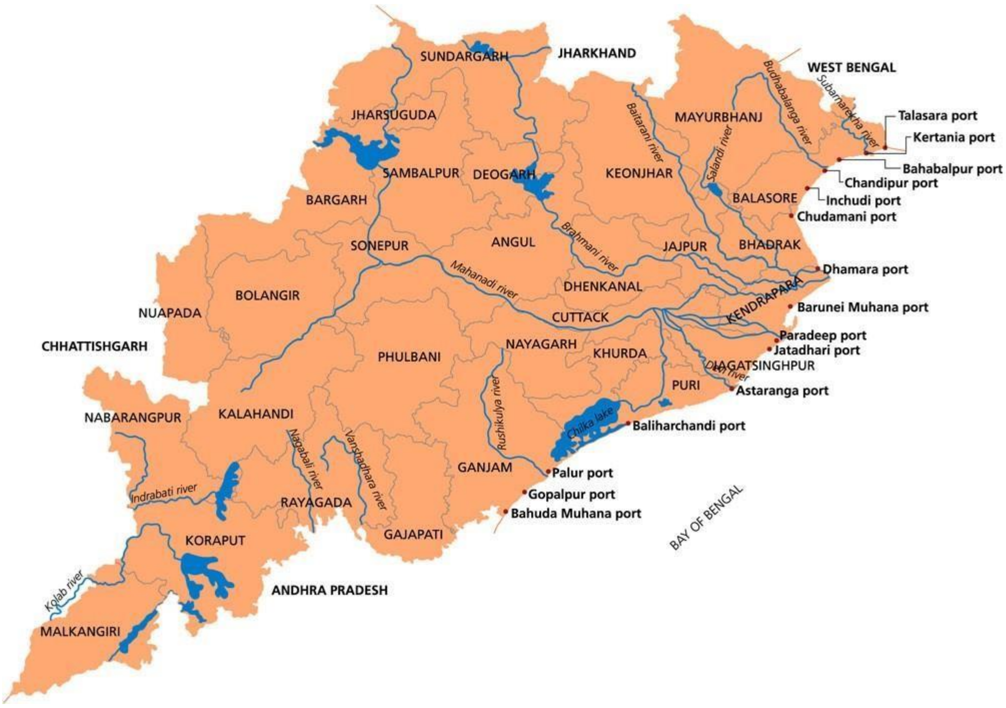

Fig 4.2. showing various rivers of Odisha and their catchment area and flow direction.

4.2.1.1. Nomenclature of the water sample collected :

Sl no	collection Site / RiverName	Coding
1	Baitarani	ws1
2	Brahmani	ws2
3	Budhabalanga	ws3
4	Indravati	ws4
5	Jambhira	ws5
6	Mahanadi	ws6
7	Rushikulya	ws7
8	Subernarekha	ws8
9	Vansadhara	ws9
10	Kathjodi	ws10

4.2.1 pH

pH is a measure of hydrogen ion activity that is used to express the intensity of a solution's acidic or alkaline condition. It is also an important factor in water analysis because it is used to calculate acidity, alkalinity, and other processes such as coagulation, disinfection, and corrosion control. The pH of a solution can be measured electrometrically or calorimetrically.

4.2.2. Electrical conductivity

Electrical conductivity is a measurement of the capacity of water to carry electric current. It is measured in Micromhos/cm3 or Microseisms/cm3

. Water conductivity varies with temperature and is proportional to its dissolved mineral matter content [4]. Because electrical conductivity determination is quick, the number of dissolved salts in a water sample can be determined quickly.

4.3 Total Dissolved Solids

Shaking thoroughly mixed the sample for total dissolved solids (TDS) measurement before filtering through standard glass fibre filters. A clean porcelain dish was dried for one hour at 180 - 200 C, cooled in a desiccator, and weighed. In the dish, a sample of the required volume (250 ml) was carefully evaporated to 38 dryness. The dish was dried for one hour at 180 - 200 C before being cooled in a desiccator and weighed [6]. The weights of the empty dish and the dish containing the TDS were only recorded after the constant weights were obtained by repeatedly drying desiccating for cooling and weighing. TDS was calculated using the following formula:

Total Dissolved Solids, mg / L = (A-B) x 10^6 V -- (1)

Where,

A = Weight of dried residue + dish, gB = Weight of the dish, g

V = Sample volume, ml.

