Full Paper of the WasteSafe 2025 – 9th International Conference on
Sustainable Solutions for Waste Management in Developing Countries
22-23 February 2025, Dhaka, Bangladesh

IMPROPER WASTE DISPOSAL PRACTICES AND THEIR IMPACT ON WATER CONTAMINATION IN KHALISHPUR, KHULNA: A COMPREHENSIVE STUDY

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ABSTRACT

Inappropriate waste disposal is a major environmental concern for developing countries that leads to significant water quality degradation. Khalishpur Thana in Khulna City is an underdeveloped area in Bangladesh, and the maximum number of inhabitants in this area live below the poverty line. This study assesses the solid waste disposal practices in Khalishpur Thana and how water contamination happens because of improper waste disposal in both the dry and wet seasons. The study involved 50 households from each of the 9 wards in Khalishpur Thana. On average, 62.33% of low-income people dispose of waste illegally in this area. Families with lower incomes dispose of waste inappropriately at a higher rate than high-income families. Water bodies are contaminated by improper disposal of waste by direct dumping or runoff from drains. The study also highlights the consequences of contaminated water to local fisheries, aquatic life, and the people who use the water bodies for domestic purposes. Water quality parameters like P^H, Temperature, Turbidity, Color, DO, BOD_5, COD, TDS, Cl^-, NO^{3-}, TC, and FC were analyzed both in the dry and wet season in the laboratory. By comparing these statistics with the standard value, it is possible to conclude that the water quality of the water bodies in these places is unsuitable for the aquatic environment and domestic purposes.

***Key words**: Waste disposal, Households, Water contaminations, Water quality parameters.*

INTRODUCTION

Improper waste disposal practices have been a rising environmental issue all over the world, particularly in the rapidly urbanized countries. Environmental problems are a global concern. The largest problem facing the leaders of both large and small communities in emerging nations is the solid waste management issue(Geetha & Rajalakshmi, 2020). “There are few certain things in life-death, change and the other is waste.” This event must occur in our life. However, we can prepare ourselves with improved management (Agarwal Professor et al., 2015). Waste generation is a regular issue in urban cities, most significantly from residential units, or manufacturing and processing-based industries. The amount of trash produced in metropolitan areas is largely determined by a variety of factors, including the nature and level of commercial and industrial activities, animal husbandry, the standard of living, and the eating habits of the local population. (Azmain, 2017). Infrastructure for sanitation and wastewater management is one of the major aspects of an urban area that leads to a healthier life(Telmo, 2002). Wastewater overflow is caused by domestic wastewater that discharges without treatment and blockage of drainage during the rainy season causing contaminated water into local drinking water and waterways (Al-Muyeed, 2017; Iribarnegaray et al., 2018; Massoud et al., 2009; Parkinson & Tayler, 2003). Disease transmission, fire hazards, odor nuisance, atmospheric and water pollution, aesthetic nuisance, and economic losses are the most common problems associated with improper management of solid waste (Jilani, 2002).

Due to the everyday use of food, clothing, and other items, a growing nation like Bangladesh produces a significant amount of household garbage, including biodegradable waste, plastic waste, paper and cardboard waste, textiles & wood waste, etc. Large-scale internal rural-urban movement is causing Bangladesh to quickly urbanize, increasing the number of people living in its cities. Major Bangladeshi cities are thus confronted with urban environmental hazards like disorganized solid waste loads and insufficient water supply and sanitation (Ahsan et al., 2015b). One such area is Khalishpur, a densely populated area in Khulna, where waste disposal practices are very poor, and that leads to widespread contamination of the surrounding environment. Khulna is well-known as an industrial city and the third -largest metropolitan city in Bangladesh. In Khulna City, piles of garbage accumulated every day cause enormous public health and environmental hazards. The rapid growth of this City and increased migration of rural and coastal populations affected by natural calamities are the main forces behind the unplanned expansion of the city and deteriorating environmental conditions (Ahsan et al., 2015a). Unplanned expansion of cities is continued in the form of slums and that has further stretched the problems of MSW management. (Ahsan et al., 2005, 2012) studied the composting of organic wastes and medical waste management in Khulna City. Solid waste management is carried out by the city corporation, for which a conservancy fee is also charged to the urban inhabitants. However,the waste management system of Khulna City Corporation (KCC) of Bangladesh is not up to the level. As a part of such an improper management system, the selection of solid waste disposal (secondary) sites for this city does not consider environmental factors. The location of disposal (secondary) sites in this city is the symbol of the unconsciousness about the environmental and public health hazards arising from disposing of waste in an improper location (Kabir & Farzana, 2002).

