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Assessment Of Water Quality Management With A Systematic Qualitative Analysis Of Water Pollution In Nalanda District

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Abstract:
Water Quality Management In Nalanda District Requires A Systematic Qualitative Analysis Of Water Pollution To Identify The Sources And Impacts Of Contamination. By Conducting Such An Assessment, The Effectiveness Of Current Management Practices Can Be Evaluated, And Targeted Measures Can Be Implemented. Nalanda District Faces Several Water Pollution Challenges. The Qualitative Analysis Reveals That Agricultural Activities, Including Excessive Use Of Fertilizers And Pesticides, Contribute Significantly To Water Pollution. Runoff From Fields Carries Pollutants Into Nearby Water Bodies, Leading To Eutrophication And Degradation Of Water Quality. Additionally, Improper Waste Management Practices, Including The Discharge Of Untreated Sewage, Contribute To Bacterial Contamination And Pose A Risk To Human Health.
Industrial Activities, Particularly In Urban Areas, Also Contribute To Water Pollution. Effluents From Industries, Such As Textile Mills And Tanneries, Contain Toxic Chemicals That Find Their Way Into Water Sources, Contaminating Them And Impacting Aquatic Life. Furthermore, Inadequate Regulations And Enforcement Result In The Improper Disposal Of Industrial Waste, Exacerbating The Pollution Problem.
To Address These Issues, Effective Water Quality Management Strategies Are Required. This Includes Implementing Stricter Regulations For Agricultural Practices, Promoting The Use Of Organic Farming Methods, And Raising Awareness Among Farmers About The Importance Of Responsible Pesticide And Fertilizer Use. Improved Waste Management Systems, Including The Construction Of Sewage Treatment Plants And The Implementation Of Proper Sanitation Practices, Are Crucial To Reducing Contamination From Domestic Sources.
Collaboration Between Government Agencies, Environmental Organizations, And Local Communities Is Vital To Achieving Sustainable Water Quality Management In Nalanda District. Regular Monitoring Programs, Public Education Campaigns, And The Promotion Of Sustainable Practices Are Essential For Ensuring The Long-Term Health And Availability Of Clean Water Resources For Both Human And Ecological Needs.
***Key Word**: Water Pollution, Agricultural Runoff, Domestic Sewage, Open Defecation, Traditional Practices.*

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I. Introduction

Water is vital for the existence and well-being of all living beings on the planet, including animals. Here are some key reasons why water is crucial for the animal kingdom. Water is essential for the survival of animals. It is involved in numerous physiological processes such as digestion, circulation, temperature regulation, and waste removal. Animals rely on water to maintain their bodily functions and overall health. Just like humans, animals need water to stay hydrated. Proper hydration is necessary for maintaining the balance of bodily fluids, which is crucial for optimal organ function. Water helps animals regulate their body temperature, especially in hot environments or during physical activities. Water plays a crucial role in the digestion and absorption of nutrients from food. It helps break down food particles, facilitates the transport of nutrients across cell membranes, and aids in the removal of waste products from the body. Water bodies such as rivers, lakes, ponds, and oceans provide habitats for countless animal species. Aquatic ecosystems are home to a diverse range of organisms, including fish, marine mammals, amphibians, and reptiles. These habitats provide food, shelter, breeding grounds, and protection for animals. Water sources act as natural gathering points for animals, particularly in arid regions. Animals rely on waterholes, rivers, and other water bodies for drinking, bathing, and social interactions. These gathering points are essential for various ecological processes, including predator-prey interactions and the dispersal of seeds and nutrients.

Many animal species undertake long-distance migrations in search of water resources. These migrations are essential for breeding, feeding, and survival. Water availability influences the timing and success of animal migrations, as well as the availability of suitable habitats for reproduction. Water supports a vast array of species, contributing to the overall biodiversity of the planet. Animals, both aquatic and terrestrial, play vital roles in maintaining ecosystem balance. They contribute to nutrient cycling, seed dispersal, pollination, and predation, which are crucial for the health and stability of ecosystems. Certain animal species, such as marine mammals, fish, and amphibians, have evolved specific adaptations to aquatic environments. These adaptations allow them to thrive in water and utilize its resources efficiently. In summary, water is essential for the survival, hydration, nutrient absorption, and overall well-being of animals. It provides habitats, supports ecosystems, and plays a fundamental role in the ecological balance of the animal planet.

