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Evaluation of Domestic Wastewater Quality Regarding Physico-chemical Parameters at Agra City, U.P., India

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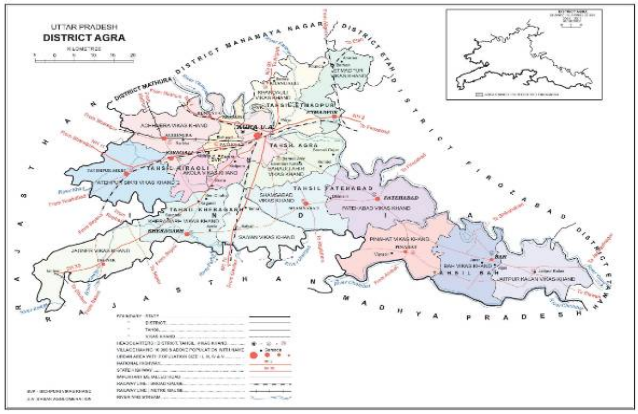
ABSTRACT

Pollutants from many different categories, such as domestic, industrial, and agricultural waste, infiltrate water resources all over the world, lowering the quality of the water. Similarly, one of the main problems at many locations in India is the lack of fresh water, which calls for human attention to sustainable water conservation. Domestic wastewater is divided into two main categories greywater and blackwater. In this study, we focused on the parameters of greywater. Greywater is the waste product of all home water consumption excluding toilet flushing. Even though it frequently makes up the majority of the domestic wastewater, it contains less pollution. The burden on the need for freshwater may be greatly reduced by recycling and reusing treated greywater for non-potable uses. This article summarizes the findings of an inquiry into the parameters of greywater produced by urban areas of Agra city. Therefore, to assess the current condition of Physicochemical pollutants and their sources in domestic wastewater, a water quality analysis was conducted for household wastewater in the city of Agra. Different parameters were analyzed that are pH, conductivity, TDS, COD, and BOD. The samples showed the level of the physicochemical parameters within the water quality standards and the possible scope of treatment of waste.

Graphical Abstract:



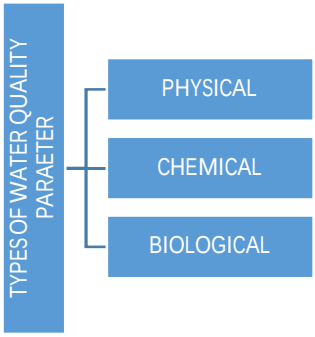
Location of sample collection.

Keywords: Domestic, Wastewater, BOD, Conductivity, COD, TDS, Turbidity, Correlation metrix.

INTRODUCTION

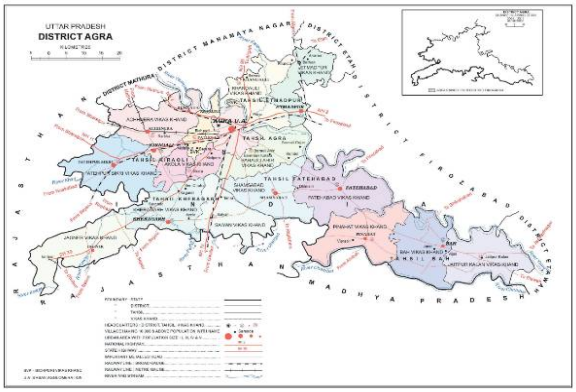
Water, the essential need of all living beings is becoming an important matter of concern in this era as the source of water is getting depleted throughout the world. The rapid growth of the population demands more and more water in all sectors: domestic, agricultural, and industrial [1].Water is a prime need for human survival and industrial development [2]. Increased demand in water supply with improved living standards, unplanned urbanization, groundwater extraction, surface water pollution, water-intensive agriculture, and industrialization are contributing depletion of future fresh water supply globally. In India also, the crisis of water is a big issue as millions of people do not have access to sufficient, safe fresh water for drinking and sanitation purposes. So, the conservation of water is an important matter of concern. When it comes to the occurrence and abundance of species, physicochemical characteristics are crucial. Water can be divided into two groups according to its source: surface water and groundwater [3]. Numerous contaminants, such as lubricants, pesticides, fertilizers, heavy metals, and toxic substances, can expose both types of water to contamination threats during agricultural, industrial, and residential operations [4]. The four classifications of water quality are drinkable, palatable, contaminated (polluted), and infected [5]. One of the promising steps for conservation of water is the treatment and reuse of wastewater [6-8]. By reusing wastewater for non-potable purposes such as toilet flushing, floor washing, car washing, garden irrigation, etc. [6], it is possible to reduce the demand for freshwater to some significant extent; otherwise, a lot of water is getting lost after a single use. Advancements in technology have boosted the human population and also enhanced water use and simultaneously put the burden on the existing water bodies to fulfill the industrial, agricultural, and domestic use of water; which is said to be an unending process of development [9]. Depending on usage, age, and the number of family members, household wastewater qualities change. The various qualities of domestic wastewater produced are also influenced by the chemicals utilized by a particular household. The bathroom's wastewater production includes a variety of shampoos, soaps, body care items, etc. Wastewater from laundry contains a variety of detergents in high concentrations. Sink Soap, toothpaste, and other products all contribute to wastewater. Kitchen sink wastewater contains a lot of food particles, oil, and other substances [10]. To the best of our knowledge, less research has ever been done on the water quality characteristics, specifically domestic wastewater, in the urban region of Agra (India). To determine the quality of the domestic waste water, it is important to research the examination of water quality in Agra, India. To establish the water quality for domestic use, this study attempts to identify the physicochemical parameters of domestic wastewater in Agra (India) and compare the results with standards. This study, investigated the amounts of pollutants in domestic wastewater from five different household sources.