Due to improper waste disposal practices, the water in the surrounding areas is contaminated. Water quality is threatened most by water pollution (Islam et al., 2015; Mohan et al., 1996; Withanachchi et al., 2018). Wastewater is a matrix consisting of raw sewage from anthropogenic activities (Benit & Roslin, 2015; Mara & Horan, 2003), whereas sewage effluent is defined as treated or untreated wastewater generated from a treatment plant(Communications & Affairs, 1997). People all over the world use the water of ponds and other lentic waters as a traditional water source for different domestic uses, including drinking. Several pollutants like detergents, agricultural pesticides, urban runoff, industries, farmlands, etc have declined the water quality of these water bodies (Hasan et al., 2014). However, chemically pure water is very hard to find in nature(Chandra et al., 2012). Industrial effluent and domestic wastes have been dumped in surface water bodies. As a result, the naturally existing dynamic equilibrium among the environmental segments gets affected, leading to the state of polluted rivers. Geological age and geochemical characteristics are continuously the water bodies like rivers, lakes, and estuaries (Thillai Arasu et al., 2007). Some human activities have changed the dynamic balance in the aquatic ecosystem causing bad taste of drinking water, offensive odors and unchecked growth of aquatic weeds, etc (Thillai Arasu et al., 2007). In recent years, metal contamination in the aquatic environment has attracted global attention owing to its environmental toxicity, abundance, and persistence (Armitage et al., 2007; Sin et al., 2001; Yuan et al., 2004). Eutrophication is caused by excess nutrients in freshwater bodies. Water quality monitoring is the key to the management and conservation of aquatic ecosystems. The physicochemical quality of water within acceptable levels can be conserved by the management of any aquatic ecosystem aiming at the conservation of its habitat (Garg et al., 2010).

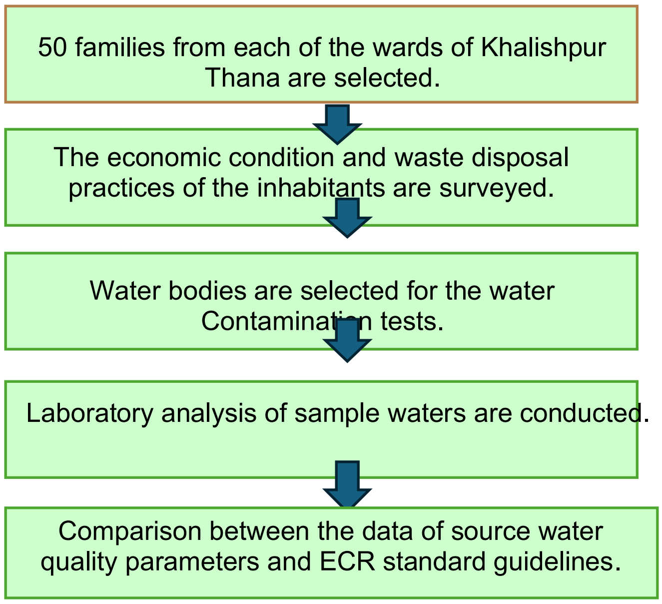
Humans exploited the surface water for several purposes. Surface water can be used as a source of potable water after treatment. It can be served as domestic water without treatment, especially in rural areas. Many freshwater sources have been used as a source of irrigation purposes by farmers, and also as a proper place for harvesting fish. Sometimes It is also a center for tourist attraction. That's why, surface water should be protected from pollution (Edokpayi et al., 2017). Surface water sources can be polluted by wastewater comprising of several microorganisms, heavy metals, nutrients, radionuclides, pharmaceuticals, and personal care products, and that causes severe damage to the aquaticecosystem. These contaminants impact food supplies, taint aquatic resources, reduce the amount of potable water available and raise the cost of purification (Edokpayi et al., 2014).