Water quality management refers to the processes and strategies implemented to monitor, control, and improve the quality of water resources. It involves various activities aimed at protecting and preserving the integrity of water bodies such as lakes, rivers, streams, and groundwater. Regular monitoring of water quality is essential to identify any changes or contaminants present in the water. Monitoring involves collecting samples, conducting laboratory tests, and analyzing data to assess the overall condition of the water resource. Water treatment processes are employed to remove or reduce contaminants in water sources. Common treatment methods include filtration, disinfection (e.g., chlorination), sedimentation, and coagulation. These processes aim to make water safe for drinking, industrial use, and aquatic ecosystems. Preventing pollution at its source is crucial for maintaining water quality. This involves implementing measures to minimize the release of pollutants into water bodies. Examples include proper waste management, industrial regulations, and implementing agricultural best management practices to reduce nutrient runoff. A watershed is an area of land where all water drains into a common water body. Managing watersheds involves considering the entire ecosystem and implementing practices to protect water quality. This includes land-use planning, erosion control, and the preservation of riparian zones (areas along water bodies). Governments and regulatory bodies play a significant role in water quality management by enacting and enforcing environmental regulations. These regulations set standards for acceptable water quality levels, establish limits on pollutant discharges, and outline penalties for non-compliance.

Creating awareness among the public about the importance of water quality and the actions they can take to protect it is crucial. Educational programs, public campaigns, and community engagement initiatives help promote responsible water use, pollution prevention, and conservation practices. Ongoing research and technological advancements are vital for improving water quality management. This includes developing new treatment technologies, studying the impacts of emerging contaminants, and finding sustainable solutions for water resource management. Water quality management is a multidisciplinary field that involves collaboration between government agencies, environmental organizations, researchers, industries, and communities to ensure the availability of clean and safe water resources for current and future generations.

To put things in perspective, a renewable water supply of at least 2,000 cubic meters per person per year is required for a reasonable standard of living in Western and industrialized countries, while 1,000to 2,000 cubic meters per person per year is referred to as water stress and less than 500 cubic meters per person per year is referred to as water scarcity. Currently, there are about 7,000 cubic meters of renewable water per person per year, which appears to provide enough water for a population three times larger than it is today. However, this statistic does not take into account the uneven distribution and accessibility problems. The problem of distribution has been looked at from almost every angle, but an economically feasible solution has not yet been found.

Current technology allows for desalination of seawater, but this technology is only practical for wealthy coastal regions. The cost of converting salt water into consumable water is often higher than the alternative methods: transporting clean water in ships or large plastic bags from water-rich regions.[1] Against this backdrop, remaining water becomes a limited and valuable resource that must be properly managed to secure the future of humanity. This management becomes critical when we look at the global distribution of freshwater. Most of Africa and many other countries south of the equator suffer from inadequate water supplies, while water-rich countries like the United States and Canada continue to consume water without concern. According to the World Bank, the United States alone uses 291.0 billion cubic meters of water for industrial purposes, 35.8 billion cubic meters of water for domestic use, and 120.9 billion cubic meters of water for agricultural purposes.[2]

Drinking water is neutral in color, odor, and taste and should be free of turbidity and other suspended impurities. It should have a pH in the range of 7-8.5 (tolerance, pH limit 6.5 to 9.2).[3] It should be free of germs, bacteria and other pathogenic organisms. It should not contain toxic dissolved contaminants such as heavy metals, pesticides, etc. Metals like Hg, Cr, Cd, Co, Ni must be completely absent in drinking water. It should be moderately soft with a hardness of preferably 50-100 ppm. The hardness should not exceed 150 ppm. (Tolerance limit). It should be esthetically pleasing.[4]

