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A CASE STUDY: ASSESSMENT OF GROUNDWATER QUALITY INDEX AROUND NAMAKKAL DISTRICT IN TAMILNADU

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ABSTRACT

This case study paper reviews ground water pollution to agriculture soil due to the natural shale value of heavy metals in soil system. Thus, untreated industrial effluents can cause an environmental threat to ground water resources and affects soil quality and agricultural plant productivity. To achieve unpolluted wastewater discharge into receiving water bodies, careful planning, adequate and suitable treatment, regular monitoring and appropriate legislations are necessary. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates, TDS, Cations, Anions and phosphates. Rapid Increase in population, Construction of residential complexes and wide spread Industrialization in Namakkal Town has drastically reduced the land area for wastewater disposal Groundwater pollution occurs when untreated or partially treated Industrial waste water are discharged on to the land or used for Irrigation, enabling the waste to migrate down the water table through soil. Twenty (20) sampling locations were selected in nearer to the sources of contamination. The water and soil samples were collected from the selected sampling points. The samples were analyzed for major chemical water quality parameters like pH, EC, Ca, Mg, Cl, SO_4, Na, CO_3 and HCO_3.The soil samples were analyzed pH, EC, Cl, SO_4, PO_4 and NO_4.bThe 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. This aim of the present study was to assess the quality of the ground water and the impacts of the Municipal wastewater. This study will be very helpful to under-stand the impact/evaluation of the rate of dumping of effluent water in ground water and impact on the quality of water in terms of irrigation and the impacts onto the environment.

KEYWORDS: Ground Water, Drinking Water, Municipal Wastewater, Water Quality Parameters.

Groundwater is generally recognized to be good for human consumption and is used as a potential source of drinking water. Agricultural development, urbanization and industrialization are the major causes for all changes in the quality of water1. In order to meet the rising water needs, evaluation of water quality is important for allocation to various uses. Only during the last three decades of the twentieth century, the concern for water quality has been exceedingly felt so that, water quality has now acquired as much importance as water quantity2. According to WHO3, about 80% of all the diseases in human beings are caused by contaminated water. Once the groundwater is polluted, its quality cannot be renovated by stopping the pollutants from the source. It is therefore vital to regularly monitor the quality of groundwater. Groundwater pollution by heavy metals has been given much attention due to their low biodegradability and toxic effects 4,5. The water from the sources viz., streams, falls, lake, hand pump, open well and bore well are contaminated with domestic, agricultural and industrial wastes and likely to cause water related diseases6. Similarly, Bullard7 inferred that polluted surface water always results in an unhealthy socio-economic environment. In this study, physicochemical parameters are determined to draw a conclusion on the quality of water whether it is good or unfit for drinking purpose.

Statistical analysis of physicochemical parameters of water has been reported from the different parts of World and India8-12. C. R. Ramakrishnaiah et al.13, have assessed the Water Quality Index for the Groundwater in Tumkur Talk, Karnataka State, India. Linear correlation analysis study of drinking water quality data for Al-Mukalla city, Hadhramout, Yemen was carried out by Sami G. Daraigan et al., 14 and from this study they showed that all the physicochemical parameters of drinking water in Mukalla city are more or less correlated with each other. Papita Das Sahaet al., 15 have assessed the water quality characteristics of River Ganga at Kolkata Region, India using water quality index and ANN simulation method15. Dadolahi - Sohrabet al.16. Have studied the Water quality index as simple indicators of watersheds pollution in southwestern part of Iran and from this study it is revealed that quality declined significantly during the dry season. So, an attempt is made to study the physicochemical parameters of water samples taken from Yercaud Talk in Salem, Tamil Nadu, and India.

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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.

LITERATURE REVIEW

The extensive literature review was carried out by referring standard journals, reference books and conference proceedings. The major work carried out by different researchers is summarized below. Dinesh Kumar Tank et.al [01] study focused on the hydrochemistry of groundwater in the Jaipur city to assess the quality of groundwater for determining its suitability for drinking and agricultural purposes. Groundwater samples were collected from eleven stations of Jaipur city during monsoon season and were analyzed for physico-chemical parameters such as pH, EC, TDS, sodium, potassium, calcium, magnesium, chloride, sulphate, carbonate, bicarbonate, nitrate and fluoride. Comparison of the concentration of the chemical constituents with WHO (world health organization) drinking water standards of 1983, the status of groundwater is better for drinking purposes. The parameters like pH, sodium, potassium, carbonate, bicarbonate, chloride are within permissible limit as per WHO but calcium, magnesium and nitrate values exceeding the limit. The calculated values of SAR, RSC and percentage sodium indicate that the water for irrigation uses is excellent to good quality. US Salinity diagram was used for evaluating the water quality for irrigation which suggests that the majority of the groundwater samples were good for irrigation.

