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A REVIEW ON ASSESSMENT OF GROUND AND SURFACE WATER

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Abstract - *Water is one of the vital needs of all living beings. Humans need water in many daily activities like drinking, washing, bathing, cooking etc. If the quality of water is not good then it becomes unfit for drinking and other activities. The quality of water usually described according to its physical, chemical and biological characteristics. Hence it becomes necessary to find the suitability of water for drinking, irrigation and Industry purpose. The groundwater quality based on Sodium percent, Sodium Absorption Ratio and Residual Sodium Carbonate will help to identify the suitability of water for irrigation purpose. Rapid industrialization and use of chemical fertilizers and pesticides in agriculture are causing deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water borne diseases. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates, TDS, Cations, Anions and phosphates.*

Key Words: WATER QUALITY ASSESSMENT, WQI, GIS CONTOURING, CLUSTER ANALYSIS.

1.INTRODUCTION

Ground water, surface water (rivers, streams and ponds), atmospheric water (rain water, snow and hail) and springs are the main source of water available to the people in general. The qualities of these water bodies vary widely depending on the location and environmental factors. The major source of ground water is precipitation that infiltrates the ground and moves through the soil and pore spaces of rocks. Other sources include water infiltrating from lakes and streams, recharge ponds and wastewater treatment system. As ground water moves through soil, sediment and rocks, many impurities such as disease-causing microorganisms are filtered out. Many water resources in developing countries are unhealthy because they contain harmful physical, chemical and biological agents. To maintain a good health however, water should be safe to drink and meet the local standards and international standards to taste, odour and appearance.

To monitor the water resource and ensure sustainability, national and international criteria and guidelines established for water quality standards are being used. (WHO-1993; 2005). The chemistry of water is very dynamic, largely controlled and modified by its medium of contact. Since the chemistry of water directly hints the quality of water for various purposes, its monitoring and assessment gained substantial importance in the present century. A tremendous increase in the population increased the stress on both surface and the groundwater. It is believed at the beginning of the human civilization itself, groundwater was the most trusted form of drinking water because of the filtering effect of the aquifer. However, in the present world drinking the water directly from the source without proper treatment is a tough task.

The groundwater analysis for physical and chemical properties is very important for Public health studies. These studies are also main part of pollution studies in the environment. The groundwater contains dissolved solids possesses physical characteristics such as odor, taste and temperature. The natural quality of groundwater depends upon the physical environment, the origin, and the movement of water. As the water moves through the hydrological cycle, various chemical, physical and biological processes change its original quality through reactions with soil, rock and organic matter. Natural processes and human activities cause the changes in groundwater quality, directly or indirectly. According to WHO organization, about 80% of all the diseases in human beings are caused by water.

2. LITERATURE REVIEW

The extensive literature review was carried out by referring standard journals, reference books and conference proceedings. The major work carried out by the different researchers is summarized below.

Y. Ouyanga et.al [1] In this study, twenty-two (22) monitoring stations located in the main stem of the LSJR and sixteen (16) physiochemical parameters obtained from each station were used for analysis. These datasets were collected during March 1998–March 2001 by staff from the SJRWMD. The water quality study is id carried by the PCA and PFA analysis method. In this method the SAS (statistical analysis system) software is used.

D. V. Moskovchenko et.al [2] In this study A total of 24 river sampling sites were selected for stream water collection and analysis: 10 sites were selected along the Vatinsky Egan River and 14 sites were located along its main tributaries. Water samples for total petroleum hydrocarbons (TPH) analysis were collected in 0.5 L sterile glass bottles previously washed with hexane. Water samples for heavy metal analysis were collected in acid-cleaned 0.5 L glass bottles and were preserved with 1 mL of HNO_3^-. Concentrations of dissolved inorganic ions were measured using "ANALYST-100" atomic absorption spectrophotometer and "CF-103" ion chromatograph. total suspended solids (TSS) – by gravimetric method. Concentrations of total petroleum hydrocarbons was

deter mined with the method of infra-red photometry. The hydrochemical information was recorded in an MS Excel database and processed using the statistical software STATISTICA v.5.0. T.