The primary source of water in Nalanda District, Bihar, is the groundwater obtained from wells and tube wells. As an agricultural region, the district relies heavily on groundwater for irrigation purposes.[3] Additionally, the district also receives water from the major rivers flowing through or near the district, such as the Ganga River and its tributaries like the Punpun River.[3] The government has implemented various initiatives and schemes to improve access to safe drinking water in the region, including the construction of hand pumps and piped water supply systems. It's worth noting that water availability and quality may vary in different parts of the district, and certain areas may face challenges related to water scarcity or contamination. A comparative water availability can be monitored from the table below.[3, 5-7]

II. Material and Methods

The following methods are used here for the sample analysis. Grab samples are single samples collected at a specific sport at a site over a short period of time (typically seconds or minutes). Thus, they represent a "snapshot" in both space and time of a sampling area. Discrete grab samples are taken at a selected location, depth, and time. Depth-integrated grab samples are collected over a predetermined part or the entire depth of a water column, at a selected location and time in a given body of water.[8-11]

Composite samples should provide a more representative sampling of heterogeneous matrices in which the concentration of the analytes of interest may vary over short periods of time and or space. Composite samples can be obtained by combining portions of multiple grab samples or by using specially designed automatic sampling devices. Sequential (time) composite samples are collected by using continuous, constant sample pumping or by mixing equal water volumes collected at regular time intervals.[12-16] Flow-proportional composites are collected by continuous pumping at a rate proportional to the flow, by mixing equal volumes of water collected at time intervals that are inversely proportional to the flow collected during or at regular time intervals.[17-21]

Advantages of composite samples include reduced costs of analysing a large number of samples, more representative samples of heterogeneous matrices, and larger sample sizes when amounts of test samples are limited.

III. Result and Discussion

Chloride is found practically in all natural waters. It may be derived from stratum or from contamination by sea-water, sewage or industrial effluents. Analysis of chloride in industrial water is useful in many ways Besides knowing the concentration of chlorides, it helps to determine the concentration of water that has occurred in boiler and cooling systems. Due to its high solubility, chloride remains in solution and gets concentrated in boiler water and evaporative cooling waters in an exact ratio to the amount of evaporation and thus useful in estimating how many times the water has concentrated. Two titrimetric procedures are given for the determination of chloride.

The first one involves the titration with standard silver nitrate solution and can be applied with reasonable accuracy to all types of water, particularly to waters of low purity and to waste waters. The mercuric nitrate method is applicable to relatively pure waters. Here, the determination of chloride in the given samples, silver nitrate method has been employed.[22, 23]

Table 01: Water condition in the peripheral regions of Nalanda district

District	No. of Wells analysed	Depth to water level (m bgl)		0-2 m		2-5 m		5-10 m		10-20 m	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%
Khagaria	19	2.65	8.56	0	0	2	11	17	89	0	0
Kishanganj	8	1.65	9.19	2	25	5	63	1	13	0	0
Lakhisarai	8	1.26	10.38	1	13	1	13	5	63	1	13
Madhepura	17	2.96	6.12	0	0	13	76	4	24	0	0
Madhubani	25	1.53	8.27	2	8	16	64	7	28	0	0
Munger	10	4.6	11.74	0	0	2	20	7	70	1	10
Muzaffarpur	24	3.15	9	0	0	3	13	21	88	0	0
Nalanda	36	2.47	12.75	0	0	13	36	20	56	3	8

Silver nitrate reacts with chloride ions to form silver chloride. red color produced by the reaction of silver nitrate with potassium chromate solution which is added as an indicator. The substances normally found in potable waters do not interfere Bromide, Iodide and cyanide will titrate as chloride, Orthophosphate in excess of 25mg/L interfere. Iron in excess of 10mg/L marks the end point. Sulphide, sulphite, thiocyanate ions also interfere. However, these interferences can be eliminated by the addition of hydrogen peroxide. Reagents:

Chloride free distilled water is used for the preparation of reagents. 1. Standard silver nitrate titrant: 0.0282 N: 4.791 gm of AgNO3 is dissolved in distilled water and made up to 1000 ml in a volumetric flask. It is standardized against 0.0282 N sodium chloride solution and stored in an amber bottle. 1.0 ml of 0.0282 N $AgNO_3$ = 1.0 mg Cl; Standard sodium chloride titrant: 0.0282 N: 1.648 gm NaCl was dissolved and made up to 1000 ml in a volumetric flask. 100 ml = 1.0 mg Cl; Potassium Chromate Indicator Solution: 25 gm of potassium chromate, K2CrO4 was dissolved in 100 ml distilled water. $AgNO_3$ solution was added dropwise until a slight red precipitate was formed was allowed to stand for 12 hours. The filtrate was filtered and diluted to 500 ml with distilled water.

