



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 2, February 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

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Environmental Scenario of Tannery Industrial Area in Savar, Dhaka, Bangladesh

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ABSTRACT: The research focuses on the evaluation of pollution particularly wastewater problems on the environment. The objectives of the study include a reconnaissance survey of the area to identify direct and indirect impacts of waste discharge mainly from tanneries and other sources on surrounding environment. The study reveals that the environmental condition of the relocated tannery area is deteriorating day by day due to anomalous emergence of industrial wastes, particularly the liquid waste into the water environment. Through repeated field visit and questionnaire survey, a total of seven different locations (five for surface water samples and two for groundwater samples) have been identified for sample collection and testing. The liquid effluent and solid waste distribution route were also examined. From the test results of the collected samples, high values of chemical organic demand (COD prior to treatment is 2436 mg/L and after treatment is 607 mg/L), Biochemical oxygen demand (BOD₅ is 390 mg/L - 310 mg/L), and color (Color is 2610 Pt-Co to 1422 Pt-Co), Pb (0.1 to 0.23 ppm), Cr (0.36 to 1ppm) etc. have been observed. The results of questionnaire survey reveal that about 58% people work for 10 to 12 hours, the range of the salary stream 350 BDT to above 650 BDT, about 27% people suffer from skin disease and 30% suffer from diarrhoea, about 82% people showed their dissatisfaction of the relocation of tannery industry in Savar. Due to the heavy pollution load, aquatic life already been wiped out from the Dhaleshwari River as was happened as with the former river Buriganga. Environmental pollution problems of the tanneries must be addressed at the source. A sustainable approach should be taken to minimize the adverse effects of tanneries.

KEYWORDS: Wastewater, Pollution, Environment, Tannery.

I. INTRODUCTION

The tannery industry belongs one of the most polluting industrial sectors. Almost every tannery uses significant amounts of chemicals in the process of transforming animal hides into leather (Dargo H, 2014 & Chowdhury M. *et al.*, 2015). In Bangladesh, about 90% of tannery industries are engaged in the chrome tanning process because it is simple in operation and renders excellent properties to the leather (Chowdhury M., *et al.*, 2013 & Chowdhury M. *et al.*, 2015). Most of the tanneries do not have proper effluent plants and generate 20,000 m³ tannery effluent and 232 tonnes solid waste per day (H. L. Paul *et al.*, 2014). Tannery effluents carry heavy pollution loads due to a massive presence of highly coloured compounds, sodium chloride and sulphate, various organic and inorganic substances, toxic metallic compounds, different types of tanning materials which are biologically oxidizable, and large quantities of putrefying suspended matter (Akan JC *et al.*, 2007 & Khan SR *et al.*, 1999). 255kg of finished leather (grain and embossed split) is obtained for every 1000 kg wet salted hides processed, i.e., just 25.5% of the raw material becomes finished leather. Around 40 m³ of water (process and technical water) is required for this and out of 452 kg of process chemicals used only 72 kg are retained in and on the leather thus, 380 kg are wasted and discharged in various forms (H. L. Paul *et al.*, 2014 & Chowdhury M., *et al.* 2015). According to a recent estimate, about 60,000 tons of raw hides and skins are processed in these tanneries every year, which release nearly 95,000 litres of untreated effluents into the open environment daily (Azom *et al.*, 2012), and which is going to resulting into the dead river Dhaleshwari like Buriganga. Several reports show that beam house process effluents contain high concentration of total solids (Gupta PK, 2003; Junior H *et al.*, 2006; Bajza Z., 2001). In the report of blacksmith institute 20% of the large number of chemicals used in the tanning process is absorbed by leather, the rest was released as waste. Due to lack of proper management facilities the tannery waste creates environmental pollution day by day (Azom *et al.* 2012).