Types of water quality parameters: The physical, chemical, and biological properties of water are what determine whether or not it is suitable for industrial, agricultural, or human consumption [11,12].The three types of water quality parameter are physical, chemical, and biological components [15, 16].



MATERIALS AND METHODS

Study area: In the western region of Uttar Pradesh, the Agra district is located between 27.11′ degrees latitude north and 78.0′ to 78.2′ degrees longitude east. 169 meters is its altitude above sea level. Its boundaries are as follows: Mathura District to the north; Dhaulpur District to the south; Firozabad District to the east; and Bharatpur to the west. Situated on the Yamuna River's bank is Agra. Agra experiences summer temperatures reaching up to 45 degrees Celsius, with a minimum of roughly 21.9 degrees Celsius, and winter temperatures reaching up to 31.7 degrees Celsius with a minimum of roughly 4.2 degrees Celsius. The best months to visit are October through March. District of Agra's census indicates that it is 10,863 square kilometers. There are 2,053,844 females and 2,364,953 men in the total population of 4,418,797. There are 15 blocks and 6 tehsils in the Agra district. 690 Gramma Panchayats in total. There are 945 inhabited settlements overall.



Site of sample collection

Parametric method: The physicochemical parameters such as pH, electrical conductivity (EC), total dissolved solids (TDSs), turbidity, biological oxygen demand (BOD), COD, and dissolved oxygen (DO) of the wastewater were tested in this study. All the chemicals and reagents used for the study were of analytical grade and instruments were of limit of precise accuracy. All analyses were carried out using Standard Methods for the Examination of domestic wastewater [**13, 14**]. Investigating the physicochemical characteristics of domestic wastewater from an urban region in Agra City is the goal of this study. Samples of domestic wastewater were taken in Agra city at four distinct places. The outcomes were contrasted with criteria established by WHO and BIS. Seven waste water samples were taken from individual houses from various locations in different parts of the city which were shown in table 1 [**20**].

Table 1. List of locations

S.No.	Place
S-1	Bodla
S-2	Shahganj
S-3	Shashtripuram
S-4	Sikandra
S-5	Khandari
S-6	Raja Mandi
S-7	Sadar

RESULTS AND DISCUSSION

Table 3 displays the correlation matrix for a range of parameters. The degree to which two quantitative variables, X and Y, "go together" is measured by correlation. A positive correlation is present when

high values of X are linked to high values of Y. A negative correlation is present when high values of X are linked to low values of Y. These results were compared with WHO (2006) and BIS (1991) drinking water standard [**18, 19**] and then discussed.

pH: pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity. pH is a measure of the hydrogen ion concentration in water and indicates the acidity and alkalinity of water. The standard values of pH for drinking water by BIS is between 6.5-8.5 while that of WHO standards is between 7.0- 8.5.In the present study all the samples have pH values were 7.1 to 8.3.