Khalishpur Thana in Khulna city is located at 22.8492° N, 89.5412° E, and on the banks of the Bhairab river. It has an area of 12.35 km^2. Khalishpur Thana consists of 9 wards. Here, most of the people are living below the poverty line. There were many jute mills in this area. Though some mills were not running in the last few years, most of the people who worked there are still living in this area and doing other jobs. So, as they are not well educated, they don't have enough knowledge about proper waste disposal. That's why the percentage of improper waste disposal is high in this area. People dump the waste at random places and also beside the water body. Moreover, the drainage system in this area is not well established. In the wet season, waterlogging is a common thing. While raining, surface runoff comes into the water bodies along with the waste and pollutes the water bodies. That's why pollution in the water bodies is higher in the wet season.

In this study, the waste disposal practices in Khalishpur Thana are assessed, and how this improper dumping affects the water bodies in this area is measured. The water quality parameters like pH, temperature, turbidity, color, DO, BOD_5, COD, TDS, TSS, Cl^-, NO^{3-}, TC, and FC are measured for testing the water quality of the water bodies in this area.

METHODOLOGIES

For conducting this research, 50 families from each of the wards of Khalishpur Thana are selected. Then, a survey was conducted to learn about their economic condition and waste disposal practices. After that, 5 water bodies are selected across the Khalishpur Thana to find out the contamination of water due to improper waste disposal. The chronological activities of the study are stated below:



50 households from the different locations of each ward were randomly visited, and a questionnaire survey was conducted to know about their socioeconomic status and waste disposal practices. Then, a correlation was found between these two parameters. The people who have limited income have little opportunity to dispose of waste perfectly. Also, they are not concerned enough about its bad environmental effects. Most of the people in Khalishpur Thana are living below the poverty line; that's why the waste disposal practice is deplorable in this Thana.

The classification of the people according to monthly income level((Ibna Rahman et al., 2020)

Table 1 Monthly Income wise categorization

Income Group	Income Range (in BDT)
High Income (HI)	>51,600
Medium Income (MI	20,601 ~ 51,600
Low Income (LI)	<= 20,600

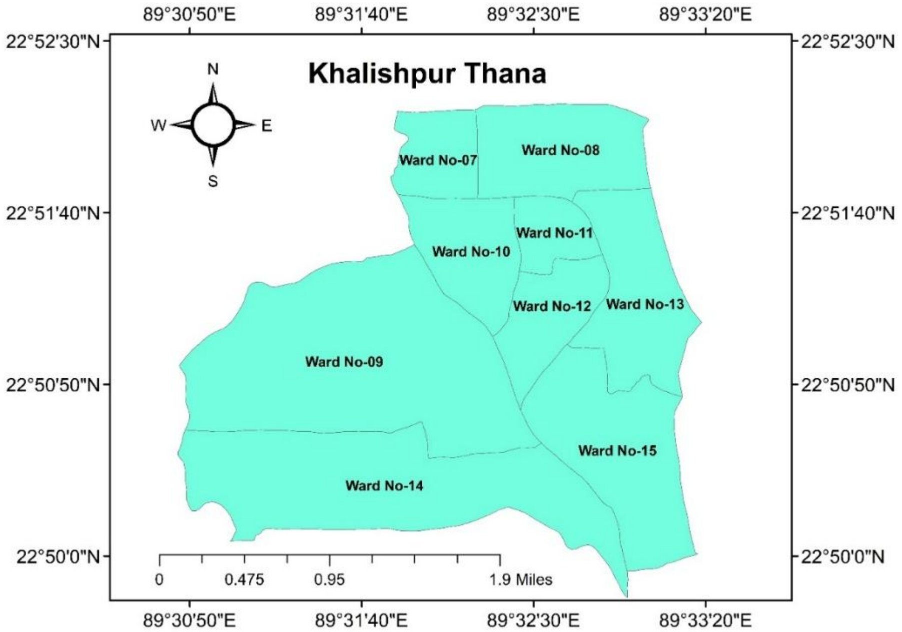


Figure 1 Khalishpur Thana

The location of the water sampling for identifying the impact of improper waste disposal on water bodies-