4.4 Total hardness

Distilled water was used to dilute a known volume (20.0 ml) of standard calcium solution to 50 ml. 1 - 2 drops Eriochrome Black-T indicator solution and 1.0 - 2.0 ml ammonium chloride-ammonium hydroxide buffer solution (pH 10) was added.

It was titrated with EDTA solution, which was slowly standardized with continuous stirring until the colour changed from Wine red to blue- The same procedure was followed for the reagent blank. The EDTA concentration was calculated using the following formula:

Concentration of EDTA, moles/ L = V xM (A – B) -- (2)

Where,

A = Volume of EDTAsolution consumed for calcium solution, ml. B = Volume of EDTA solution consumed for reagent blank, ml

V = Volume of calcium solution, ml

M = Concentration of calcium solution,moles.

4.5 Calcium estimation

A known volume (20.0 ml) [7,8] of sample was diluted to 50 ml with distilled water before being mixed with 2.0 ml Sodium hydroxide buffer solution and 0.2 to 0.4 g murexide indicator. It was titrated with standardized EDTA solution while stirring continuously until the color changed from red to blue-violet.

4.6 Estimation of magnesium

Magnesium was calculated as Mg mg/l by using the formula:

[(A-B) — (C—D)] x M x V --(3)

Amount of Magnesium, Mg = ___________________________mg/L

2400

Where,

A = Volume of EDTA consumed for the sample with EBT indicator, m1, B = Volume of EDTA consumed for the blank with EBT indicator, ml

C = Volume of EDTA consumed for the sample with murex idée indicator, ml D = Volume of EDTA consumed for the blank with murex idée indicator, ml M = Concentration of EDTA, moles/l

V = Volume of the sample.

4.7 Determination of Chloride

A given volume of the sample (20.0 ml) was taken and pH of the sample was acclimated in between 7.0 to 10.0 with nitric acid of sodium hydroxide. To this potassium chromate index result was added and adulterated to 100 ml with distilled water. It was titrated against formalized tableware nitrate result with nonstop shifting till the conformation of red tableware chromate precipitate was just observed.

4.8 Sulphate (Gravimetric system) Determination of sulphate

A given volume (250 ml) of filtered sample was taken, acidified with hydrochloric acid to a pH between 4.5 to 7.0 using methyl red index and 2.0 ml hydrochloric acid was added in excess. The sample was also concentrated to an optimum position by boiling, while the result was in hot condition, 10 barium chloride result was added drop wise with gentle shifting until the rush was completed.

4.9 Nitrate

Glass hair draw was fitted into the bottom of a reduction column. The column was also filled with distilled water.

Sufficient bobby - cadmium grains were placed to produce 18.5 cm long column. Proper care was taken to avoid the rise of air while filling- up the column with grains. The column was washed with 200 ml dilute ammonium chloride EDTA result and actuated by passing a admixture of 75 ml dilute ammonium chloride- EDTA result and 25 ml, 1 mg N03-/ L standard nitrate solution, at a rate of 7 to 10 ml/ min, through the column[9,10]. A series of standard nitrite results were prepared in the required range (0.04 to mg N02-/ L) by lacing working nitrite result to25.0 ml. A series of standard nitrate 43 results were prepared in the required range (0.2 to2.0 mg N03-/ L) by lacing working nitrate result to 100 ml. The pH of a given volume of the sample (20.0 ml) was acclimated between 7 and 9 with dilute hydrochloric acid or dilutes sodium hydroxide solution

75.0 ml adulterated ammonium chloride- EDTA result was added to the sample and made up to 100 ml. It was passed through the column at the rate of 7 to 10 ml/ min.

A given volume of eluent (20.0 ml) was collected after discarding the first 35 ml of the eluent. Whenever necessary, the sample was first duly adulterated before it was passed through the reduction column. The reduction of nitrate norms and blank was carried out exactly as described in the sample. Within 15 twinkles after the collection of eluent of the sample and the norms, ml sulphanilamide result and 1.0 m1 N-(1- naphthyl) ethylene di amine di hydrochloride result was added and adulterated to 25 ml. A sanguine grandiloquent color was redounded. The same procedure was espoused for reagent blank. The absorbance of the color developed for the sample and reduced nitrate norms were measured at 543 nm against reagent blank.

A standard wind was prepared by conniving absorbance of norms against their corresponding attention. The attention of nitrate in the sample was determined directly from the standard wind. The effectiveness of the reduction column was checked for confidence as follows. Standard results of nitrite were prepared with the same attention as that of nitrate norms used. The reagents were added to the nitrite norms as explained over and the color was developed.