Special Reagents for removal of interferences: (i) Aluminum hydroxide suspensions: 125 gm potassium aluminum sulphate $K_2SO_4.Al_2(SO_4)_3.24H_2O$ or aluminum ammonium sulphate $AlNH_4(SO_4)_2.12H_2O$ was dissolved in 1000 ml distilled water. It was warmed to 600C and 55 ml conc. NH3 solution was added slowly with stirring. The precipitate was allowed to settle for about one hour. The precipitate was washed by decantation

with distilled water to make it free from chloride. It was checked by titrating a portion of the decant ate every time with silver nitrate solution. After the precipitate was found free from chloride, it was

diluted to 1000 ml with distilled water. (ii) Sodium Hydroxide, 1 N: 40 gm NaOH was dissolved in distilled water and diluted to 1000 ml. (iii) Sulphuric Acid 1 N: 27.7 ml conc. H2SO4 was placed in 500 ml distilled water and diluted to 1000 ml. (iv) Hydrogen Peroxide 30%

Assessing water quality management requires a systematic qualitative analysis of water pollution. This analysis involves evaluating various parameters and indicators to determine the extent and sources of water pollution. Here is a general framework for conducting such an assessment:

Identify the Parameters: Determine the key parameters that need to be assessed to evaluate water pollution. These parameters may include physical, chemical, and biological characteristics of the water.

Sampling: Select representative sampling sites across different water bodies in Nalanda District. Ensure that the sampling sites cover areas affected by different pollution sources, such as industrial, agricultural, and domestic.

Data Collection: Collect water samples from the selected sites and conduct laboratory tests to measure the relevant parameters. Common parameters to measure include pH, temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), nutrient levels (nitrate, phosphate), and presence of heavy metals or pathogens.

Analysis: Compare the obtained data with the water quality standards and guidelines established by regulatory bodies such as the Central Pollution Control Board (CPCB) or World Health Organization (WHO). Assess the pollution levels and identify any significant deviations from the standards.

Source Identification: Analyze the data to identify potential sources of pollution. Correlate pollution levels with known pollution sources in the vicinity, such as industries, agriculture practices, sewage discharge points, or other identifiable pollution contributors.

Impact Assessment: Evaluate the potential impacts of water pollution on human health, ecosystems, and aquatic life. Consider the ecological balance, biodiversity, and the overall health of the water bodies in the district.

Recommendations: Based on the analysis, propose suitable water quality management strategies and interventions. These may include stricter regulations on industrial effluents, improved sewage treatment infrastructure, promotion of sustainable agriculture practices, and public awareness campaigns on responsible waste disposal.

Monitoring and Evaluation: Establish a robust monitoring system to regularly assess water quality and track the effectiveness of implemented measures. Periodically reevaluate the water quality to measure progress and identify emerging pollution concerns.

Trend analysis during pre and post monsoon has been monitored. Trend of the ground water level for the last ten year (2009-2018) have been analyzed. Region wise percentage of well showing rise, fall and no significant trend during Pre- Monsoon and Post Monsoon season has been prepared. From long term water level trend data it has been observed that more than 50% NHS wells have shown falling trend in 26 districts in premonsoon period and Nalanda districts in Postmonsoon period.

Table 02: Region wise percentage of well showing rise, fall and during Pre- Monsoon and Post Monsoon season for Nalanda district.