Though being of the new area quite enough pre-planned, the right way they are not properly following pertinent to solid and liquid wastes disposal direct to the vicinity and open area. Thus, after being installation of CETP [Figure 2(d)], it could not go through as it was supposed to have. The lack of effective implementation of legislative control, poor

processing practices and use of unrefined conventional leather processing methods have further aggravated the pollution problems (Chowdhury M. et al., 2015). During study it was also found that the solid wastes were dumped in open places and were burned openly [Figure 1(b & d)]. Thus, the vegetative cover is harmed and affecting the aquatic biology. The tannery effluent damages the normal life of the receiving water bodies [Figure 1(a)]. The direct discharge of these wastes has contaminated the ground and surface water with dangerously high concentrations of BOD, COD, Cr, Pb as well as CO₂, Color, and alkalinity, hardness etc. With suggesting possible mitigation measure the main theme of this research was to find out the environmental impact assessment (EIA) of surroundings sources of pollution regarding vitiation of the environment due to disposal of tannery effluent to the immediate vicinity. Tannery discharge to marshy land causes sever diseases for instance dermatology, gastrointestinal and other disorders etc.

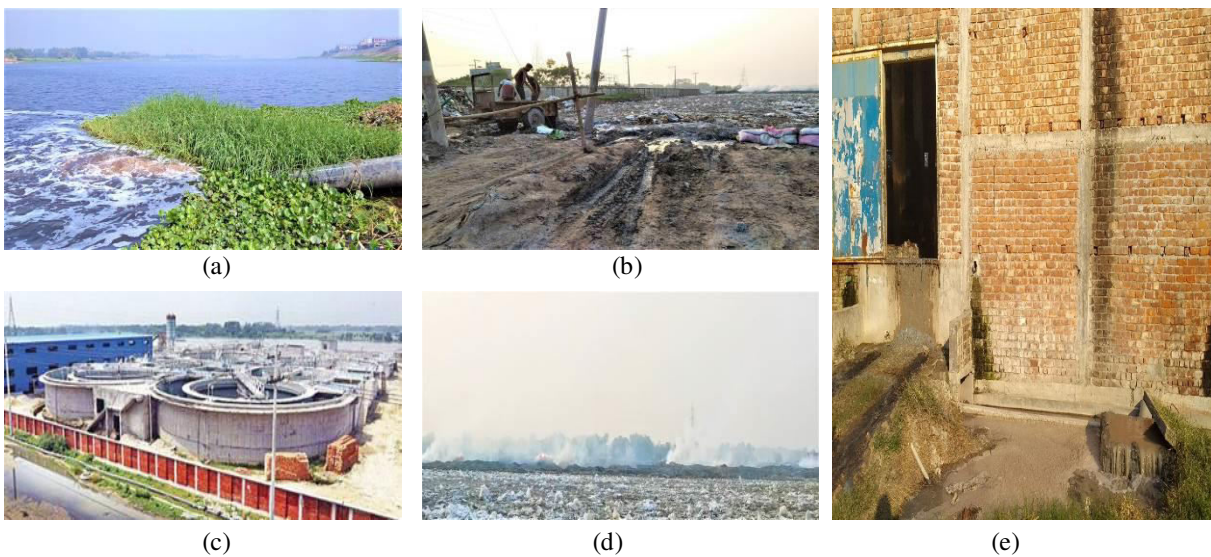


Fig. 1: Photographs Presenting: (a) A view of wastewater outfall into the river side; (b) Cattle ears, noses and other unimportant are shifting from tannery to last corner south-west part of the estate nearby the river; (c) Needless pieces of tannery effluents are burnt in open place that creates severe air pollution; (d) The CETP in Saver Tannery Industrial Estate, & (e) The liquid waste emanating directly from the tannery

II. METHODOLOGY

The study assesses the quality of water surroundings to Savar Tannery Industrial Park, the water which emerges from industries that direct to the adjacent water bodies throughout the stream [Figure 1(a)] including finding out the effect on groundwater due to developing the tannery industrial park as well as determining the neighboring environmental pollution over the study area [Figure 1(a, b & c)]. With due questionnaire survey over there in study area, the potential pronouncement has been established after the data relevant to measuring the disparate of pollution awareness.