The absorbance of the results was measured and compared with that of nitrate standard results. The nitrate and nitrite norms of same attention redounded in nearly same absorbance. Whenever there was a distinction the reduction column was prepared lately.

4.10 Determination of Fluoride

A series of norms (0.5, 1.0, 2.5, 5.0 mg F-/ L) were prepared from the working fluoride result in 100 ml volumetric steins. A given volume of the sample (50.0 ml) was taken in a 100 ml volumetric beaker and equal volume of TISAB buffer was added.

An analogous system was espoused for the norms and the reagent blank. The fluoride picky electrode and the reference electrode (single junction electrode) were completely washed with distilled water. Reference electrode was filled with the single junction electrode stuffing result. Both the reference and fluoride sensitive electrodes were immersed in the reagent blank.

After attaining stable reading, the cadence was set for zero attention.

Also, the reagent blank was replaced by fluoride standard. The instrument was set for the attention of that standard. Again, the electrodes were placed in the alternate standard. The attention of the alternate standard was achieved by conforming the pitch.

CHAPTER- 5

RESULTS AND FINDINGS

5. Result :

5.1. Study Area

Fig 5.1. Various River Basins are selected for collection of Ground Water

S.NO	PARAMETERS	UNITS	TEST METHOD	MAXIMUM VALUE	MINIMUM VALUE	STANDARD VALUE
1	pH	Na	IS 3025:PART11	8.4	6.9	6.5-8.5
2	ELECTRICAL CONDUCTIVITY		IS 3025:PART 14	2962.81	124.72	_
3	TOTAL DISSOLVED SOLIDS	mg/L	IS 3025:PART 16	2962.81	464.58	500
4	TOTAL HARDNESS	mg/L	IS 3025:PART 21	884.8	48.8	300
5	CALCIUM	mg/L	IS 3025:PART 40	303.4	15.4	75
6	MAGNESIUM	mg/L	IS 3025:PART 46	129.6	5.3	30
7	CHLORIDE	mg/L	IS 3025:PART 32	957.5	5.3	250
8	SULPHATE	mg/L	IS 3025:PART 24	308.2	28.2	200
9	NITRATE	mg/L	IS 3025:PART 34	81.8	10.6	45
10	FLUORIDE	mg/L	IS 3025:PART 60	0.29	0.07	1.5

Table 5.1. Standard Value as per IS3025

Readings taken from various river basin groundwater samples collected from different rivers in Odisha State:

Table 5.1. pH Test results of different water samples

Coding	**pH**
ws1	8.2
ws2	7.7
ws3	7.6
ws4	7.7
ws5	7.9
ws6	7.8
ws7	7.6
ws8	8
ws9	8.2
ws10	8.4

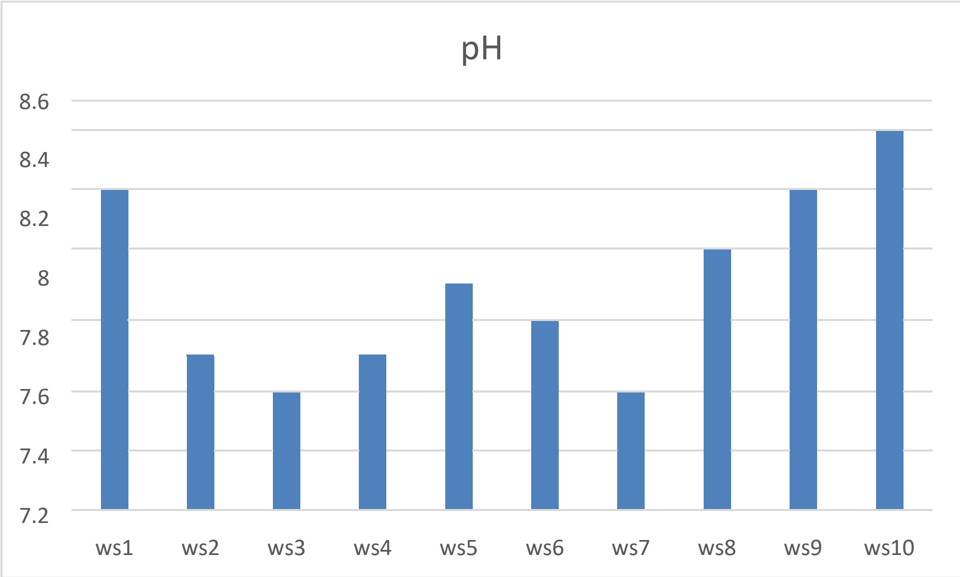

Fig 5.2. pH Test results of different water samples

Table 5.2. Total Hardness Test Results of different water samples

Coding	**TH**
ws1	440
ws2	394
ws3	430
ws4	374
ws5	500
ws6	832
ws7	800
ws8	823
ws9	900
ws10	840