Table 2 Location of the water bodies

Location	North Latitude	East Longitude
Sample 1	22.85506369502426	89.5396991504282
Sample 2	22.861431578467595	89.53775188574684
Sample 3	22.856351908616983	89.54329845170822
Sample 4	22.85361964295407	89.546515459637
Sample 5	22.84667043106062	89.53872959427957

RESULTS AND DISCUSSIONS

First, 50 households were chosen at random from each ward's various locations, and a questionnaire survey was conducted to know about their economic status and waste disposal practices. The results are stated below:

Table 3 Percentage of economic stratus and waste disposal practices of different income groups in all the wards of Khalishpur Thana

Ward No.	Low income		Middle income		High income	
	Percentage of People (%)	Improper Waste Disposal Practices (%)	Percentage of People (%)	Improper Waste Disposal Practices (%)	Percentage of People (%)	Improper Waste Disposal Practices (%)
7	47	61	41	34	12	16
8	53	68	38	42	9	17
9	41	58	46	35	13	14
10	32	52	48	29	20	13
11	45	57	44	28	11	15
12	58	80	33	47	9	16
13	48	63	42	35	10	14
14	36	57	46	26	18	9
15	51	65	37	33	12	12

As shown in the above table, most people in Khalishpur Thana are either low or middle-income. On average, 45.67% of people are low-income, 41.66% of people are middle-income, and 12.66% of people are high-income. Because there were many jute mills in this area. Though the mills were closed a few years ago, the maximum labor of the jute mills was still living in this area and doing other jobs for their livelihood. It is clear from the table that the waste disposal practices of most of the low-income people living in this area are very poor. On average, about 62.33% of low-income people, 34.33% of middle-income people, and 14% of high-income people dispose of waste illegally. A huge number of low-income people in this area are living in slums. There are very few opportunities for proper waste disposal in slums. That's why most of the low-income people dump their waste in open places and beside the water bodies. In Ward 12, lots of people are living in slums. Because of that reason, the condition of waste disposal is very poor in this area. On the other hand, maximum high-income families have proper waste disposal practices.

Figure 2 Waste disposal in open places

Figure 3 Waste disposal in the water bodies

When dangerous materials accumulate in streams, rivers, lakes, the ocean, aquifers, and other bodies of water, they can contaminate them chemically or biologically, lowering their quality and making them hazardous to people or the environment (Denchak, 2018). A huge number of people in Khalishpur Thana dump their waste beside the water bodies, and that causes serious water pollution. We took the sample water in both the dry and wet seasons from five water bodies and tested the necessary parameters for surface water quality and compared the values with the Water Quality Standards according to ECR, 1997.