Study Area

The Savar Leather Industrial Estate comprising former Char Narayanpur and Bakchar area alongside the Dhaleshwari River and close to the Jhauchar area, Hemayetpur, Savar, Dhaka. The newly relocated park is 20 kilo meters away west-south of Dhaka city. The park territory is proximate to a regular rectangular shape as it was a planned industrial area [Figure 2(a)]. It lies on the east embankment of Dhaleshwari River and 1.5 km away west to the Jhauchar local market [Figure 2(c)]

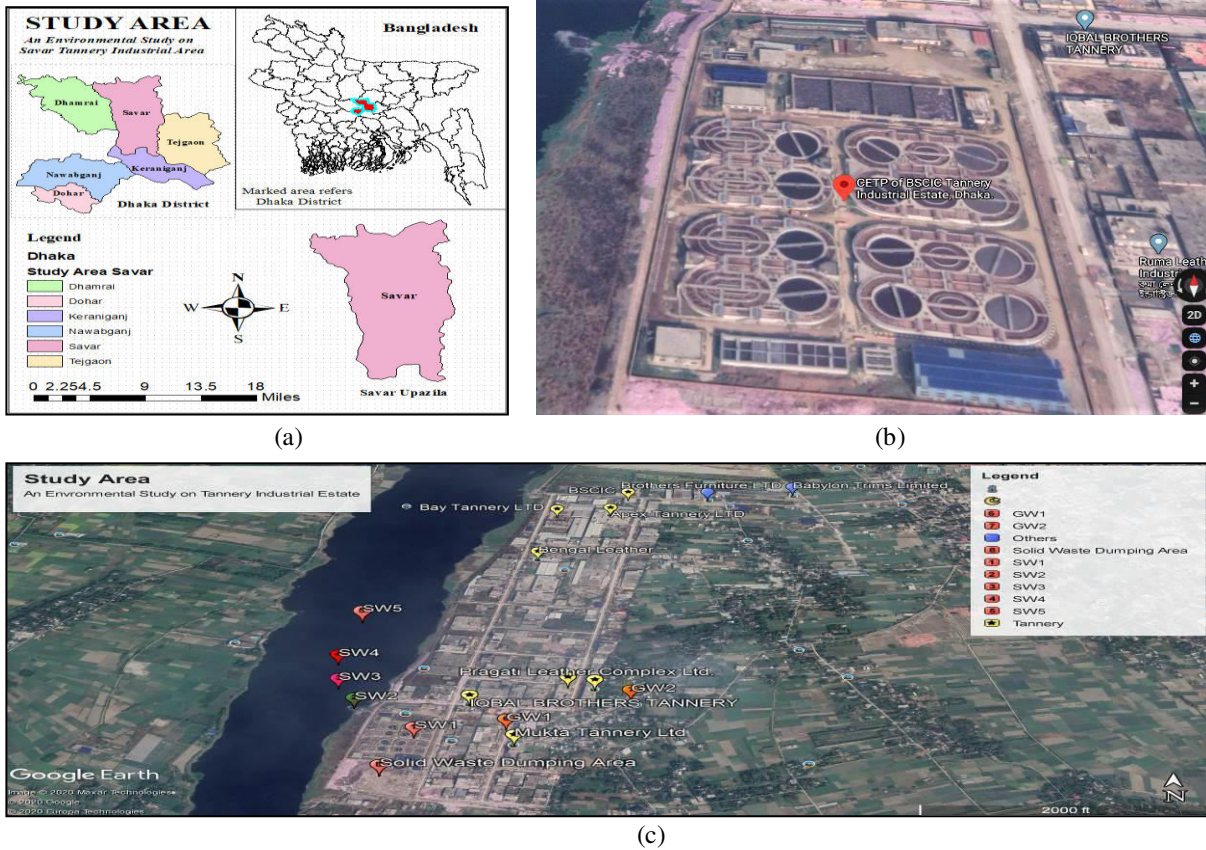


Fig. 2: Fig. Showing: (a) An ArcGIS map of the study area, (b) The CETP of BSCIC Tannery Industrial Estate Savar, Dhaka & (c) The study area (Savar Tannery Industrial Park).