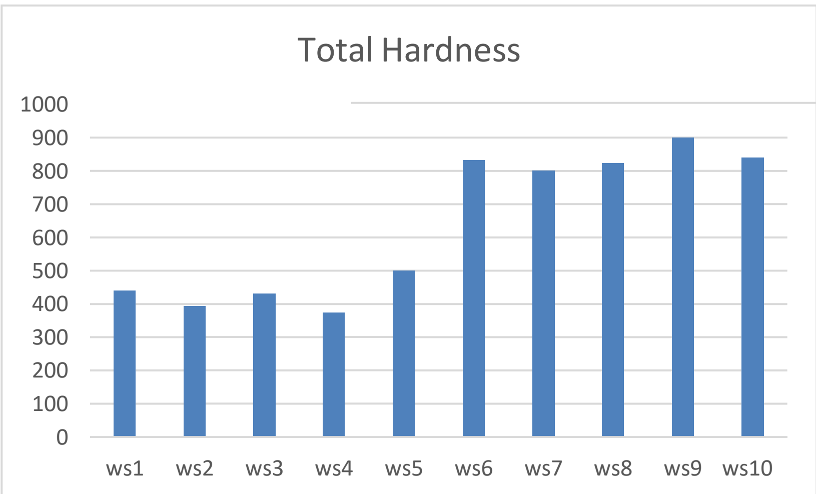

Fig 5.3. Total Hardness Test Results of different water samples

Table 5.3. Total Dissolved Solids Test Results of different water samples

Coding	**TDS**
ws1	1505
ws2	1218
ws3	1480
ws4	1250
ws5	1404
ws6	1504
ws7	1332
ws8	1440
ws9	1360
ws10	1470

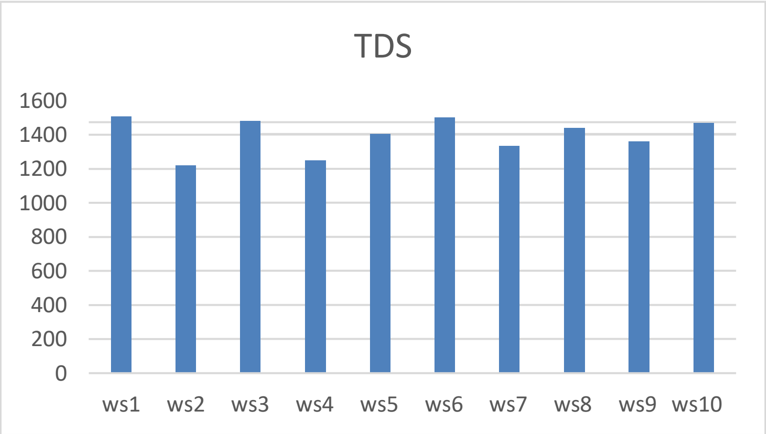

Fig 5.4. Total Dissolved Solids Test Results of different water samples Table 5.4. Calcium Content Test Results of different water samples

Sl no	Coding	**Calcium**
1	ws1	56
2	ws2	59
3	ws3	110
4	ws4	87
5	ws5	94
6	ws6	96
7	ws7	140
8	ws8	133
9	ws9	128
10	ws10	143

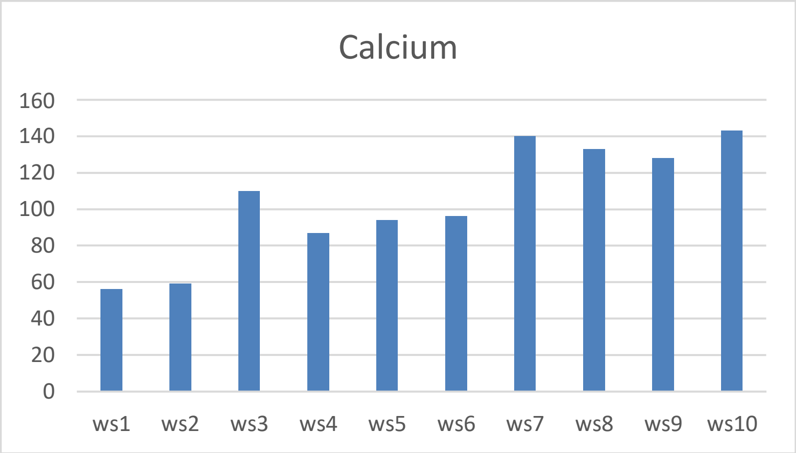

Fig 5.5. Calcium Content Test Results of different water samples Table 5.5. Magnesium Content Test Results of different water samples