ISBN: 978-984-35-7297-4

Table 4 Tested results of the water quality parameters in dry and wet season

No.	Sample ID / Parameters	Sample 1		Sample 2		Sample 3		Sample 4		Sample 5		Water Quality Standards according to
		Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
01	P^H	7.5	8.2	7.9	8.8	6.9	7.7	7.3	8.3	7.4	8.1	6.5-8.5
02	Temperature (°C)	28	24	33	27	29	26	32	28	31	26	20-30
03	Turbidity (NTU)	12	19	15	23	9	13	13	16	11	17	≤10
04	Color (Pt. Co.)	20	24	27	31	18	22	21	26	18	23	15
05	TDS (mg/L)	1230	1153	1832	1978	1215	1135	1332	1233	1444	1289	≤1000
06	DO (mg/L)	5.8	7.2	5.3	6.5	6.1	7.6	5.6	6.8	5.4	6.2	> 5
07	BOD (mg/L)	5.7	8.8	6.8	9.9	4.2	5.1	5..9	7.5	6.3	8.1	≤ 3
08	COD (mg/L)	67	82	72	91	47	59	70	88	65	82	≤ 10-25
09	Chloride (mg/L)	852	748	1057	1167	789	632	787	865	887	812	150-600
10	Hardness (mg/L as CaCO3)	430	378	523	580	356	254	398	345	432	354	200-500
11	TSS (mg/L)	34	45	39	53	31	48	27	43	41	58	≤ 20
12	Ammonia as Nitrogen((mg/L)	1.3	1.7	1.6	2.1	0.8	1.3	1.2	1.7	1.4	1.9	1.2
13	Nitrate (mg/L)	7.9	11.3	8.9	12.4	7.2	10.5	8.2	11.3	9.6	12.2	≤10
14	Phosphate (mg/L)	0.52	0.71	0.76	1.12	0.47	0.66	0.48	0.77	0.38	0.67	≤0.1
15.	Iron((mg/L)	1.17	1.35	1.34	1.68	1.04	1.30	1.27	1.58	1.14	1.64	0.3-1.0
16	TC (col/100ml)	15	23	25	33	17	21	23	26	27	32	≤200
17	FC (col/100ml)	14	22	24	32	16	20	22	25	26	31	≤200

From the above table, it is the condition of these water bodies that is vulnerable because the water quality parameters like Turbidity, Color, TDS, TSS, BOD, COD, chloride, ammonia, Nitrate, Phosphate, Iron are exceeding the permissible value.

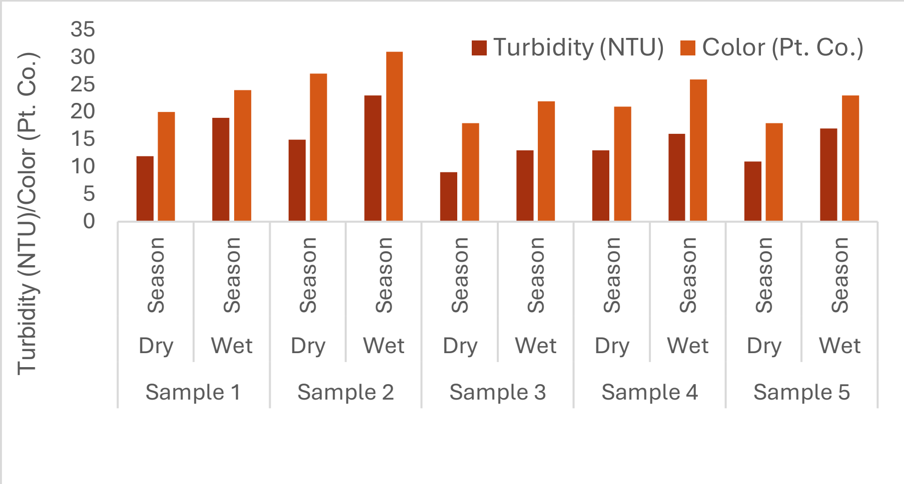


Figure 4 Seasonal variations of Turbidity and color in water body

Turbidity is caused by the solid particles like dirt, silt, clay, algae, plankton, and organic matter that are suspended in a liquid. When the percentage of dissolved organic substances or pollutants is high, that makes the value of color in water high. In the wet season, surface runoff carries the organic substances and pollutants into the water bodies. That increases the suspended and dissolved particles in the water. Moreover, high surface runoff can increase the nutrients in water, which is favorable for algae growth, and leads to an increase in the value of turbidity and color.