The pH of water in wells within 500-700m is contaminated by the leachate of landfill. Concentrations of Hardness, TDS, and Nitrate ranged from 0 to 80 mg/L, 49 to 190 mg/L, and 4 to 79.89 mg/L respectively. The analysis was done for four months from Feb to May. The results showed that within 500 m bore wells were contaminated by E-Coli bacteria, also nitrate concentration is above the permissible level described by WHO and Bureau of Indian Standards for drinking water and pH were acidic in nature. The polluted water requires certain levels of treatment before use. Public enlightenment on waste sorting, adoption of clean technology, using climate change mitigation strategies and the use of sanitary landfill to prevent further contamination of ground water flow are recommended. Sarala C. et.al [04] studied the groundwater quality parameters in the surrounding wells of Jawaharnagar, in upper Musi catchment area of Ranga Reddy district in Andhra Pradesh. The bore wells data was collected from the study area for two seasons i.e., post monsoon in December 2007and pre monsoon in June 2008. The groundwater is acidic in nature and very hard. It is done by using Arc GIS software. The study reveals that the concentrations of major constituents are well within the permissible limits of IS- 10500-1994, except in few cases where total hardness and fluoride concentrations are high. The fluoride conc. exceeded the permissible limit. From the analysis it was observed that the groundwater is polluted in the entire study area. During last few years, the utilization of surface and groundwater for drinking, industrial and agricultural purposes has increased manifolds but consequently it is observed that the water is polluted and affecting the human health, soil nutrients,livestock,biomass and environment in certain areas.

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The special concern is pH, dissolved oxygen (DO), oxygen demand (chemical and biological), solids (suspended and dissolved), nitrogen (nitrite, nitrate and ammonia), phosphate, and metals (DeCicco, 1979; Larsdotter, 2006).

The hydrogen-ion concentration is an important quality parameter of both natural and waste waters. It is used to describe the acid or base properties of wastewater. A pH less than 7 in wastewater influent is an indication of septic conditions while values less than 5 and greater than 10 indicate the presence of industrial wastes and non-compatibility with biological operations. The pH concentration range for the existence of biological life is quite narrow (typically 6-9). An indication of extreme pH is known to damage biological processes in biological treatment units (EPA, 1996; Gray, 2002). Another parameter that has significant effect on the characteristics of water is dissolved oxygen. It is required for the respiration of aerobic microorganisms as well as all other aerobic life forms. The actual quantity of oxygen that can be present in solution is governed by the solubility, temperature, partial pressure of the atmosphere and the concentration of impurities such as salinity and suspended solids in the water (EPA 1996; Metcalf and Eddy, 2003). Oxygen demand, which may be in the form of BOD or COD, is the amount of oxygen used by microorganisms as they feed upon the organic solids in wastewater (Water Environmental Federation, 1996; Gray, 2002; FAO, 2007). The 5 day BOD (BOD5) is the most widely organic pollution parameter applied to wastewater. It involves the measurement of dissolved oxygen used by microorganisms in the biochemical oxidation of organic matter. The presence of sufficient oxygen promotes the aerobic biological decomposition of an organic waste (Metcalf and Eddy, 2003). Although BOD test is widely used, it has a number of limitations, which include the requirement of a high concentration of active acclimated micro-organisms and the need for treatment when dealing with toxic wastes, thus reducing the effects of nitrifying organisms. The BOD measures only the biodegradable organics and requires a relatively long time to obtain test results (Gray, 2002; Metcalf and Eddy, 2003). Similarly, the COD test measures the oxygen equivalent of the organic material in wastewater that can be oxidized chemically.

The COD will always be higher than the BOD. This is because the COD measures substances that are both chemically and biologically oxidized.

The pH part of the Durov diagram reveals that groundwater in study area is alkaline and electrical conductivity of most of samples lies in the range of drinking water standards adapted in Pakistan. From the SAR and conductivity plot it was found that most of groundwater cannot be used on soil without restricted drainage and special requirement of Management for salinity control. Comparison of data with WHO(2011) standards for drinking water indicate that the groundwater in the most of study area are suitable for drinking purpose except some few places. The groundwater recorded a wide range in TDS M.R.G.

Based on the hydro geochemical facies it has been found that the groundwater regime is severely deteriorated by the anthropogenic activities. The predominant SO_4 and Cl in the wells of Fursungi and Mantarwadi areas has strong influence of leachate throughout the year due to solid waste disposal site. He was done water analysis for the parameters like pH, DO, BOD, COD, TDS, Calcium, Magnesium and Hardness for lake water. The analysis of Water quality indicates the temperature in the range of 240^{o}C.The pH was 7.3 to 8.45.It shows slightly alkaline water. The DO varied from 4.8 to 5.7 mg/l. The total hardness ranged from 160 to 298 mg/l which is higher than permissible limit. The turbidity of water was 28 to 42 NTU which is higher as per the APHA limit. Mona A. Hagras et.al to assess the quality of groundwater and to characterize the hydro chemical characteristics of the groundwater in Punjab, groundwater samples were collected from different cities of Punjab Province and analyzed for 28 water quality parameters Groundwater suitability for domestic and irrigation purposes was assessed by using WHO and USDA standards.SAR values and the sodium percentage (Na%) in locations indicate that majority of the groundwater samples are suitable for irrigation. This investigational study indicates that water in many cities of Pakistan is unsafe for human consumption due to presence of both bacterial and chemical contamination.