Sl no	Coding	**Magnesium**
1	ws1	16
2	ws2	18
3	ws3	32
4	ws4	63
5	ws5	32
6	ws6	36
7	ws7	42
8	ws8	41
9	ws9	32
10	ws10	25

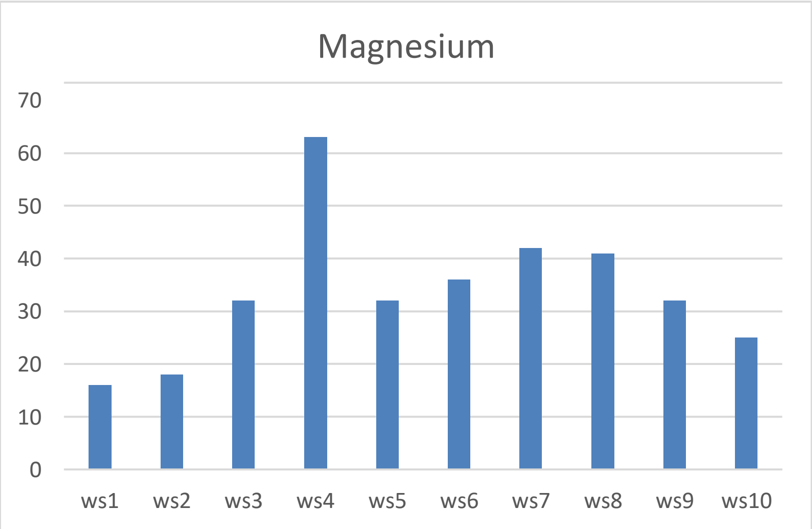

Fig5.6. Magnesium Content Test Results of different water samples

Table 5.6. Chloride Content Test Results of different water samples

Sl no	Coding	**Chloride**
1	ws1	230
2	ws2	244
3	ws3	213
4	ws4	320
5	ws5	319
6	ws6	310
7	ws7	302
8	ws8	250
9	ws9	202
10	ws10	224

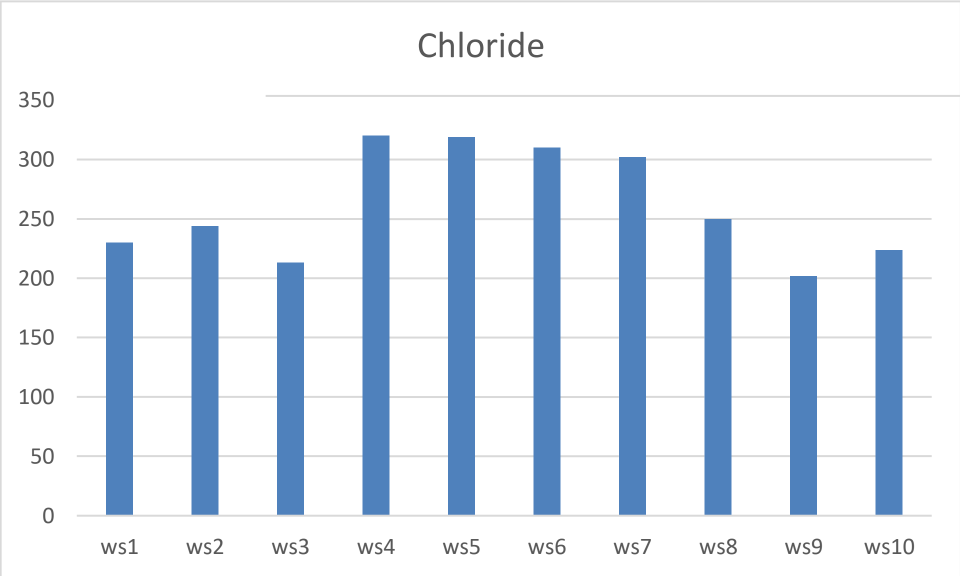

Fig 5.7. Chloride Content Test Results of different water samples

Table 5.7. Sulphate Content Test Results of different water samples

Sl no	Coding	**Sulphate**
1	ws1	94
2	ws2	96
3	ws3	140
4	ws4	133
5	ws5	59
6	ws6	110
7	ws7	87
8	ws8	94
9	ws9	96
10	ws10	111