Sample Assembling

The tests were led in the period from August 2019 to February 2020. During that time the industrial estate has been scrutinized several times for collecting samples to meet the different tests. Samples were retrieved from a similar point over and over again. Two types of water have been collected, [1] Surface Water (SW) & [2] Ground Water (GW). Water sample collection locations are shown in Table 1. The sample had been handled like the way that no significant changes get to come along in the composition prior to meet the test in the laboratory.

Table 1: Global Positioning System data of the sampling locations.

Types of Water & Sample No.	Mapping Point	Latitude(N)	Longitude(E)
Surface Water	Sample No. 1	SW ₁	23°46'29.51" N 90°14'25.42" E
	Sample No. 2	SW ₂	23°46'34.04" N 90°14'20.08" E
	Sample No. 3	SW ₃	23°46'37.24" N 90°14'18.33" E
	Sample No. 4	SW ₄	23°46'41.28" N 90°14'17.75" E
	Sample No. 5	SW ₅	23°46'48.91" N 90°14'18.82" E
Ground Water	Sample No. 6	GW ₁	23°46'30.69" N 90°14'32.66" E
	Sample No. 7	GW ₂	23°46'35.22" N 90°14'42.64" E

Preliminary Survey, Industry Scrutiny & Questionnaire Survey

To come up with the whole activity regard to leather processing to finished leather and how the worker work through, which machines are used for, how many chemicals have been used with as well as their quantity and timing for mixing with including the types of pollutants generated in leather processing, types of instruments used for including the unremitting time for completing any task and types of protections the worker has got while operating themselves through the whole process, it was chuckle scope scrutinized two leather industries, [A] Apex Tannery Ltd. & [B] Bay



Tannery Ltd. The survey program was laid for 14 working days in November 2019. The whole area was screened through the vehicle first. Then the main tanneries were toured to catch variant activities [Figure 1 (b & c)]. Then the area beside the embankment including the way local people living there and the real-life scenario were screened. People were enquired several questions to experience their living conditions, environmental consciousness, and so on. Seven precise interrogations were designated for the people of the locality. About 100 people were selected randomly for the survey.

III. EXPERIMENTAL RESULTS

The physio-chemical parameters of the composite tannery effluents and the standard limits in years 2019 to 2020 have been speculated by Environmental Conservation (ECR) Rules / Act, 1995/1997.

pH, Temperature, Odor & CO₂

The GW samples is within the bearable range 6.5 to 8.5. Also, water at SW₁ is 10.2 which is high compared to the range of 6.0 to 9.0. The likely reason is that CO₂ is dispelled by aeration causing a rise in pH value. And what more, pH values of SW meet other guidelines as well. All samples were about to malodor (Table 2). But it could not take a firm stand beingness of H₂S which is a natural by-product of anaerobic digestion, which gives off a strong, nauseating smell. Due to its low solubility in wastewater, it is released into the atmosphere, producing an offensive odor. Every samples being temperature below guideline is the manifestation of eco-friendly. Exposure of CO₂ released into the river then to the ocean because of water pollution by nutrients a major source of this greenhouse gas. Dumping greenhouse gases into the atmosphere makes the atmosphere more humid. And since water vapor is itself a greenhouse gas, the increase in humidity amplifies the warming from Carbon-di-oxide.

Table 2: Coalescence of Lab test report of various parameters.

Parameters	ECR 1997 Standards		Surface Water					Ground Water	
	Drinking Water	Surface Water	Mapping Point [Fig. 1(c)]					GW ₁	GW ₂
			SW ₁	*SW ₂	SW ₃	SW ₄	SW ₅		
pH	6.5 – 8.5	6 – 9	10.2	7.7	7.6	7.9	7.8	7.2	7.1
Temperature	20 - 30	40 - Summer	25±1	25±1	25±1	25±1	25±1	25±1	25±1
Odor	Odorless	-	Severe Odor	Very Bad	Moderate	Slight	Odorless	Slight	Odorless
Color	15	-	2610	1422	714	126	519	22	75
Alkalinity	-	-	100 & 502	0 & 281	0 & 210	0 & 221	0 & 222	-	0 & 193
Hardness	200 (PA) – 500 (TA)	-	494	502	262	208	258	178	172
CO ₂	-	-	0	127	73	59	90	31	38
Turbidity	10 JTU	-	51.10 JTU	63.80 JTU	53.4 JTU	4.07 JTU	90.8 JTU	0.51 NTU	6.83 NTU
BOD ₅ at 20°C(mg/l)	0.2	100	310	390	210	190	170	0.9	0.7
COD	4.0	400	2436	607	315	230	324	-	-
Pb	0.05	0.1	0.231	0.222	0.184	0.143	0.109	0.0127	0.0123
Cr	0.05	1.0	1.0	0.706	0.521	0.432	0.363	0.101	0.062