Memet Varol et.al [3]This study was conducted at Behrimaz Stream, which is fed with springs arising near Ba¸skaynak Village in the western part of the Behrimaz Plain, is in the South of Hazar Mountain in Eastern Anatolia Region of Turkey and has a catchment area of 101 km2 (Özdemir 1995a). The data for four water quality monitoring stations, consisting of 20 water quality parameters, were monitored over 1 year. Grab water samples were collected at monthly intervals from sampling sites between January 2003 and December 2003. And the data obtained by the experiments are analysed using Cluster analysis and the PCA method.

Rima Chatterjee et.al [4] A total of 26 surface water, 41 subsurface water and 12 mine water samples were collected by Singh et al. (2007) from 79 locations including urban, rural, ndustrial and mining areas, during the pre-monsoon months. The anions F, Cl, NO3, SO4, HCO3 and cations Ca and Mg were measured by ion chromatograph at the Central Mining and Fuel Research Institute, Dhanbad. The various thematic layers on hardness, pH and ionic concentrations have been generated using GIS contouring methods with ArcView 3.2a.

Masood Alam et.al [5] In this study, 50 groundwater samples were collected to assess the ground water quality from various rural areas. General procedure for ground water sampling, preservation and chemical analysis were carried out according to the standard procedure. the SAR, percent sodium, RSC, Kelly's index, permeability index, and indices of base exchange were calculated. Metal ion concentrations were determined by Atomic Absorption Spectrophotometer, Perkin Elmer (Model 3110) using air– acetylene flame.

A. Gibrilla et.al [6] In this project the authors collected the water sample from the boreholes of the Densu river basin area in China. A total of twenty-one boreholes, one hand-dug well and four surface water points (River Densu) were sampled at various locations, see. All the water samples were collected in 500 ml preconditioned high density polyethylene bottles. They were conditioned by washing initially with five percent (5%) nitric acid, and then rinsing several times with distilled water. This was carried out to ensure that the sampling bottles were free from contaminants. The water quality assessment is done by WQI method.

Bing Zhang et.al [7] In this project water samples are collected along songhuna river. Two 50 ml polyethylene bottles with watertight caps were used to store filtered (0.45 mm Millipore membrane filter) water for cations and anions analysis. The major ions of water samples were treated and analysed in the physical and chemical analysis centre laboratory of the Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS). Fuzzy sets and fuzzy optimization provide a useful technique in addressing water quality management.

Fatma Gultekin et.al [8] In this study Water samples were collected from two ground water stations and 31 surface water stations in the wet season (May 2009), in order to conduct major anion–cation, pollution parameter concentration and trace element analyses. Major anion and pollution parameter concentrations were determined by photometer. Major cation (Ca, Mg, Na, K) and trace element (Fe, Al, Cu, Pb, Mn, Ni, Co, Cd, Be, As, Ba, Bi, Mo, Sb, W, V) analyses were carried out with the ICP/OES (inductively coupled plasma–optical emission spectrometry; the ionic balance for the analyses is within ±5 %).

S. Mehdi Saghebian et.al [9] The Ardebil watershed is located in Ardebil province, northwestern part of Iran with an area of about 920 km2, and was used as the study area. The region has a cold and semi-arid climate, with maximum absolute temperature of about 25 °C in July and minimum absolute temperature of −7 °C in January. The parameters are obtained by the laboratory experiments and the data are analyzed using Principal component analysis and Evaluation of water quality using USSL diagram.

Pardeep Singh et.al [10] This is carried out to assess the ground and surface water quality along the Varuna River in Varanasi, India. The seven sampling cities were selected randomly along the river and the laboratory experiments are conducted.

K. Brindha et.al [11] In this study the Surface water samples were collected along the Uyyakondan channel in 14 locations and groundwater samples were collected adjacent to these locations in 15 locations during January. Samples were collected in high density polyethylene bottles of 500 ml capacity. These bottles were pre-cleaned with 1:1 dilute hydrochloric acid and washed with distilled water. Colorimetric analysis was used for determining the concentration of fluoride and nitrate in the water samples. Ion balance error was calculated to check the accuracy of the analysis which was within ±5 %.