Table 5.8. Nitrate Content Test Results of different water samples

Sl no	Coding	**Nitrate**
1	ws1	54
2	ws2	56
3	ws3	100
4	ws4	93
5	ws5	19
6	ws6	70
7	ws7	47
8	ws8	54
9	ws9	56
10	ws10	71

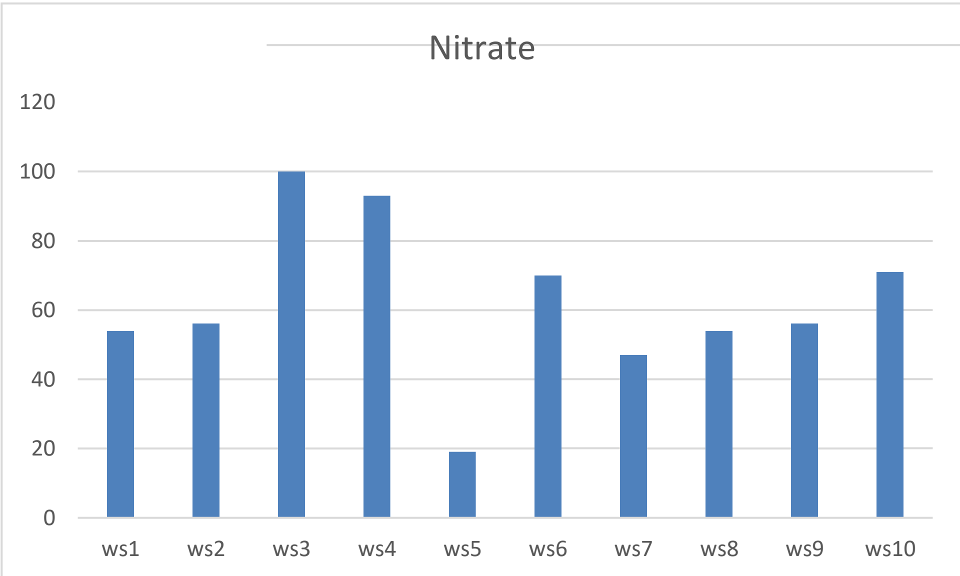

Fig 5.9. Nitrate Content Test Results of different water samples

Table 5.9. Fluoride Content Test Results of different water samples

Sl no	Coding	**Fluoride**
1	ws1	0.1
2	ws2	0.12
3	ws3	0.56
4	ws4	0.49
5	ws5	0.23
6	ws6	0.26
7	ws7	0.03
8	ws8	0.1
9	ws9	0.12
10	ws10	0.27

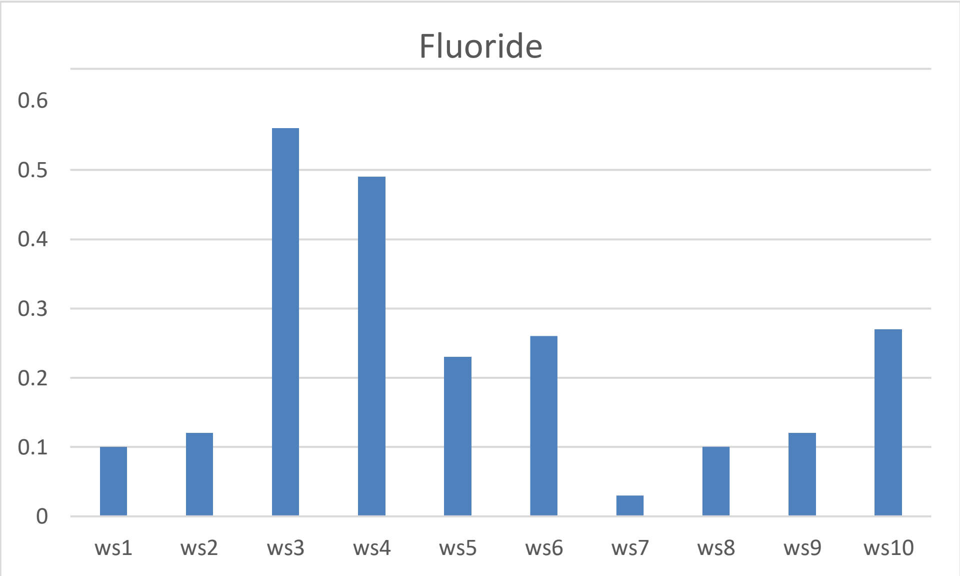

Fig 5.10. Fluoride Content Test Results of different water samples

Table 5.11. Comparison of Different parameters from the collectedwater sample.