Total dissolved solids: Another crucial physio-chemical factor determining the water quality is TDS, which is the concentration of all inorganic salts combined with a little amount of naturally occurring salts that have disintegrated in the water. TDS observed in the study area is found to be between 650 to 1422 ppm. Humans often experience gastrointestinal irritation from greater TDS levels, but chronic consumption of water with higher TDS levels can result in kidney stones and cardiac conditions [**17**]**.**

COD: Showed a minimum value of 300 mg L^{-1} and a maximum value of 834 mg L^{-1} COD test measures the oxygen demand of biodegradable pollutants plus the oxygen demand of non-biodegradable oxidizable pollutants. COD is a water quality measure used not only to measure the amount of biologically active substances such as bacteria but also biologically inactive organic matter in water

Turbidity: The turbidity in the present area of study was found to be between 212-314 NTU.

BOD: BOD is a measure of the amount of oxygen required for the Biological Oxidation of the organic matter under aerobic conditions at 20c and for a period of 5 Days. Basically, BOD is directly related to the extent of pollution of waste water, sewage and industrial effluents [**22, 23**]. Studied in the range from 55 to 76.4.

Temperature: Sample of wastewater showed approximately 33℃ Temperature.

Table 2. Water quality parameters

S.No.	pH	COD	BOD	DO	TDS	Turbidity	Conductivity
S1	7.1	300	55	1.5	650	212	398.4
S2	7.6	685	68	1.2	745	225	390.08
S3	8.2	768	59.41	1.6	865	314	456
S4	7.9	428	62	2.0	966	263	481
S5	8.3	567	52.59	1.5	1038	254	564

DO: In liquid wastes, dissolved oxygen is the factor that determines whether the biological changes are brought about by aerobic or by anaerobic organisms. It is an importance factor in natural water both as a measure of metabolic process of biotic community & indicator of aquatic health. The low DO readings point to organic matter contamination, which suggests that there is some pollution in the water. Concentration of DO varies at all sampling sites and has values varying from 1.2 mg L^{-1} to 2.0 mg L^{-1}.

Electrical conductivity: Electrical conductivity, the measure of the concentration of a total ion in water is the important physio-chemical parameter determining the water quality. EC tells about the capacity of the water to convey electric discharge and higher EC shows enhancement of salts in the groundwater. The prescribed limit by WHO is 750 µS cm^{-1}.

Table 3. Correlation metrics of water quality parameters

S.No.	pH	COD	BOD	DO	TDS	Turbidity	Conductivity
pH	1						
COD	-0.1763	1					
BOD	-0.4713	0.7117	1				
DO	-0.0769	-0.0319	-0.1287	1			
TDS	-0.2397	0.7426	0.6155	0.3245	1		
TURB.	0.1614	0.7462	0.4479	0.2992	0.6999	1	
COND.	0.1394	0.3358	-0.1406	0.5955	0.6437	0.3943	1

Table 4. Statistical analysis of water quality parameters

Parameter	pH	COD	BOD	DO	TDS	Turbidity	Conductivity
Mean	7.642857	652.5714	63.53143	1.571429	996.1429	266.8571	469.0371
SE	0.19983	90.04334	3.302458	0.110657	105.6385	14.93546	27.72781
SD	0.5287	238.2323	8.737483	0.29277	279.4932	39.51552	73.36089
Range	1.4	686	23.81	0.8	772	102	178.17
Min	6.9	300	52.59	1.2	650	212	390.08
Max	8.3	986	76.4	2	1422	314	568.25
CL(95.0%)	0.488966	220.3281	8.080824	0.270767	258.4881	36.54576	67.84751

APPLICATION

There results bring awareness in Public to know level of contamination in domestic wastewater.

CONCLUSION

The study's characterization findings have revealed details on the intrinsic variation in wastewater quality from various houses. Because of its poisonous nature or because of the different pollutants that lower oxygen levels in the water, polluted water has negative and harmful impacts [21]. The properties of the wastewater discovered during this inquiry show that treatment is required before it is disposed of into the environment or used again. Use for non-potable applications is one of them. The correlation matrix of the water quality parameter is given to explain the correlation between various parameters. The purpose of this study is that we can get an actual idea about the level of contamination that is used for treating procedures.

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