Ashek Ahmed et.al [12] In this water samples were collected during monsoon period (June to August) from 50 sampling stations located in the study area. The information regarding well depths were collected from the record taken by the well owners and local government offices. For water sampling, 50 plastic bottles (each of 1 L volume) were collected and washed by 4 to 5 times using de-ionized water. The membrane filtration technique (American Public Health Association 1998) was used to estimate the counts of coliforms in the surface water samples. For the E. coli and fecal coliform (FC) count, 100 mL sample of water was filtered by a 0.45-µm pore-size membrane filter. ArcGIS 10.3.1 was used for the preparation of surface and groundwater quality map of the study area.

Madan Kumar Jha et.al [13] In this water quality assessment is carried out in Tiruchirappalli district which is in Tamilnadu state. The main source of surface water is the Cauvery River and its tributaries (Ayyar, Uppar and Koraiyar rivers) which flow through the center of the study area. For the groundwater-quality assessment of the unconfined aquifer system underlying the study area, groundwater-quality data of 24 observation wells during pre-monsoon season (July 2013) and 37 observation wells during post-monsoon season (January 2014) were obtained from Institute of Water

Studi
es, Chennai, Tamil Nadu. Both the pre-monsoon and post monsoon seasons' groundwater-quality data were used in this study to investigate seasonal variation in the groundwater quality and the influence of the rainfall on the quality of groundwater. The water quality assessment is carried out by Fuzzy-GIS-based Groundwater Quality index (FGQI).

Gita Farzaneh et.al [14] The studied landfill site is located 30 km southwest of Tehran Province in Robatkarim District. Iran. The Shur River, one of the largest rivers of Iran's central basin, is only 400-m away from the landfill. Surface and groundwater data were collected during 2 years from 2017 to 2019. Samples were obtained, with four replications, each month from nearby wells and the Shur River adding up to the total number of 576. Three sampling stations on the Shur River were selected 500 m apart from each other, to investigate the polluting impact of landfill. The water quality study is carried out by Statistical analysis and the Water Quality Index (WQI) method.

Akshay Kumar et.al [15] The study area is situated in Ramgarh and partially in Hazaribagh district of Jharkhand state, Water samples from 45 observational wells were collected during May (2015) for the pre-monsoon season, whereas for the post-monsoon season, the water samples were collected in December (2015) from 31 observational wells. Altogether, the collected groundwater samples were chemically analyzed in a laboratory to assess the seasonal variation in groundwater quality during both seasons (pre and post-monsoon). Water quality parameters andWQI maps for both seasons (pre and post-monsoon) were generated and analyzed in a GIS environment using an inverse distance weighted (IDW) algorithm, a spatial interpolation method in ArcGIS (v10) software.

3. WATER QUALITY ANALYSIS

This is a composite index that summarizes results from several influencing parameter on water quality into a single value to assess the status of the water quality. The WQI was calculated as follows: (1) a weight was assigned to each water quality parameter (w_i) reflecting the relative importance of the parameter to the overall quality of water for different purposes. (2) The relative weight (w_i) of each parameter was calculated using equation. (3) The quality rating scale (qi) is calculated for each parameter. In this step, the measured concentration for each parameter is divided to standard values. And finally, WQI is calculated.

WQI	Water quality category
50>	Excellent
50-100	Good
100-200	Poor
200-300	Very poor
300<	Unsuitable for drinking

Table1 Water quality classification based on WQI

GIS

Mapping

GIS is widely used for the assessment of water quality and developing solutions for the resource-related problems and was also used in the present study. The working maps were prepared from 1:25,000 scale topographic paper maps which were scanned and digitized to generate a digital output using arc/Info GIS software.
The sampling locations were integrated with the surface water data for the generation of spatial distribution maps of the selected water quality parameters including pH, EC, TDS, total hardness, NO_3^-, NO_2^{-2}, DO, COD, F^-, total Fe, total AL, total Mn; the ground water data were disregarded. The water data were linked to the sampling locations using database creation function of ArcGIS 9.3 software.