slno	Water Collected from River	pH	TH	TDS	Calcium	Magnesium	Chloride	Sulphate	Nitrate	Fluoride
1	Baitarani	8.2	440	1505	56	16	230	94	54	0.1
2	Brahmani	7.7	394	1218	59	18	244	96	56	0.12
3	Budhabalanga	7.6	430	1480	110	32	213	140	100	0.56
4	Indravati	7.7	374	1250	87	63	320	133	93	0.49
5	Jambhira	7.9	500	1404	94	32	319	59	19	0.23
6	Mahanadi	7.8	832	1504	96	36	310	110	70	0.26
7	Rushikulya	7.6	800	1332	140	42	302	87	47	0.03
8	Subernarekha	8	823	1440	133	41	250	94	54	0.1
9	Vansadhara	8.2	900	1360	128	32	202	96	56	0.12
10	Kathjodi	8.4	840	1470	143	25	224	111	71	0.27

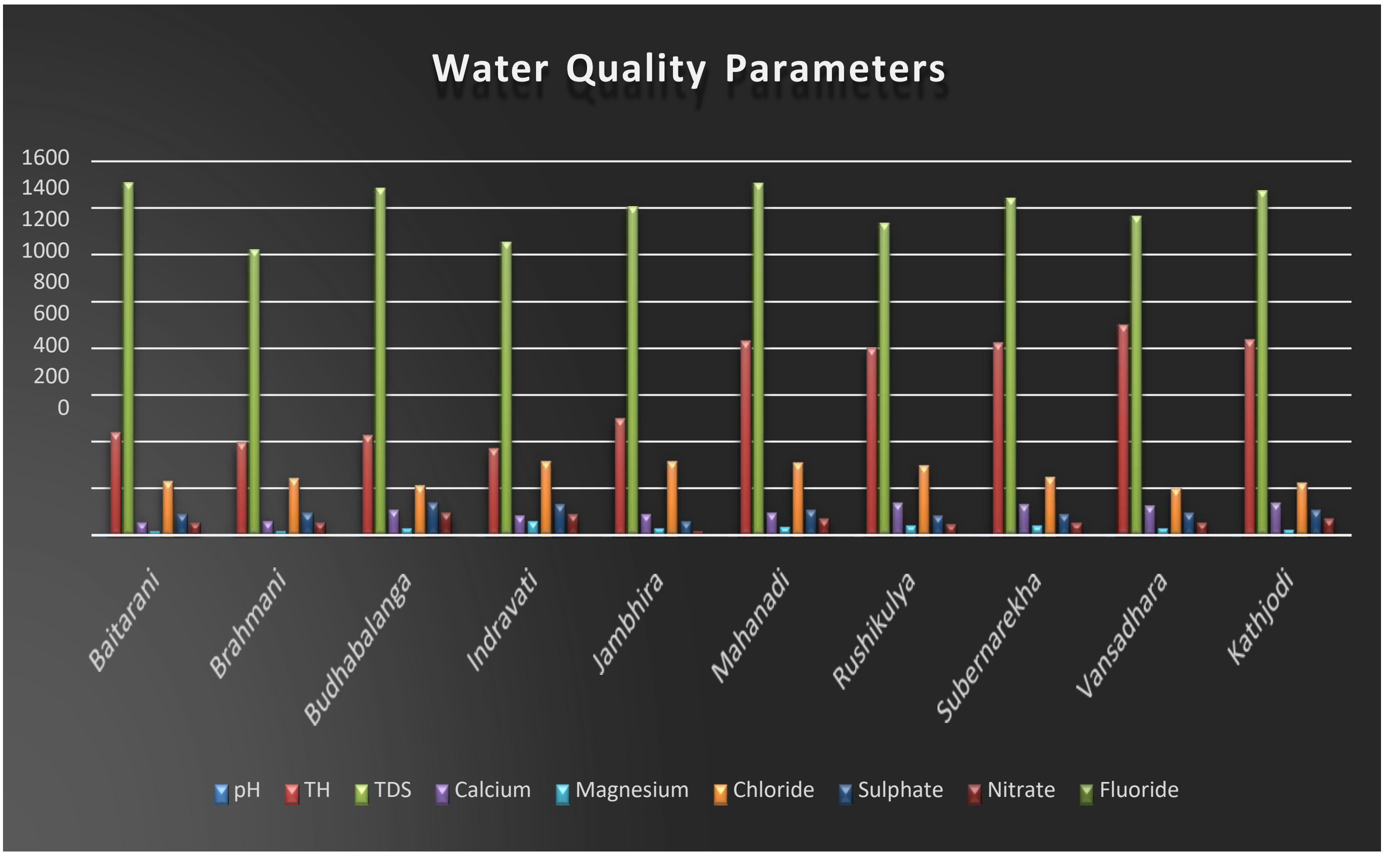

Fig 5.11. Comparison of Findings from different water sample

CHAPTER 6 . CONCLUSION

- In conclusion, the assessment of groundwater quality in GW collected from river basins at different districts of Odisha for agricultural and drinking purposes has provided valuable insights into the state of this vital resource.
- The comparison of the obtained data with national and international standards served as a critical benchmark for identifying areas with groundwater quality concerns.
- Spatial analyses through GIS mapping enhanced the visualization of variations, aiding in pinpointing regions requiring immediate attention and targeted intervention. The hydrogeological mapping correlated geological features with water quality, providing a holistic perspective on the underlying factors influencinggroundwater composition.

REFERENCE

1. Vakacharla Veera Mnikanta Srikar, "Performance of Concrete with adding of Steel Fibers", IJTSRD, 7(3) Mar 2018, pp 290-308.

2. Puli Sai Manohar, "A Practical Investigation on the Behavior of Steel Fibre Reinforced Concrete", IJTSRD Nov 2016, Vol-3: 5, pp 17-21.

3. Ahmad Bazgir, "The Behaviour of steel Fibre Reinforced Concrete Material and its Effect on Impact Resistance of Slabs", CITY UNIVERSITY LONDON, May 2016, pp 1-101