Assessment of Water Quality

In now days due to increase in population, industrialization, agricultural activities and urbanization, large quantities of sewage and industrial wastewater are discharged into water bodies has significantly contributed to the pollution of the surface and ground water. The objective of the present study was to assess water quality of various ground water sources in India for drinking and agriculture. For the assessment of water pollution status of the water bodies, the following water quality parameters were analyzed: (1) pH (2) Conductivity (3) Temperature (4) Total dissolved solid (TDS) (6) Total Alkalinity (7) Hardness (8) Cations and Anions (9) Carbonates and Bicarbonates. (10) Sulphates. Measurement 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

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 600µm/cm.

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Measurement of Alkalinity

Standard desirable limit of alkalinity of potable water is 120 mg/l. The maximum Permissible level is 600 mg/l. Excessive alkalinity may cause eye irritation in human and chlorosis in plants. It is measured by titration with standardized acid to a pH value of 4.5 and is expressed commonly as milligrams per liter as calcium carbonate.

Measurement of TDS

TDS in groundwater can also be due to natural sources such as sewage, urban runoff and industrial waste. According to BIS and ICMR the desirable limit of TDS is

500 mg/l. If TDS value is more than 500 mg/l, it may cause gastro intestinal irritation. High TDS presence in the water decreases the quality and affects the taste of water (Guru Prasad, 2005).

Measurement of Hardness

The limit of total hardness value for drinking water is to be within 300 mg/l of $CaCO_3$.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 Chloride: Chloride is one of the most important parameter in assessing the water quality and higher concentration of chloride indicates higher degree of organic pollution. According to BIS and ICMR the permissible limit of chloride in drinking water is 250mgl.

High concentration of chloride was observed may be due to natural processes such as the passage of water through natural salt formations in the earth or it may be an indication of pollution from industrial or domestic use. In drinking water, high chloride content may lead to laxative.

Measurement of Turbidity

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

Temperature is measured with help of Digital Thermometer. The thermometer is immersed in sample and temperature is recorded. Total Hardness was observed some evidence indicates its role in heart diseases and hardness of 150-300 mg/l and above may cause kidney problems and kidney stone formation, as it causes unpleasant taste and reduce ability of soap to produce lather. Hard water is unsuitable for domestic use.

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 quality of wastewater effluents is responsible for the degradation of the receiving water bodies. This is because untreated or inadequately treated waste water effluent may lead to eutrophication in receiving water bodies and also create environmental conditions that favor proliferation of waterborne pathogens of toxin-producing cyanobacteria. In extension, recreational water users and anyone else coming into contact with the infected water is at risk. Although various microorganisms play many beneficial roles in wastewater systems, a great number of them are considered to be critical factors in contributing to numerous waterborne outbreaks. Also, wastewater effluents have been shown to contain a variety of anthropogenic compounds, many of which have endocrine-disrupting properties. Since large amounts of wastewater effluents are passed through sewage treatment systems on a daily basis, there is a need to remedy and diminish the overall impacts of these effluents in receiving water bodies. In order to comply with wastewater legislations and guidelines, there is a need for adequate treatment before discharge. This can be achieved through the application of appropriate treatment processes, which will help to minimize the risks to public health and the environment. To achieve unpolluted wastewater discharge into receiving water bodies, careful planning, adequate and suitable treatment, regular monitoring and appropriate legislations are necessary.

The world is faced with problems related to the management of wastewater. This is due to extensive industrialization, increasing population density and high urbanized societies. The effluents generated from domestic and industrial activities constitute the major sources of the natural water pollution load. This is a great burden in terms of wastewater management and can consequently lead to a point source.

CONCLUSION

Wastewater effluents are major contributors to a variety of water pollution problems. Some of these problems include eutrophication, which can stimulate the growth of algae, increased water purification cost, interference with the recreational value of water, health risks to humans and livestock, excessive loss of oxygen and undesirable changes in aquatic populations. Since

large amounts of wastewater effluents are passed through sewage there is a need to remedy and diminish the overall impacts of these effluents in receiving water bodies. In order to comply with wastewater legislations and guidelines, wastewater must be treated before discharge. This can be achieved through the application of appropriate treatment processes, which will help to minimize the risks to public health and the environment. To achieve unpolluted wastewater discharge into receiving water bodies, there is the need for careful planning, adequate and suitable treatment, regular monitoring and appropriate legislation. This is will enhance science-based decisions and ensure the sustainability of the environment and the health of plants and animals. There is also a need to ensure that effluents standards and limitations, as set by regulatory bodies are not compromised.

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