GIS Analysis

The various thematic layers on hardness, pH and ionic concentrations have been generated using GIS contouring methods with ArcView 3.2a. The spline contouring method has been used for generating the contours needed for the creation of a triangulated network for each thematic layer. Spatial distribution maps for Hardness, pH, TDS, HCO3, SO4, NO3, Ca, Mg, Cl and F have been created for selected area. The flow chart was followed to develop a ground water quality classification map from thematic layers based on the WHO (1984) and Indian (ISI 1983) Standards for drinking water. The classification of water quality is essential for an assessment of suitability for domestic, agriculture or industrial uses.

Cluster analysis

Cluster analysis is a group of multivariate techniques whose primary purpose is to assemble objects based on the characteristics they possess. Cluster analysis classifies objects so that each object can be similar to the others in the cluster with respect to a predetermined selection criterion. The resulting clusters of objects should then exhibit high internal (within-cluster) homogeneity and high external (between-cluster) heterogeneity. Hierarchical agglomerative clustering is the most common approach, which provides intuitive similarity relationships between any one sample and the entire data set, and is typically illustrated by a dendrogram (tree diagram). The dendrogram provides a visual summary of the clustering processes, presenting a picture of the groups and their proximity, with a dramatic reduction in dimensionality of the original data. The Euclidean distance usually gives the similarity between two samples, and a distance can be represented by the difference between analytical values from the samples. In this study, hierarchical agglomerative CA was performed on the normalized data set by means of the Ward's method, using Euclidean distances as a measure of similarity.

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Meas
urement of pH:
The pH is important parameter of water, which determines the suitability of water for various purposes such as drinking, bathing, cooking, washing and agriculture etc. The pH level of water having desirable limit is 6.5 to 8.5 as specified by the BIS. Pure water is said to be neutral, with a pH of 7. Water with a pH below 7.0 is considered acidic while water with pH greater than 7.0 is considered as basic or alkaline.

Measurement of Conductivity:
Electrical conductivity is the capacity of electrical current that passes through the water. It is directly related to concentration of ionized substances in water and may also be related to problems of excessive hardness. According to BIS and ICMR the desirable limit of Conductivity is 600 µS/cm. Solutions of most inorganic acids, bases, and salts are relatively good conductors. In contrast, the conductivity of distilled water is less than 1 µmhos/cm.

Measurement of Hardness:
The limit of total hardness value for drinking water is to be within 300 mg/l of CaCO3.Higher concentration of hardness was found may be due to natural accumulation of salt, or surface runoff, water enter from direct pollution by human activities.

Measurement of Turbidity:
Nephelometer instrument measures the intensity of scattered light by turbid particles at right angle to the incident beam of light in comparison with the intensity of light passing through the sample. Scattering of light is a function of Tyndall effect exhibited by colloidal suspended particles. Turbidity of samples is measured by Nephelometer based on this principle. The maximum Permissible level is 5,NTU.

Measurement of Temperature:
The temperature is measured with help of Digital Thermometer. The thermometer is immersed in sample and temperature is recorded.

Physiochemical characteristics of Water in India

Sl. No	Parameter	BIS Specification
1	pH	6.5-8.5
2	EC	600 µs/cm
3	Alkalinity	200 mg/L
4	TDS	500 mg/L
5	Total Hardness	200 mg/L
6	Chlorides	250 mg/L
7	Turbidity	5 NTU
8	Temperature	23º C
9	Ca	75 mg/L
10	Mg	30 mg/L
11	Na	200 mg/L
12	K	200 mg/L
13	Sulphate	200 mg/L
14	Iron	0.3 mg/L
15	BOD	1-2 mg/L
16	DO	6.5-8 mg/L
17	COD	10 mg/L
18	Fluoride	1 mg/L
19	Nitrate	45 mg/L
20	Copper	0.05 mg/L
21	Lead	0.01 mg/L
22	Zink	5 mg/L

4 CONCLUSION

- The suggested measures to improve the ground water quality includes total ban on the activities that causes pollution, avoid use of pesticides and prevent entrance of sewage in to ground water.
- Water quality assessment shows that the most of the water quality parameters slightly higher in the wet season than in the dry season.
- Water quality is dependent on the type of the pollutant added and the nature of self purification of water.
- The undesirable amount of any substances in the water may cause diseases to the human being. So that we have to take care of the water being polluted.

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