*SW₂ is the point from which effluents are being passed off directly to the river. [SW₁ (inlet point) & SW₂ (outlet point)]

Color & Turbidity

GW sources are high. Conversely, SW color tests allude significantly high other than to the guideline range. It is seen that color concentration for surface water showing results too high as compared to the guideline above mentioned is indicating really wounding to the environment as well as the water bodies where there is desegregating through the



stream. In drinking water, the higher the turbidity level, the higher the risk that people may develop gastrointestinal diseases. This is especially problematic for immunocompromised people because contaminants like viruses or bacteria can become attached to the suspended solids. In addition, some organisms found in water with high turbidity can cause symptoms such as nausea, cramps, and headaches.

Alkalinity & Hardness

Alkalinity is the fully new trial that is an influential issue for fish and aquatic life because it protects or buffers against rapid pH changes. Both GW samples being with the test values border onto the ECR range 200 to 500. Therefore, higher alkalinity levels in surface waters buffer acid rain and other acid wastes and prevent pH changes that are harmful to aquatic life. Though these values refer to the sample as hard (hard = 121-180 & Very hard > 180 mg/L). As of being very hard intensity, evidence has been accumulating about an environmental factor, which appears to be influencing mortality cardiovascular mortality, in particular, cardiovascular mortality, and this is the hardness of the drinking water. In addition, several epidemiological investigations have demonstrated the relation between risk for cardiovascular disease, growth retardation, reproductive failure, and other health problems and hardness of drinking water or its content of magnesium and calcium. In addition, the acidity of the water influences the reabsorption of calcium and magnesium in the renal tubule. Not only, calcium and magnesium, but other constituents also affect different health aspects. Nevertheless, this can be disregarded according to ECR.

BOD & COD

GW concern the 5 days BODs are too much high likened to ECR 1997 that means the microorganisms are using most of the Oxygen. [Fig. 4], a trend line being delineated to have come up with the real scenario. Looking to the SW from [Fig. 4] the intensity of BOD level through the stream is really threatening for the environment. Nonetheless, the findings regarding BOD₅ results signal the too much higher value that is really threatening for the environment. Owing to these higher BOD levels, DO levels decrease due to the presence of oxygen in water is being squandered by the bacteria. Since less dissolved oxygen is available in the water, fish and other aquatic organisms are being hindered to survive. The inlet point of ETP results in an identical high COD level but after refining this effluent direct to

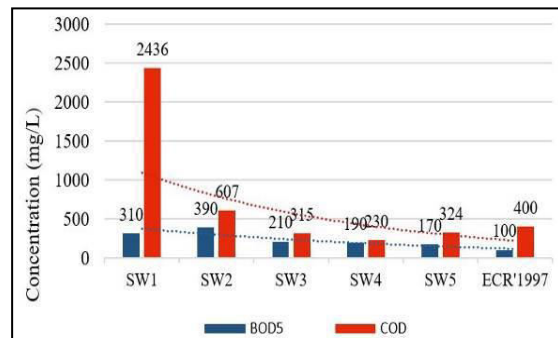


Fig. 4: BOD & COD of Surface Water

then river, the SW₂ sample represents higher COD considering to ECR that threatens to the stream including the environment also. However, the other samples (SW₂, SW₃, SW₄ and SW₅) have less COD value likened to ECR. That means a greater amount of oxidizable organic material in the sample, which will reduce dissolved oxygen (DO) levels. In addition, a reduction in DO can lead to anaerobic conditions, which is deleterious to higher aquatic life forms.