4. Dr Th. Kiranbala Devi Faculty, "Effects of Steel Fibres in Reinforced Concrete", IJTSRD Oct 2013, Vol-2: 10, pp 2906-2913

5. Shashank Shubham, "Review on Steel Fiber Enriched Reinforced Concrete", IJTSRD June 2020, Vol-10: 6(Series-III), pp 53-56.

6. Sameer Malhotra, Jagdish Chand, "Experimental Investigation on High Strength Concrete with the Addition of Steel Rebar", IJCIET July 2017, Vol-8: 7, pp 1130-1140.

7. Kamran Mohi Ud Din Bhat, "Effect of Steel Fiber Reinforcement on Early Strength of Concrete", IJTSRD, 2(5) July-Aug 2018, pp 198-225.

8. Tomasz Blaszezynski, "Steel Fiber Reinforced Concrete as Structural Material", IJTSRD, 2015, pp 282-289.

9. Rahul Chaudhary, "Experimental Analysis of Steel Fibre Reinforced Concrete Composite", IJTSRD, 4(5) May 2017, pp 2797-2800.

10. Elisante, E. & Muzuka, A. N., Environmental Earth Sciences 75(3), 1– 15 (2016)

11. Elisante, E. & Muzuka, A. N., Environmental Monitoring and Assessment 188(7), 1–19 (2016).

12. Favero, D., Cotta, A. J. B., Bonomo, R. & Rodrigues, M. B., Environment, Development and

Sustainability24(1), 320–351 (2022)

13. Gabr, M. E., Soussa, H. & Fattouh, E., ShamsEngineering Journal 12(1), 327–340 (2021)

14. Gad, M. & El Osta, M., Arabian Journal of Geosciences 13(17), 1–23 (2020)

15. Gatseva, P. D. & Argirova, M. D., International Journal of Hygiene and Environmental Health 211(5-6), 555–559 (2008)

16. Gray, N. F., Cambridge University Press (2008)

17. Gumbo, B., Physics and Chemistry of the Earth, Parts A/B/C 29(15–18), 1225–1231. (2004)

18. Heyns, P., Water Resources Management 1, 113– 150 (2009)

19. Kisaka, M., International Journal of Environment Geoinformatics 5(3), 337– 352 (2018)

20. Karthick, A., Ramkumar, S., Raja, R., Sreelal, G., Materials Today: Proceedings, 69, pp. 668– 673 (2022)