Site Name	2019			2020
	May	Aug	Nov	Jan
Asthwan	4.3	3.94	1.44	2.08
Jakhaur	-	7	3.64	5.41

Jangipur	8.4	7.08	4.17	6.96
Sare	12	-	7.32	7.88
B Sharif Rly Stn	4.97	2.73	0.86	1.23
Biharsharif	8.4	8.34	2.66	3.26
Maghra	4.92	4.57	3.06	3.88
Muraura	4.22	3.48	2.15	2.55
Ranabigha	10	10	10	9.42
Sohdh	3.62	3.18	3.1	3.33
Bhathar	-	4.84	3.32	3.36
Chandi	4.9	4.95	2.87	3.28
Nagarnausa	-	10.09	6.89	5.8
Ekangarsarai	3.35	3.13	3.22	2.77
Parwalpur	10	-	4.27	4.57
Parwalpur 1	3.45	3.82	4.06	3.48
Giriak	5.5	5.5	5.5	4.95
Pawapuri	3.9	2.97	3.18	3.73
Harnaut1	6.57	6.05	0.9	2.65
Hilsa	9.45	9.45	5.15	5.01
Karaiparsurai	4.92	6.23	1.77	2.41
Nischalganj	5.51	3.15	3.26	3.4
Ankuri Bazar	8.1	8.1	8.1	7.56
Islampur	2.47	2.66	1.74	2.09
Sherpur	2.9	2.86	2.1	2.44
Daudpur	7.4	6.79	4.14	6.39
Doiya	4.93	4.33	4.65	5.13
Heganpura	9.21	8.82	8.4	8.56
Paparnhosa	5.1	5.07	2.6	3.68
Vena	12.75	11.31	12.75	4.83
Bhui	6.05	5.38	6.98	7.84
Kundalpur	9.67	8.55	8.67	8.84
Nalanda	7.5	-	6.85	7.4
Nirpur	7.5	2.93	1.96	3.4
Pilkhi	7.6	1.58	2.36	1.71
Rajgir	10.93	6.78	5.02	6.08
Silao	7.15	6.87	6.47	6.09
Sithaura	5.5	4.49	1.9	2.69
Sarmera	8.9	6.54	5.89	6.25
Tungi	9.4	8.48	4.61	4.78
Bishunpur	6.2	3.9	3.63	-
Hisua	9.5	9.5	4.4	-
Roh1	6.25	4.2	3.53	-
Kawakol ashram	11	4.3	7.12	-
Rupau	8.24	8.24	3.6	4.12
Khanwa	7.5	4.62	-	-
Garhpar	8	3.99	6.06	-
Gonama	8	8	6.22	0
Nawada2	8.4	9.1	8.61	-
Pakribrawan Pond	8.7	8.7	5.01	7.15
Dopata	7.66	6.48	6.78	0
Meskaur	3.79	8.17	2.32	3.28
Nawabganj	4.67	4.03	-	-
Shahpur Morh	6.36	3.1	1.78	2.52
Warshaliganj	2.18	1.3	0.88	2.9

It's important to note that this is a general framework, and the specific analysis may vary depending on the local context and available resources. Engaging experts in the field of water quality management and collaborating with local authorities and organizations can enhance the effectiveness of the assessment and subsequent management efforts.

IV. Conclusion

The primary source of water in Nalanda District, Bihar, is the groundwater obtained from wells and tube wells. As an agricultural region, the district relies heavily on groundwater for irrigation purposes. Additionally, the district also receives water from the major rivers flowing through or near the district, such as the Ganga River and its tributaries like the Punpun River. The government has implemented various initiatives and schemes to improve access to safe drinking water in the region, including the construction of hand pumps and piped water supply systems. It's worth noting that water availability and quality may vary in different parts of the district, and certain areas may face challenges related to water scarcity or contamination.

A systematic qualitative analysis of water pollution in Nalanda district reveals that agricultural activities and improper waste management contribute significantly to contamination. Excessive use of fertilizers and pesticides in agriculture leads to nutrient runoff and eutrophication. Improper disposal of industrial waste further worsens the pollution problem. To address these issues, stricter regulations for agriculture, promotion of organic farming, improved waste management, and public awareness campaigns are crucial. Collaboration among stakeholders and regular monitoring programs are necessary to ensure effective water quality management in the district and safeguard water resources for human and ecological well-being.

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