Lead & Chromium

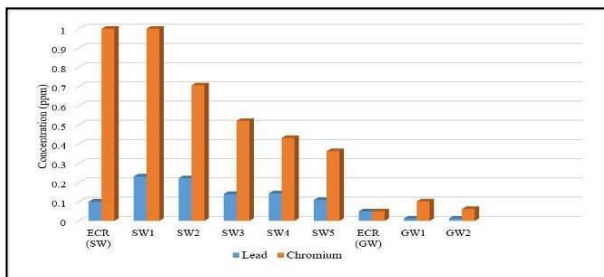


Fig. 5: Pb & Cr of Surface & Ground Water

According to Office of Environmental Health Hazard Assessment (OEHA), Canada, Trivalent chromium (Cr⁺³) is a nutrient but Hexavalent chromium (Cr⁺⁶) is toxic and carcinogenic. In the study, Chromium (Cr) concentration of all ground water samples [Fig. 5], have been exceeded the standard limit of ECR 1997 whereas Chromium in all surface water is still within limit. Lead (Pb) concentration is far above the limit for surface water samples and within the standard limit for ground water samples (Fig. 5).

Findings of Questionnaire Survey

Questionnaires related to the tannery workers working period, their wages, mostly suffered diseases people, their thinking about relocation of tannery etc. have been filled up by direct interview with the workers of the tanneries. From

the questionnaire survey it is found that 58% of the tannery laborers have to work 10 to 12 hours in a day and about 20% have to work 12 to 15 hours in a day. The most common (60%) wage in a day is in the range 350 to 450 BDT in a day. 30% and 27% respondents identified diarrhoea and skin diseases respectively as most common diseases of the locality. Around 82% people are not satisfied of the decision of relocation of the tannery industries in Savar.