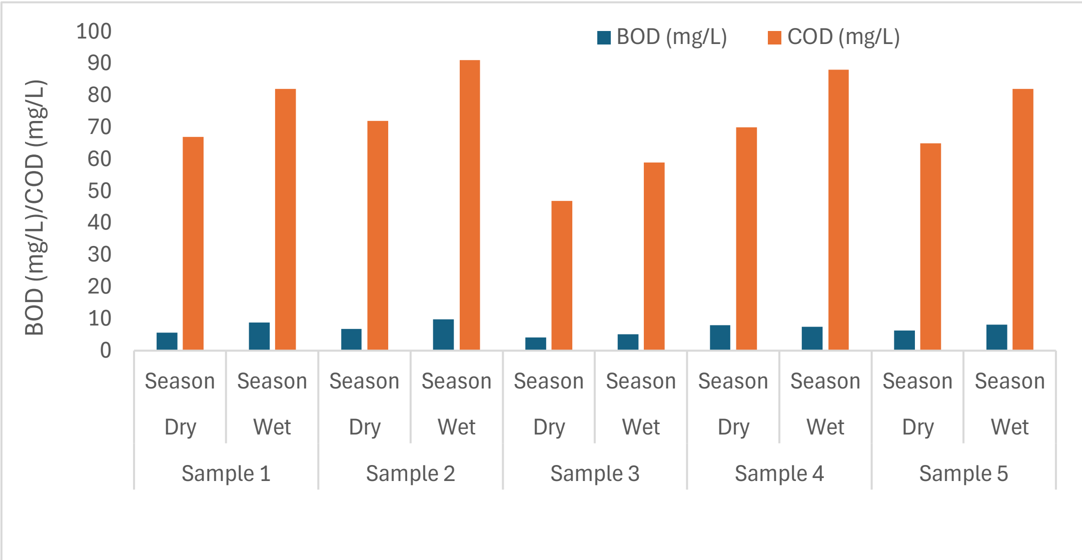


Figure 5 Seasonal variations of BOD, COD in water body

High BOD (Biochemical oxygen demand) means the biodegradable organic substances are present in large amounts in water. Microorganisms consume this organic material by decomposition, which requires oxygen. High COD (Chemical Oxygen Demand) means both biodegradable and nonbiodegradable organic substances are highly present in water. Due to the increased amount of organic matter coming into the water bodies by surface runoff in the wet season, the values of BOD and COD are higher in the wet season.

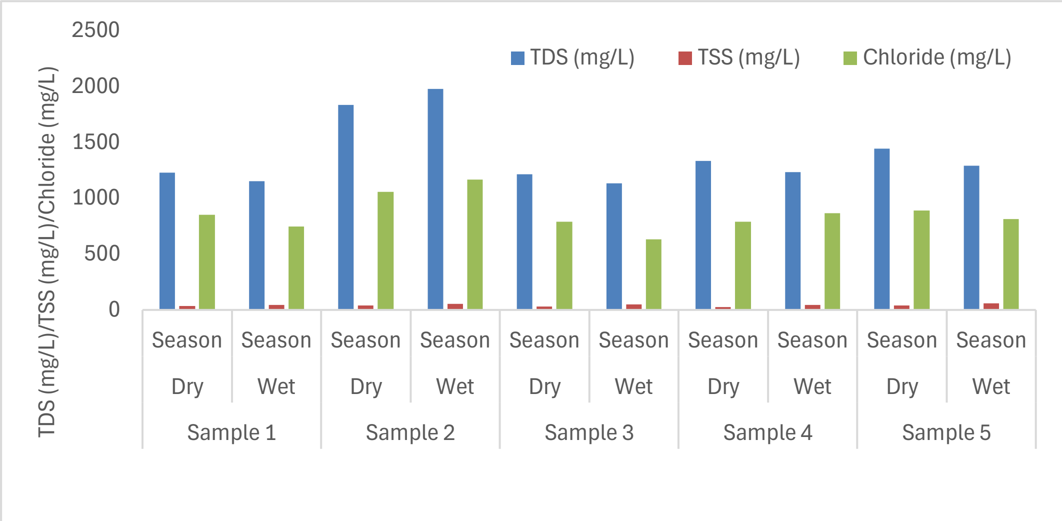


Figure 6 Seasonal variations of TDS, TSS, Chloride in water body

The total dissolved substances in water, including organic and inorganic substances, are referred to as Total Dissolved Solid (TDS). Total suspended solid (TSS) refer to the particles that are suspended in water. In the form of sodium, calcium, and magnesium salts, chlorides are present in surface water. If the chloride levels are high, it indicates that there is water contamination, particularly from salt and chemical pollutants. Due to the dilution. In most cases, TDS and chloride values are lower in the wet season because heavy rainfall brings significant volumes of freshwater to water bodies, and that dilutes the concentrations and lowers their levels.