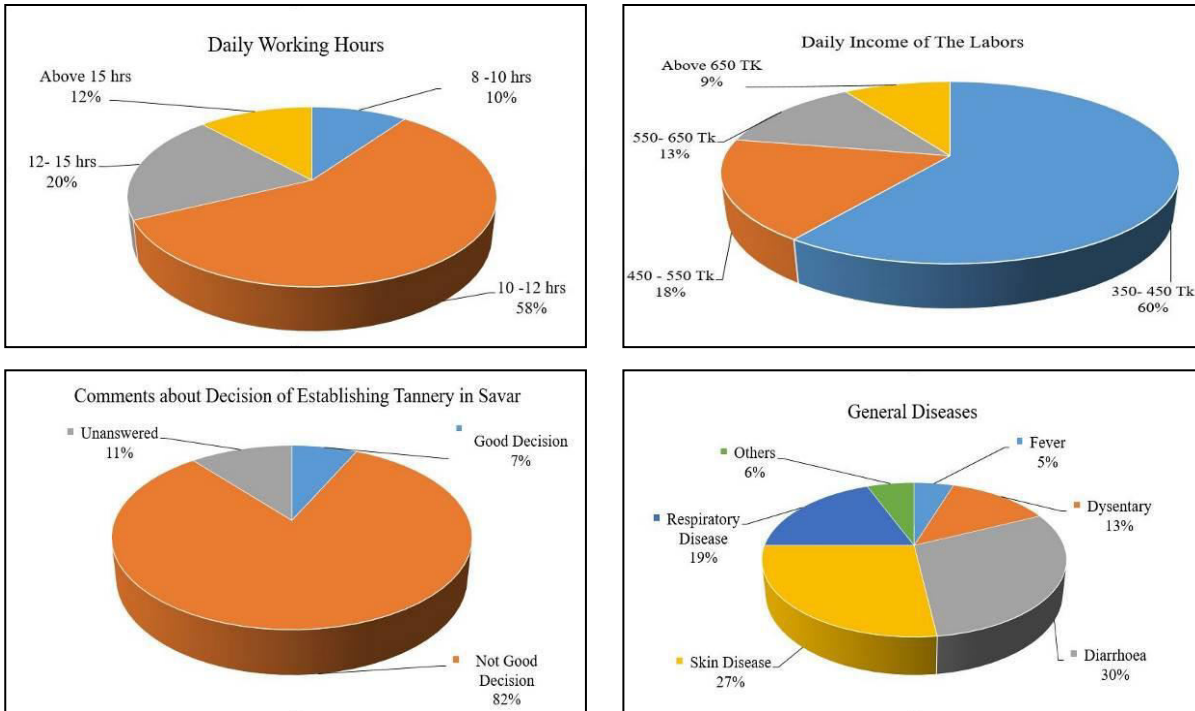


Fig. 6: Questionnaire Survey Results

Major Concerns Determined

Immense field observations in and around the Industrial Estate long give-and-take with the administrative body of incidental organizations and canvasses of accessible data convey the following to be the prima findings of the socio-environmental conditions in Hemayetpur, Savar, Dhaka.

✓ *Bump alteration on the milieu*

- i. The poor discharge capacity of existing drainage pipes.
- ii. Encumbering of existing drainage pipes due to inadequate collection of solid wastes, sweepings, and lack of maintenance.
- iii. Unfitness of evacuation reed dimension.
- iv. Corroborated environmental degradation due to uncontrolled discharges of waste.
- v. The indiscriminate disposal is being egested to the water bodies and nearby the environment. For paradigm can be written as poor solid waste disposal system in the open area as no plan for dispose of solid waste, liquid effluent after being treated is getting direct to the river.
- vi. Despite not being fully functional of the CETP, tanners release untreated water into the nearby Dhaleshwari River, polluting it.
- vii. Dhaleshwari River is comely “unusable” and “toxic” since the tanneries arrived in this new area as well yet CETP not providing proper feedback.
- viii. The aquatic life already been demolished due to high toxic effluent.
- ix. The hot air is made almost unbreathable by a strong, pungent smell. A mix of putrefaction and chemical substances that becomes stronger and stronger the closer one gets to one of the buildings.

✓ *Insight Labor Environs*

- i. Illiteracy and deficiency of adequate knowingsness.

- ii. Most workers lack personal cautionary equipment and must manipulate tools and machinery. Most tanneries, apart from a few larger ones, do not chase national or international standards for storing, transporting, or using harmful chemicals, and workers and supervisors unremarkable suffer from diseases of the skin and lungs, headaches, diarrhea, and fatigue. In addition, some small and medium-sized factories don't provide pure drinking water or gender-sensitive washrooms.
 - iii. Most workers are still impermanent, with no benefits or allowances for their higher detriments. Most of them do work without formal employment agreements, factory identity cards, or provisions for leaves of absence. Women receive no maternity leave as well.
 - iv. Inside the tannery, it is as hot as the hell and there is very little light. Full of chemicals and stacks of pelts including several large tanks topped by enormous wooden barrels with the stench is hard to stomach and the vapors make eyes burn.
- ✓ **Life Consequences**
- i. The village social life has also changed. Previously, people of all ages used to swim and bathe in the river and wash their cattle there but now unlikely this is happening.
 - ii. Farmers, who used to make up 75 percent of the people in the riverbank villages, can no longer use the river water for irrigation and have had to install motor-driven tube wells, increasing their costs substantially.
 - iii. The hasty, disorganized, and incomplete construction of the Tannery Industrial Estate (TIE) appears to have thwarted this hope. For the workers, housing, transportation, and food are more expensive in Savar than earlier age, which is the big concern for poor people.
 - iv. The people living there were subjected to the river as like with fishing, farming, etc., however, due to resettlement of tannery industry there, they had to switch their working into as rickshawpuller, some of them started working to the tannery as day labor, some other had to leave their places due to search of life.
- ✓ **Backstage Mystery**
- i. A lack of co-ordination amongst sectoral modification bureaus in stipulating headlong provisioning to meet the demands and needs of the flourishing population.
 - ii. The exploitation of underage workers persists, and the workforce remains underpaid, operating in terrible safety conditions and suffering serious health consequences.
 - iii. No lodgings, hard to buy food and if any worker gets suffered from any kind of injury there are no hospitals or healthcare facilities nearby tannery estate area.
 - iv. Crumbling public health conditions, peculiarly for the hapless.
 - v. The deficiency of cohesive urban development policy to provide clear itineraries for the basic provisions of rural improvement, strategies, rural programing, and social control strategies and the assuagement of rural belongings.
 - vi. No arrangement of accommodation of all stakeholder like workers, law paid staffs etc.
 - vii. According to government promises, it was supposed as going to be hospitals, accommodation for workers, and even improved salaries. But the promises weren't taken a firm stand.

In fine, the scarcity of concern for workers' rights and environmental problems, as well as the laxity in the government's enforcement of existing laws, are the main causes behind such issues like cited earlier.

IV. CONCLUSIONS

The pollution from the effluents of the leather industries in Bangladesh is a major environmental and social concern. When in April 2017, under international pressure the Bangladeshi government forced the tanneries to move to the Savar, many were convinced that things were going to change. But the situation is apart of what was expected. The results demonstrate that the major physio-chemical parameters of all composite effluents at 7 different monitoring points exceeded the standard disposal limits. Local inhabitants' life is now seemed in trouble due to unrecognized drawbacks. With respect to the concentration of these parameters, the study observes that coagulation and sedimentation occurred during effluent runoff through the drain. Lower dissolved oxygen level along the river has been found during the year 2019 and 2020. The aquatic life already got vanished due to high toxic effluent falling into the river. Despite being reckoned for a high salary, they did not get paid so far as was supposed to. Needless to say, that, the only things that have changed are the location, the name Savar Leather Industrial Park, and the river that is being polluted as used to be contaminated by 22,000 cubic liters of toxic waste every day to Buriganga. The regulating agency is facing difficulties to regulate polluting tanneries which has brought trouble to over three lakh people of 4 unions in Savar upazila, Dhaka. In order to arrange proper and systematic approaches to restore the water quality of the

Dhaleshwari River as well as the permanent solution of the socio-economic condition of surroundings the tannery industrial estate, the following recommendations should be considered.

- As the tannery industry is situated in the bank of the Dhaleshwari River, so proper measures should be taken to prevent the water body from further adulteration.
- Proper treatment of sewage through the effluent treatment plant (ETP) should be ensured before sewage disposal to the Dhaleshwari River.
- The treated wastewater released from the industries should be within the standard limit according to the ECR 1997 through regular monitoring by the government administrative body.
- Tannery wastes containing chemicals specially chromium should not be used in poultry food.
- The environmental management plan should be brought out for slenderizing pollution and make the process more compatible with environmental sustainability.
- The workers' rights must be ensured under direct taking action of the government which has to be deemed as the main measure.
- A sustainable approach should be taken to minimize the adverse effects of tanneries.

The following suggestions can be made from the present study:

- In this study, all the analyses and modeling activities were done based on July 2019 to March 2020 data only. Field sampling and laboratory analysis can be done for another season also. It will provide a comparative study of the water quality parameters.
- A vast study regarding the proper activation of CETP did not cover here in details, a further study could have been conducted next time in this field.
- While performing this study, the lack of decent data was a major problem. To represent the pollution trend over a long period of time, sufficient water quality data at specified locations are necessary. Further study may be undertaken to upgrade the existing data.
- Only for some selected stations on the Dhaleshwari River, this study has been conducted. To get the overall pollution scenario of the whole river reaches, study on more stations as far as possible is recommended.
- A naturalistic scientific approach such as a comprehensive survey may be conducted to quantify effects on the health and socio-economic condition of the people living in this area.

Acknowledgments

The authors express their sincere appreciation and heartiest thanks to Md. Sazal Hossain, Qaium Hossain & Avijit Karmoker, students of Department of Civil Engineering of Stamford University Bangladesh for their unconditional co-operation and help in the data collection through questionnaire survey. The authors also express their sincere thanks to laboratory staff, Mr. Somen Tanvir of Environmental Engineering Laboratory for his assistance and support during the laboratory tests.

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