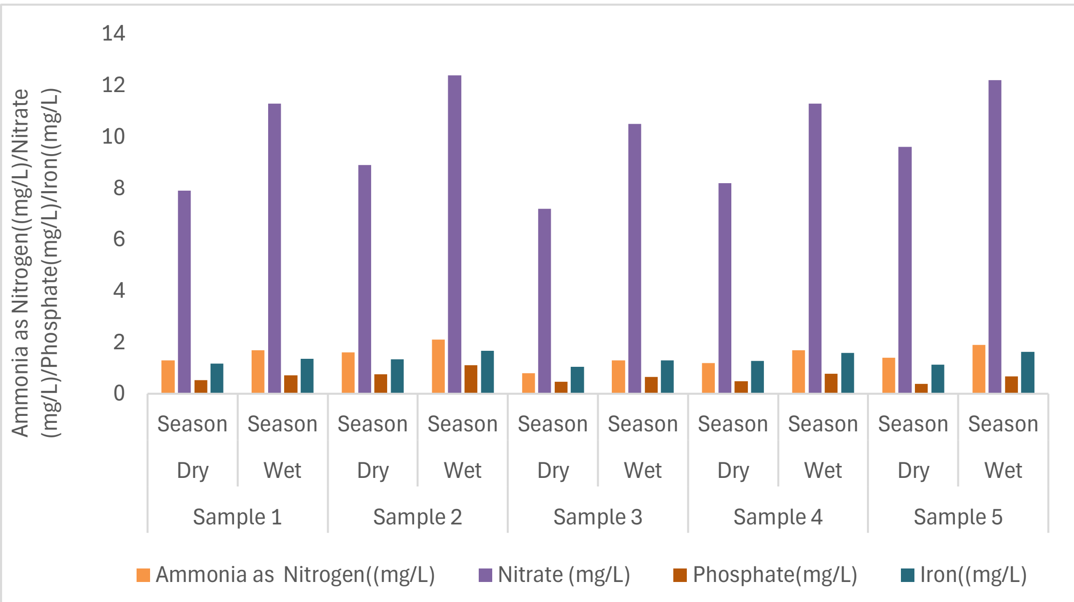


Figure 7 Seasonal variations of Ammonia as Nitrogen, Nitrate, Phosphate, Iron in water body

High ammonia levels are toxic to aquatic life and indicate significant water pollution. High nitrate and phosphate values refer to eutrophication, which leads to algae blooms and a reduction of oxygen levels in water. Excessive iron hampers the growth of aquatic plants and creates anoxic conditions while iron deoxidizes. Due to the increased surface runoff, the waste waters are coming in large numbers in the wet season, and that makes the values higher in the wet season and disrupts the ecosystems, threatening the water usability for humans and wildlife.

CONCIUSIONS

Khalishpur Thana is a low-developing area in Khulna City. Most of the people in this area are not economically well off. Their waste disposal practices are very poor, and that leads to significant water pollution. The final findings of this research are as follows:

- In Khalishpur Thana, on average, 45.67% of people are low-income, 41.66% of people are middle-income, and 12.66% of people are high-income. 62.33% of low-income people, 34.33% of middle-income people, and 14% of high-income people dispose of waste illegally. As there are many slums in this area, the waste disposal practices of most of the low-income people are very poor.
- Sample water was taken from five water bodies in both the dry and wet seasons, and the necessary parameters were tested for surface water quality. It was found that parameters like Turbidity, Color, TDS, TSS, BOD, COD, chloride, Ammonia, Nitrate, Phosphate, and Iron exceeded the permissible value. Most of the parameters are worst in the wet season because of the excess surface runoff carrying the improperly disposed waste of the surroundings.

So, it can be said that the water quality of Khalishpur Thana is very poor and unsuitable for both household purposes and aquatic life.

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